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The Veterinarian and the Law.

By C. P. BRESLER, M.A., LL.B., Pretoria.

(a) The Private Practitioner.

I have been asked to discuss the question of the private practitioner in relation to the government and also in relation to the acquisition and use of tuberculin, proprietary medicines and remedies, vaccines and drugs in so far as the State has assumed control of these.

Unfortunately one cannot be very helpful as there is very little that can either be said or done. True, there is a charter for Veterinarians, *Act No.* 16 *of* 1933, which provides for the establishment of a Veterinary Board, for the Registration of Veterinarians and other incidental matters. Probably the circumstances of its birth differ in no way from those which prevailed in Great Britain. "The first definite control of the practice of the healing art in this country came from within the body of practitioners. It arose out of the desire to maintain a high standard of learning and skill, and was directed towards the safeguarding of the interests of the public. Rules drawn up for the observance of practitioners became incorporated in Ordinances, later in Royal Charters and ultimately in Acts in Parliament."

"Similarly, the modern Medical, Dental and Veterinary Acts were all initiated by the members of these professions, but in the process of passing through Parliament these enactments, owing to the conflicting claims of rival parties and the resulting compromise, in every case became so modified as to prevent their giving such complete control as was sought and as would be in the best interests of the country." (*Bullock, The Law Relating to Medical, Dental and Veterinary Practice,* London, 1929, p. 9.) Of course, we have not progressed in exactly the same way but the impetus has been, one imagines, very similar. In South Africa, the preference has always been enjoyed by the Government Veterinary Officer and the interest displayed by the Government in its institutions and its officers no doubt makes that good logic and good business. The incidence of animal diseases in a country in which agricultural interests, to put it mildly, has never been ignored, has of course created the situation. And, moreover, the sparseness of the population together with the wide jurisdiction of the Government Veterinary Officer have not conduced to make South Africa the Eldorado for private practitioners. If one might make so bold as to take to task a beneficent government, one would for its own sake and that of the veterinary profession and ultimately of the whole country urge upon it the necessity for taking

some steps to ensure the existence and the expansion of the class of veterinarians in private practice. A sound, healthy, independent practice is the pre-requisite of any efficient, contented and dignified profession. No country needs such a class more urgently than does South Africa. Unfortunately the discontent of the private practitioner has not been allayed by the fact that the Government Veterinary Surgeon is frequently called in to advise, prescribe and treat in cases which strictly do not fall within his jurisdiction. The result is fourfold : (a) The Government Veterinary Officer is distracted from pursuing his own prescribed work; (b) he is compelled to undertake extraneous work against his will and in circumstances which do not allow of his doing justice to this super-imposed work; (c) the veterinarian in private practice is deprived of the legitimate opportunity of earning a living and applying his skill; (d) the suppliant himself loses in moral fibre and independence. In fact, he is demanding everything for his vote. However, whatever the predisposing causes may have been and whatever the merits of the present situation may be, there seems no legal machinery available for improving the position of the private practitioner. The matter would seem to be one rather for compromise. Take a topical example. If the Department of Justice decided to hand all its briefs to its law advisers to the detriment of the members of the Bar, the latter would obviously have no legal redress. The private practitioner has by Act of Parliament been granted his status and has been granted some form of protection against the charlatan, but otherwise he has no power to intervene where a Government Veterinary Officer is acting within the course of his employment and within the scope of his authority. And if the latter were to exceed these bounds there would seem to be but one remedy—protest directed to the proper quarter. On this aspect it would seem that apart from the protection provided by registration and the disciplinary measures included in the Act, the veterinarian in private practice would not appear to stand in any more especial relationship to the government than, say, the doctor or the lawyer.

(b) Tuberculosis.

(Regulation No. 19.)

In respect of the treatment of tuberculosis the private practitioner is utterly dependent upon the discretion of the Principal Veterinary Officer.

Vide :

(b) No person shall import into the Union any tuberculin except under the written authority of the Principal Veterinary Officer or the Medical Officer of Health for the Union, who shall deal with applications emanating from medical practitioners.

(c) No person shall sell or otherwise dispose of any tuberculin except under the authority of the Principal Veterinary Officer

unless the tuberculin is sold by an authorised importer to a registered medical practitioner or to a registered chemist, who may sell or dispense the same for treatment of human beings to a registered medical practitioner or on the precription of such a practitioner.

(d) No person, except a registered medical practitioner or an authorised importer, a registered chemist, a Government Veterinary Officer or a veterinary surgeon authorised thereto by the Principal Veterinary Officer shall have in his possession, and no person other than a Government Veterinary Officer or a veterinary surgeon authorised thereto by the Principal Veterinary Officer shall use any tuberculin for the purpose of testing any class of stock.

No doubt the necessity for stringent control can more than be justified, but in an age in which law by proclamation is becoming an all too frequent event the application of the restriction should not be arbitrary. The discretion is vested in the officers mentioned and the exercise of a discretion that may well be within the law may none the less be engendered by a deliberate desire to refuse the private practitioner a just share of the work that is going. I think reference has already been made to the question of discretion in the course of these articles, but as this part of the law is difficult an *ad hoc* re-statement may not be out of place.

" It is settled law that where a matter is left to the discretion or the determination of a public officer, and where his discretion has been ***bona fide*** exercised or his judgment *bona fide* expressed, the Court will not interfere with the result. Not being a judicial functionary no appeal or review in the ordinary sense would lie; and if he has duly and honestly applied himself to the question which has been left to his discretion, it is impossible for a Court of Law either to make him change his mind or to substitute its conclusion for his own . . . . There are circumstances in which interference would be possible and right. If, for instance, such an officer had acted *mala fide* or from ulterior and improper motives, if he had not applied his mind to the matter or exercised his discretion at all, or if he had disregarded the express provisions of a statute—in such cases the Court might grant relief. But it would be unable to interfere with a due and honest exercise of discretion, even if it considered the decision inequitable or wrong " (per INNES C. J. in *Shidiack v. Union Government*. 1912 A.D. 582—583).

In these circumstances then it would be very easy for an officer in whom discretion is vested to abuse his power. The aggrieved person would have to show *mala fides* or an ulterior motive, or a failure to consider the question at all. Even unreasonableness by itself would not justify intervention.

" In my judgment, however, the unreasonableness of the Minister by itself affords no grounds for a Court's interference with the exercise of his discretion. The only assumption in the Act is that the Minister, whoever he may be, shall honestly bring his mind to bear upon the real question he has to decide. There is no authority that I know of, and none has been cited, for the proposition that a Court of Law will interfere with the exercise of a discretion on the mere ground of its unreasonableness. It is true that the word is often used in the cases on the subject, but nowhere has it been held that unreasonableness is sufficient ground for interference; emphasis is always laid upon the necessity of the unreasonableness being so gross that something else can be inferred from it, either that it is ' inexplicable except on the assumption of *mala fides* or ulterior motive,' see *African Realty Trust v. Johannesburg Municipality* (1906 T.H. 179), or that it amounts to proof that the person on whom the discretion is conferred, has not applied his mind to the matter. See *Crown Mines, Ltd., v. Commissioner for Inland Revenue* (1922 A.D. 91)." (Per STRATFORD J. A. in *Union Government v. Union Steel Corporation (South Africa), Ltd.,* p. 236—237.)

There is another possible ground for interference. " If a discretion is conferred by Statute upon an individual and he fails to appreciate the nature of that discretion through misreading the Act which confers it, he cannot and does not properly exercise that discretion. In such a case the Court will correct him and order him to direct his mind to the true question which has been left to his decision . . ." (per STRATFORD J. A. *supra,* p. 234—235).

A recent application of the doctrine is to be found in the *South African Railways v. Swanepoel* (933 A.D. p. 370 *et seq.*).

By *Act 27 of* 1930, a new section (II. (A)) was inserted in the Railways and Harbours Service Act (23 of 1925). This section now reads as follows :—

" The services of a servant may be dispensed with prior to the due date of his superannuation if he is found in manner prescribed to be incapable by reason of severe bodily injury or permanent ill-health or physical disability of discharging the duties of his office or post, provided the Administration is satisfied on enquiry, that such incapacitation is permanent or will become permanent if the servant continues to perform the duties of his office or post or any other duties the Administration may assign to him."

Now as to the facts of the case. In April 1932 the stationmaster at Springfontein noticed that Swanepoel was wearing spectacles while engaged as a shunter. He spoke to him and eventually wrote to him asking categorically whether he was " able to perform shunting duties day and night without the aid of glasses." To this Swanepoel replied on the 10th April, 1932, as follows : " It is impossible for me to do

my work by day without glasses, but by night it is possible . . ." On the 2nd May, 1932, Swanepoel signed the following statement :

" Cannot see with one eye, otherwise state of health good. Could see previously out of both eyes, but now cannot without glasses. Unless glasses are worn, cannot see signals, otherwise can perform duties satisfactorily."

Swanepoel was examined by two medical practitioners.

The medical board reported that Swanepoel was incapable of discharging his duties as shunter without glasses, but that if allowed to wear glasses he was capable of discharging those duties. The confidential report was laid before the committee which considered it and recommended to the General Manager that Swanepoel should be retired from the service. A copy of the report was forwarded to the General Manager who approved of Swanepoel's retirement on the ground of " permanent ill-health."

One of the grounds urged by Swanepoel's counsel was that the General Manager had been shown to have come to his decision on a mistaken view as to the meaning of Regulation 42 and that therefore the Court would be entitled to interfere with his decision. The Court, however, remarked as follows : " It is trite law that where a statute commits a matter to the determination of an administrative official, his determination is final, and the Court cannot interfere, even if his discretion is exercised on a mistaken view of the law . . . . The principle of all . . . decisions is, of course, that subject to certain exceptions, the Court can only enquire whether the official has in fact decided, not whether he has decided rightly or wrongly . . ." In the course of the judgment DE VILLIERS J. A. remarked : ". . . even if the General Manager had attributed some other hypothetical disease to Swanepoel, his decision would nevertheless be final and beyond the interference of any Court of Law, on the principle previously mentioned."

These cases show only too clearly the need for the utmost *bona fides* in matters governed exclusively by administrative discretion and the need in the case of veterinarians for the utmost reciprocity and consideration. Without understanding and co-operation the profession may easily be irritated into petty schism.

Farm Surgery.

By J. R. FREAN, M.R.C.V.S., Potchefstroom.

The accompanying photograph illustrates a remarkable case brought to me for advice and assistance. The owner had had his horse castrated by a neighbour about three weeks earlier. The "operator" had experienced great difficulty in finding and removing the left testicle. After the operation this wound did not heal properly and the animal appeared to urinate through the castration wound.

Upon examination I found the penis protruding through the left castration wound to the edges of which it appeared to have become grafted. Apparently in searching for the testicle the operator had incised

A striking result of quack surgery. Penis protruding through and grown on to scrotal castration wound in a horse.
(Photo: Dr. A. R. Saunders).

through the wall of the scrotum into the prepuce and drawn the penis through the incision.

The preputial wound had healed and I did not consider further operative treatment justified in view of what the animal must already have suffered. I therefore arranged with the police for the animal's destruction.

The animal urinated without apparent effort during the period that I was examining him.

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Personal Reminiscences with a Mobile Veterinary Section in the South-West African Campaign, 1915. *

By F. J. DUNNING, F.R.C.V.S., Stellenbosch.

The following article is written by request and in the hope that other confrères will put some other interesting phase into print before our part in the past is forgotten.

The S.W.A. Campaign was essentially a mounted man's campaign and the S.A.V.C. played a very useful if inconspicuous part. I think considerable credit is due to all officers and men for their guiding hand everywhere, that is, in the purchase of animals, supervision and advice to maintain health, control and prevention of contagious diseases, also keeping a close personal touch throughout the campaign. Representatives of the Corps were ever there when wanted, and I always noticed a splendid cheerfulness in face of many difficulties. In all probability this will be the last we shall see of large scale operations with mounted troops and animal transport which may be one excuse for recording experiences in print.

When the Burger mounted forces were mobilising in the beginning of 1915 for active service in S.W.A. I was given command of a Mobile Veterinary Section attached to the 5th (Free State) Mounted Brigade, which Brigade by the way was an exceptionally fine body of men and all volunteers.

After leaving the Free State we camped under canvas on Green Point Common, Cape Town, for a three weeks course of Brigade training before embarkation. Realising from previous experiences that most of our troubles in the field would arise from sore backs, I had a general inspection of each unit's saddlery as opportunities offered.

Most of the saddles were the colonial pattern type very suitable for our irregular troops, provided the panels were properly stuffed with a good channel and the arches did not break. Unfortunately a fair percentage were of the cheap type, with defective arches which nothing could prevent giving trouble eventually, and which could not at the time be replaced, as no spares were available in the Union.

In the field, however, as a man dropped out I advised officers to make a point of retaining the best saddles.

* See *Official History of the Great War: Veterinery Services*, published in 1925 by His Majesty's Stationery Office. Capt. Dunning was attached to the Northern Force (p. 395).

A severe outbreak of ringworm amongst the Brigade animals was successfully eradicated by rubbing on pure Jeyes' or Little's disinfecting fluid, a tip given me by Sgt. Averre in Cape Town.

At Green Point our commonest trouble was heel rope-galls caused by animals getting entangled in their halter ropes or reins when on the picket line. These were treated effectively by a thorough washing with soft soap and warm water, then dried quickly by rubbing with dry bran and afterwards a dusting powder applied.

It must be accepted that veterinary supplies were scarce and distinctly limited in the Union and that my issue for a Mounted Brigade and attendant transport was a field service chest which compelled us to use simple remedies and conserve drugs as far as possible.

Ordinary colic cases were often treated successfully by administering a handful of coarse salt dissolved in a bottle of warm water.

The sea voyage to Walvis Bay was accomplished without any untoward incidents, also the disembarkation into lighters. I was greatly intrigued by the way the coloured stevedores handled recalcitrant mules in order to harness them for slinging from the ship to the lighters. One boy would stand in front of the mule, take a firm grip with a hand on each ear, turn down his thumbs and press one on each upper eye exerting a certain pressure on the eye-balls. This effectively stifled any attempted resistance and unloading was accomplished with remarkable speed. At Walvis Bay and Swakopmund the Field Veterinary Hospitals under Captain Howie and Major Lee were working at high pressure attending to animals of the Expeditionary Force. At Swakopmund I was issued with a scotchcart and four mules as our section transport and also a water cart. I formed the opinion that the scotchcart was unnecessarily heavy and cumbersome and that a lighter type like the ammunition cart would have been easier on the mules, but we had no alternative.

The water cart theoretically should have been of great value. Unfortunately owing to the rate mounted troops travelled it could never carry water. Also, when in temporary camp there was usually no time or opportunity to get water into it for camp or field veterinary purposes. As a rule when water was reached troopers might stand for hours in a queue waiting to water a horse or fill a water bottle or nosebag.

On one occasion we had no water for 24 hours and each unit was told to dig for its own water in the sandy bed of a river, a heartbreaking job with inefficient tools. When eventually my section struck water it was commandeered by a Staff Officer for Headquarter use and we must perforce commence again.

On another occasion my men stood in a queue most of the day to get a water-bottleful each and before their turn came the well ran dry and the Brigade trekked.

Eventually the native driver brought the water cart's travels to an end by colliding against a tree, thus breaking a wheel during a night march and it was left behind without regret. At Otjimbingue our supply wagons issued us with one day's rations per man and a nosebag of mealies each and returned to Swakopmund for further supplies. At Wilhelmshohe, having no supplies for man or beast, we went into camp for three weeks to await the return of our supply wagons. The Brigade animals went out daily under protection of a grazing guard and this respite allowed many of the sore backs time to recover, although they only managed to keep body and soul together on the spare grazing, whilst the men subsisted on only fresh meat without even salt. Owing to this restricted diet many of the men, including myself, were suffering badly from initial scurvy. The slightest scratch turned into an unhealthy sore, also our gums were so swollen and teeth so tender that we could not chew the meat. The joy of life therefore had disappeared from the performance of ordinary camp duties.

With the return of the supply wagons six pounds of crushed mealies per day per animal for a week put them in good trim again. It was remarkable how quickly they recovered condition and vitality, and a plentiful supply of biscuits and mealie meal soon improved the men's condition.

Our final and general advance northwards from Wilhelmshohe to Otavifontein was a series of quick rushes with a big strain on animals and men. My Veterinary Section had very little chance for sleep, we usually marched all night and instead of proper opportunity for alternative sleep during the day, we were kept busy on various and endless fatigues, such as grazing and watering our own animals, attending sick animals, inspecting units by request or as opportunity offered, etc.

The most frequent causes of trouble were sore backs, laminitis, lameness, rope-galls, and sand colic. Regarding the latter much of it could have been prevented by forethought.

Every trooper was issued with a nosebag which was one of his most precious possessions; but instead of putting it to its lawful use, it was used for various camp purposes, also as a wash basin, therefore mealies were fed off the sandy ground.

It must be understood that very few of the officers or men had come in contact with veterinary services either in a civil or military capacity, and the idea of a Veterinary Section to attend sick animals was new to them and not appreciated as was intended.

A sick animal was never under veterinary orders but must, according to the exigencies of the Campaign, continue to do duty as long as possible and there was often an uphill fight against considerable opposition.

The customary treatment for sore backs by owners was to pour on

fresh urine without washing, as water was scarce. When an animal had been so treated for a few days, what with accumulated secretions, matting of hair, sticking of sand and dust, and the decomposition of urine with heat under the saddle and blanket, there was often such a foul and obnoxious odour that my sergeant would refuse to attend the animal until the owner himself had washed the foulness off. This attitude I had to uphold as being perfectly just and to protect my men from imposition.

Combatant officers insisted, and probably rightly, that animals be ridden as long as they had a leg to stand on, unless I could act as remount officer and supply a substitute. When an animal became unfit for service it was either destroyed or turned loose to be collected later by salvage operations if still surviving. Because of the nature of the Campaign the wastage from exhaustion was fairly high, but otherwise a high standard of health was maintained. It may not be remarkable but still it can be noted that in our Brigade no cases of contagious disease were observed whilst in the field.

In passing I may say that according to my observations a horse with a dropped hip, that is, fracture of the external iliac spine, no matter how sound he may shew himself, is actually unsatisfactory for the long tiring saddle work of a military campaign. As the muscles tire the deformed side droops, the leg drags, the rider is thrown out of balance and a sore back results.

In Wooldridge's book on Surgery, vol. II, page 610 is stated :—

" The deformity may be accompanied by lameness if the accident is recent, but in old standing cases lameness should be absent and the defect should have no influence on the horse's capacity for work." I think this requires slight modification as experience in South West and East Africa under arduous military conditions shew there is a latent weakness.

In conclusion I wish to pay a tribute to the stamina and courage of the South African horse, mule and donkey. One conductor I knew had an effective if maybe unkind ruse for getting his heavily laden wagons over a bad patch or through a difficult sandy drift. Having successfully got the first wagons across and the rest in danger of sticking fast, he would issue loud orders to outspan those through. A babel of cries, whinneys, neighing and braying, from all the transport line was the immediate response and all animals pulled their best to get through to the outspan.

When the objective was achieved the order would probably be cancelled and the march resumed. Those having taken part will remember with what eagerness the toiling mules and donkeys greeted the welcome order to outspan and how they would strain every nerve and muscle to reach the allotted place.

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Studies in Native Animal Husbandry.
14. The Native Cattle Types of Africa, with particular reference to South Africa. [1].

By H. H. CURSON, Dr. Med. Vet., F.R.C.V.S.

Introduction.

One of the most striking facts within the past decade has been the change in outlook in regard to the value of indigenous stock in African animal husbandry. That this should have taken so long is surprising when one considers the results already attained by Europeans in improving indigenous stock by selection, *e.g.* the Longhorned Zebu (Afrikanders), the Blackhead Persian sheep (Somali) and the ostrich. In India too, similar excellent results have been obtained by the veterinary authorities, *e.g.* Gunn (1909).

It seems to be appreciated at last that except for a few wealthy farmers who can provide the necessary attention, the vast majority of owners, both European and Native, must continue with the present unsatisfactory farming methods.

Contributing largely to this altered outlook are the observations of McCall and Hornby in Tanganyika, Stewart in the Gold Coast, Anderson [2] (1933) in Nigeria, and Bisschop (1934) in South Africa. When one considers that for generations many thousands of pounds have been spent each year in the importation of European cattle, and that Bisschop has found that grading up our indigenous stock with sires of European breeds in our semi-arid and arid regions, leads to progressive degeneracy of type and function, then the position is indeed serious, in fact very serious, for during these years the indigenous stock has been allowed to deteriorate.

Would that farmers of the calibre of Bates and Booth had arisen and demonstrated that lasting improvement could be brought about only by selecting animals of the right type for each particular locality!

Important contributions on indigenous types have been made by Carlier of the Belgian Congo, Stewart of the Gold Coast, Pierre in French West Africa, Doherty of Kenya, McCall of Tanganyika, Sheppard Cruz of Mozambique, da Costa in Angola and Nobbs in Southern Rhodesia.

Apart from the above practical considerations, a knowledge of indigenous stock is essential if veterinarians are to contribute their fair share to anthropology, a science which attracts students of all professions. The fact that both the Longhorned Zebu and Brachyceros cattle arose in Asia, occur on the Egyptian monuments of 4,000 years ago, and are

(1) The paper was illustrated by lantern slides.

(2) See *Problems of Animal Nutrition and Animal Husbandry in Northern Nigeria* by A. W. Anderson.

represented in Southern Africa and West Africa respectively, at least indicates the extent of the folk wanderings that have taken place during the past five millenia.

Finally it must be emphasised that the time has long passed for describing the indigenous cattle of the Cape, Orange Free State, and Southern Transvaal. Apart from the scattered Afrikander herds, there has been so much intermingling with cattle of European origin that a nondescript type possessing chiefly Brachyceros characteristics, has arisen. See Map.

Our field therefore is the rest of Africa.

Cattle Types.

For practical purposes native cattle fall into five chief groups or types, three of which are parent stocks and two the result of intermixture. Our knowledge of the racial history of indigenous cattle is due largely to Epstein, who is still conducting his researches at the British Museum.

With regard to parent stocks it should be added that one, the Hamitic Longhorn, is probably extinct but it must, however, receive attention before a description of the derived types is given. Another type, the polled, is mentioned by Neffgen (1904) in the *Veterinary Papyrus of Kahun,* but I have not yet seen hornless cattle represented in Egyptian paintings, except Keller's illustration (Kronacher, 1921).

The various features of the three parent stocks are best tabulated as follows :—

Conformation.

Feature.	*Hamitic Longhorn* (3)	*Brachyceros* (4)	*Longhorned Zebu* (5)
1. Head.	Comparatively short and broad.	Elongated frontal region which is concave.	Long and narrow. Forehead convex.
2. Horns.	Long and upright. "Of same length and shape" in bull and cow. Base almost circular, substance "light coloured with dark tips, rarely dark througout."	Short, fine and dense in texture. Base circular.	Long and slender. Base oval. Horns leave head in lateral direction and show a moderate twist.
3. Dewlap.	"Only moderately developed."	Moderately developed.	Well developed and commencing at chin.
4. Hump.	"Not the slightest sign of a hump."	Not present.	Well developed and does not fall abruptly on to withers, but slopes gradually. Cervico-thoracic in position.
5. Hump at withers.	"About 57 inches."	Varies from 3 feet to 4 feet.	About 5 feet.
6. Type of beast.	Beef ("large framed beasts").	? Milk. Generally a small beast.	Beef.

(3) The description of this type is based entirely on Epstein's observations in Berlin.

(4) The Brachyceros skeleton was kindly furnished by Capt. W. W. Henderson, M.R.C.V.S., P.V.O., Nigeria.

(5) Epstein believes that the modern representative of this type is the Afrikander.

Osteological Differences : Skull.

General Description.

Feature.	*Hamitic Longhorn.*	*Brachyceros.*	*Longhorned Zebu.*
Frontal Surface.			
1. General shape.	"The head is comparatively short and broad."	Long, especially forehead, and fairly broad.	Long and comparatively narrow.
2. Margin of orbit.	"The eye is big and prominent."	Slightly prominent.	Not prominent.
3. Profile.	(Appears straight).	Straight.	Convex.
Lateral Surface			
4. Temporal fossa.	"The temple (temporal fossa) is broad and deep."	Deep, horizontal, and widely expanded caudally.	Deep and curved. Markedly influenced by base of horn.
5. Horn.	"Lyre-shaped and slender." Upright. Horn core has wreath at base and there is a neck.	Short and horizontal. No wreath or neck.	Lateral direction and slender with twist. No wreath but distinct neck.
Basal Surface.			
Choanae	"The choanae begin a little more than ½ inch behind the third molar."	Choanae begin approximately 1 cm. in *front* of posterior edge of third molar.	As for Egyptian Longhorn.
Nuchal Surface.			
6. General.	Separated from frontal surface by prominent and thick frontal ridge, which is level when viewed anteriorly and straight from side to side.	Frontal ridge thick but not prominent. From front it is convex (with central depression) and is straight from side to side.	Frontal ridge thick and prominent. From front it is convex and markedly curved from side to side.

Another most important differential character is the bifid superior spine of the 6th thoracic vertebra backwards of the Longhorned Zebu. As will be seen later this occurs also in the Shorthorned Zebu, a derived type.

The two chief types resulting from the intermixture of the parent stocks may be differentiated as follows[6]:—

(6) An important intermixture described in French West Africa is that between Brachyceros and the Shorthorned Zebu (Pierre, C. *L'Élevage dans l'Afrique Occidentale Francaise*. Gouvernement Général de l'Afrique Occidentale Francaise. Augustin Challamel, Rue Jacob 17, Paris, 1906). Hamitic Longhorn influence is also striking.

Feature.	*Shorthorn Zebu. Brachyceros X Longhorned Zebu.*	*Sanga* (7). *Hamitic Longhorn X Longhorned Zebu.*
Conformation.	Generally small.	Generally large.
Head.	Generally long and coffin-shaped. Orbital region not prominent.	Generally broad at the forehead and the orbital region is prominent.
Horns.	Usually short and oblique in direction.	Usually long and vary from lateral direction to upright lyre-shaped form.
Dewlap.	Moderately developed.	Well developed.
Hump.	Thoracic and musculo-fatty.	Cervico-thoracic and muscular.
Thoracic vertebra.	Superior spine of 6th vertebra caudally is bifid.	May be single or bifid.
Distribution.	Native cattle of East Africa.	Native cattle of South and Central Africa (Ankole).

As will be observed from the map, the Sanga type in Southern Africa includes five sub-types as follows :—

(a) *Bechuana,* which is represented in Angola, South-West Africa Protectorate, Northern and Southern Rhodesia and Northern Transvaal. The cattle are big horned, large framed, and long in the limb, but nevertheless well supplied with muscle. Many are well above the Union embargo limit, *viz.* 1,050 lbs. for oxen and 790 lbs. for cows, and on slaughter a good carcase is obtained. The influence of Afrikander blood is noticeable in Ngamiland where frequently the profile is convex and the horns lateral. With selection this sub-type would be at least equal to the Afrikander.

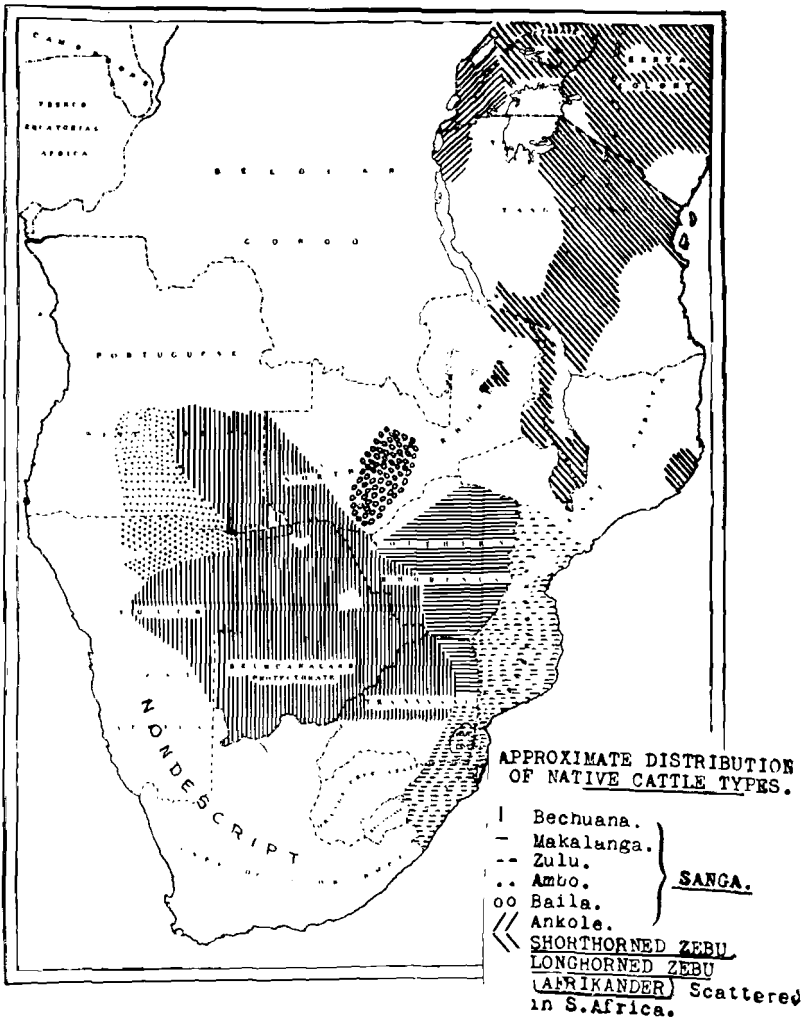
(b) *Ambo.* To the North-West of the Bechuana region in Angola and South West Africa is the Ambo sub-type, a smaller and more sturdy beast. There is no sign of Afrikander blood in this group, and the colour is generally dun or black.

(c) *Baila.* To the North-East of the Bechuana region, entirely in Northern Rhodesia, is another sturdy sub-type, the Baila or Mashukulumbwe.

(d) *Makalanga.* In Mashonaland are to be found the small, short-legged and light-boned Makalanga or Mashona cattle. Nobbs (1927) states that a carcase of a full-grown ox weighs about 300—400 lbs. An intrusion of this sub-type is to be seen in the N.-E. Transvaal.

(e). *Zulu.* This hardy group extending throughout Natal and Swaziland and as far north as the Zambesi R. is medium in size and stockily built. The bulls often possess well developed dewlaps and apart from the cervico-thoracic hump somewhat resemble Shorthorned Zebus. The thoracic vertebrae frequently show bifid superior spines indicating

(7) The term Sanga varies according to the author. Kronacher (1921) employs the word in its widest sense and includes any humped African bovine. Epstein's use is preferred, namely, the type originating from the Hamitic Longhorn and Longhorned Zebu-intermixture.



possibly additional Zebu admixture on their southerly route centuries ago along the east coast.

An extensive field awaits the breeder in developing the above sub-types, which at present lack uniformity. In Zululand the Department of Native Affairs has recently become interested in the white Nyoniaipumuli breed (8).

(8) One imagines that a more dominant colour would have been selected, *e.g.* black "nkone." The phrase "nyoniaipumuli" means "the bird that does not rest" and it was suggested by Chief Solomon (letter 13/327 (2) of 5/10/35 from Director of Native Agriculture to D.V.S.) that as "Cetewayo confiscated all white animals occurring in the herds of his followers . . . the name . . . might be derived from these cattle never having been allowed to remain in their breeders' herds."

In addition to the features mentioned above, Sanga cattle have smooth, short hair and long tails.

Of particular interest is a comparison of two of the so-called Zebu types. The position may be summarised thus :—

Resemblances.

External.

Head : From frontal view the head is coffin-shaped and the orbital region is not pronounced. From lateral aspect the profile is generally convex. The horn core in each case has a neck.

Dewlap : Well developed, and extends from chin to back of chest.

Hump : Large and prominent.

Differences.

External.

Feature.	*Longhorned Zebu.*	*Shorthorned Zebu* [9].
Horn.		
(a) Length.	Long, oval (cross section) and slender.	Comparatively short and circular (cross section).
(b) Direction.	Lateral.	Obliquely upwards.
(c) Horn core.	No wreath at base.	African cattle appear to have a wreath.
Hump.		
(a) Situation.	Cervico-thoracic.	Thoracic.
(b) Attachment.	Firm.	Less firm.
(c) Shape.	Pyramidal.	Dome-shaped.

The above descriptions have been based on typical specimens. As one can understand in the derived types all varieties of intermediate forms are possible.

Cattle Migrations.

Before referring to these, it should be explained that in the time of the Pharaohs, apart from the " Egyptian aristocrats of the Pyramid Age" (who were of Alpine stock), the inhabitants of Africa belonged to Elliot Smith's Negroid type [10]. Then came the hordes of Mediterranean type, who in their migration westwards from Asia not only compelled the Hamitic tribes to retreat westwards (Tauregs) and southwards (Somalis), but also the Bushmen, Hottentots and Bantus to withdraw in a southerly direction.

It was in those far off days that the Egyptians succeeded in domesticating the wild ox of the Nile Valley, called by Hilzheimer *Bos*

(9) According to Pease, H. T. *Breeds of Indian Cattle*, the Indian Zebu was domesticated about 2,100 B.C. See *Vet. Rec.* 14.1.05, p. 450.

(10) Taken from *The Primordial Ocean* by W. J. Perry, Methuen & Co., London, 1935.

primigenius Hahni, nova sub-species Hilzheimer. Then appeared the first tribes of Mediterranean stock, bringing with them cattle of Brachyceros type.

As the invaders pressed upon the original inhabitants so did the latter seek refuge by themselves migrating. In this way the Hamitic Longhorn was carried west along North Africa into the Iberian Peninsula, where descendants of these cattle are still to be seen.

In the meantime the numerically superior Brachyceros had displaced the Longhorn in Lower Egypt; and today this type is still dominant not only in North-East Africa but along the entire littoral from the Cameroons to Erithrea, thus indicating the route followed by the original owners.

Then about the end of the 3rd pre-Christian millenium [11] there arrived in Upper Egypt cattle of the Longhorned Zebu type. These accompanied Semitic tribes (Mediterranean type), and so great was their influence, chiefly on the Hamitic Longhorn that (except for comparatively recent importations of the Shorthorned Zebu) the majority of all indigenous cattle south of the Sahara represents a cross of these two parent stocks, called by Epstein the Sanga. Fortunately, as a result of representatives of the Longhorned Zebu type coming into the possession of the people now called Hottentots, cattle of this stock were saved for posterity. The Hottentots, being in the van of the human stream which migrated southwards, kept their herds pure [12]. On the arrival of the Dutch colonists at the Cape in 1652 some of these Hottentots were passing along the west coast of the Cape Province, but the advance guard with their numerous herds had already entered what is now the Eastern Province. Here they came into contact with the Bantu tribes which had migrated south along the east coast. According to Maingard (1934) their cattle were few [13]. As a result of European settlement cattle were imported chiefly from Holland and Great Britain, and in this way has arisen a mixed type at the Cape (referred to previously as nondescript). It is possible that the Great Trek in 1836 was an important factor in again preserving the Afrikander, now of the migrating

(11) As far back as 1887 B.C. the negroes of Kush (South of the Second Cataract) possessed cattle. Weigall, A. *The Glory of the Pharaohs*, p. 198. Thornton Butterworth, Ltd., London, 1923. It would be interesting to know to which type they belonged. They were probably Hamitic Longhorn.

(12) Sir Harry Johnston contends that "the first Bantu invasion from across the Zambesi" took place "about 700 A.D." Quoted by L. F. Manigard. *S.Afr. Jl. Sc.*, 1929, p. 845. The Hottentots must therefore have arrived in South Africa still earlier.

(13) Maingard (*S.Afr. Jl. Sc.*) (1934), apparently believes the native cattle south of the Limpopo River to be mainly of the Afrikander type, and that north of the same river they belong to another type, *i.e.* non-Afrikander (p. 133)! The map indicates the approximate distribution of types.

Boers, although most work in placing the type on a proper basis has been done by careful selection only during the past 33 years.

So much for the parent stocks. The Shorthorned Zebu is believed by Epstein to represent in Asia the influence of Brachyceros on the Longhorned Zebu. Its arrival in Africa is of comparatively recent date, at any rate since the Christian era, and is due to the Arabs and Indians who for centuries have traded along the eastern coast from Abyssinia to Mozambique [14].

The Sanga originated in Abyssinia and Upper Egypt through the intermixture of Longhorned Zebu and Hamitic Longhorn as explained above. Through folk wanderings of people of Negroid stock the type has been dispersed in two chief directions, west to Nigeria (Fulani cattle) and south to the Subcontinent, where several sub-types occur (*e.g.* Ambo, Bechuana, Baila, Makalanga and Zulu).

The map referred to previously gives only the approximate distribution of native cattle in Southern Africa, and some allowance has been made for areas where Glossina are present. It must be emphasised, however, that native cattle may live in lightly infested fly areas, *e.g.* Zululand, particularly if trypanocidal treatment is available.

Summary.

Above has been emphasised the necessity for research into African native cattle, followed by brief descriptions of the various types along with the probable migration routes. The need for a policy, in native (as well as European) animal husbandry is urgent [15].

Acknowledgment.

Thanks are due not only for the receipt of anatomical material from Messrs. A. D. MacGregor, F.R.C.V.S., Calcutta; H. E. Hornby, F.R.C.V.S., and G. S. Cowin, M.R.C.V.S., Tanganyika; Major H. H. Brassey-Edwards, M.R.C.V.S., Kenya; and W. W. Henderson, M.R.C.V.S., Nigeria; but also for notes, photographs, and references from J. L. Stewart, Esq., M.R.C.V.S., Gold Coast; Dr. J. Botelho, Mozambique; Dr. H. Epstein, London; Drs. R. Dart and Galloway, and Col. Irvine-Smith, M.R.C.V.S., Johannesburg; Messrs. R. A. S. MacDonald, M.R.C.V.S., and H. S. Purchase, B.Sc., M.R.C.V.S., North Rhodesia, and Miss D. Armstrong, Onderstepoort. I am also indebted

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(14) While the view is held that African cattle have been influenced by Asiatic importations, Matson, quoted by Kelly (1932), believes that cattle, possibly from Africa, have had an influence on the Indian Zebu!

(15) Provision of a museum at Onderstepoort in 1936 will prove invaluable for the study of African indigenous stock.

for assistance to Messrs. J. L. Dickson, R. Clark, W. O. Neitz, L. T. Edwards and C. T. Nilsen, all B.VSc., South Africa, and to Messrs. S. G. Turner and P. R. Mansvelt of Onderstepoort.

Literature.

Useful references bearing on African cattle are to be found in the subjoined :—

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2. CURSON, H. H., THOMAS, A. D., and NEITZ, W. O. (1930). 1. Notes on the Wankonde. *Jl. S.A.V.M.A.*, I. (4).
3. CURSON, H. H., THOMAS, A. D., and NEITZ, W. O. (1931). 2. Proposed Plan of Investigation. *Jl. S.A.V.M.A.*, II. (2).
4. CURSON, H. H., THOMAS, A. D., and NEITZ, W. O. (1933). 3. Native Milking Pails. *Argcologiese Navorsing van die Nasionale Museum*, Bloemfontein.
5. DICKE, B. H. (1934). 4. Bantu and Cattle in the Northern Transvaal. *Jl. S.A.V.M.A.*, II. (2).
6. THOMPSON, F. R. B. (1932). 5. Indigenous Cattle in the Transkeian Territories. *Jl. S.A.V.M.A.*, III. (4).
7. GROENEWALD, J. W., and CURSON, H. H. (1933). 6. A Note on Ovambo Cattle. *Onderstepoort Jl. Vet. Sc. and Anim. Indust.* I. (2).
8. BISSCHOP, J. H. R., and CURSON, H. H. (1933). 7. Makalanga Cattle : A Representative Described. *Id.*
9. DART, R. A. (1933). 8. The Domesticated Animals of Pre-European South Africa . *Jl. S.A.V.M.A.* IV. (2).
10. EPSTEIN, H. (1934). 9. The West African Shorthorn. *Jl. S.A.V.M.A.* V. (3).
11. CURSON, H. H. (1934). 10. The West African Shorthorn (*Bos brachyceros*). *Id.*
12. BISSCHOP, J. H. R., and CURSON, H. H. (1935). 11. An Ambo Bull described. *Onderstepoort Jl. Vet. Sc. and Anim. Ind.* IV. (2).
13. CURSON, H. H. (In the Press). 12. A Wankonde Milk Pail.
14. CURSON, H. H. (In the Press). 13. A note on the Three Parent Stocks of African Cattle.

Anatomical Studies.

15. CURSON, H. H., and EPSTEIN, H. (1934). 50. A Comparison of Hamitic Longhorn, West African Shorthorn and Afrikander Cattle, particularly with regard to the Skull. *Onderstepoort Jl. Vet. Sc. and Anim. Indust.* III. (2).
16. CURSON, H. H., and BISSCHOP, J. H. R. (In the press). 60. Some Comments on the Hump of African Cattle.
17. CURSON, H. H. (In the press). 61. A Comparison of two of the so-called African Zebus.

Miscellaneous.

18. CURSON, H. H. (1934). Bechuana or Mangwato Cattle. *Farming in South Africa*. Sept.
19. CURSON, H. H. (In the press). The Native Cattle Types of Africa.

Reference No. 1 belongs to Miscellaneous.

Jl. S.A.V.M.A.
VII (1) 1936.

Studies in Native Animal Husbandry.

15. Notes on Customs and Animal Management of the Malaboch Tribe

By A. E. LUND, B.V.Sc., Pietersburg.

In the first place I wish to compliment Dr. Curson on his very valuable work and research on the indigenous breeds of stock. Were it not for his enthusiasm and energy, little, if any attempt would have been made to collect and record data relating to Native Animal Husbandry in this country. I wish also to endorse the statement made in his introductory remarks in regard to the failure of grading up with European breeds, especially in an area such as the N. Transvaal. Many farmers are now realising this fact from practical experience and in consequence, the demand for our only indigenous breed, the Afrikander, is steadily increasing. Other indigenous breeds, *e.g.* Bechuana and Mashona, which were the native breeds of the N. Transvaal, may have proved superior to the Afrikander under the conditions of this area, had they received similar attention in the past. It is not too late to undertake the improvement of these breeds and also the breeds of indigenous small stock.

Whereas Dr. Curson has concentrated on the anatomical features of native cattle, I intend to make a few remarks on :

(1) the conformation of the small stock of the Malaboch tribe;
(2) its customs in regard to stock, the study of which is of value from an anthropological point of view, and
(3) its system of animal management including disease.

The Malaboch tribe, which migrated from Bechuanaland, has resided in the Blaauwberg area of the Pietersburg District for the past century.

Small Stock.

(a) *Sheep.* Prior to the Malaboch War of 1894 there were two breeds of sheep in this area, both of which were of the fat-tailed type. One breed possessed the ordinary long ear and the other, known as *masusu,* a rudimentary external ear, but there were no other apparent differences in conformation.

These sheep were big, standing about 26" at the withers, long in the leg, with fine bone and of various colours, white with black or brown markings being the most common. They were goose-rumped and the tail which was broad at its base, tapered gradually to the tip which reached

the hocks. The majority were hornless. They possessed good legs and moved well and freely.

A few specimens of the Masusu breed with external ears less than ½" in length are still to be found and cross-breds with ears of different lengths are fairly common. The latter show a well developed fold of skin around the base of the ear. The very short external ear is pointed and resembles the tip of an ordinary ear with a small slit-like opening to the *cavum conchae*, which is also small. The external meatus is of normal length and patent. The conchal cartilage is small, the auricular muscles are rudimentary or absent and the scutiform cartilage is entirely absent.

(b) *Goats.* The goats prior to the Malaboch War were all of one type, specimens of which are still to be found. They are small, about 22" high, compact with good bodies and short legs. The coat is short and of different colours. The ears are characteristic; they are long, narrow, stiff and movable, unlike the drooping ears of introduced goats. The majority are horned and the horns which are fairly short and slightly flattened antero-posteriorly are directed upwards and backwards.

These goats are prolific, twins being the rule and occasionally triplets.

Native Customs.

(a) *Lobolo.* The number of cattle given as lobolo is not fixed, but depends on the wealth of the bridegroom and varies from 20 head down to 2. Sheep and goats may also be included in the *lobolo.* Seven head are, however, never given because this is considered a gross insult to the parent of the bride. The reason for this is that the native starts counting from the little finger of the left hand and seven is thus the index finger of the right hand. It is the finger that is used when remonstrating with a person.

(b) *Mokato.* A form of harvest festival, known as *Mokato,* was celebrated by this tribe. Natives were not allowed to partake of their crops before permission had been granted by the Chief. To celebrate this permission, which was usually granted in March, a race for cattle over a distance of 10 to 15 miles was held. The cattle from each kraal were lined up separately and on a given signal they were chased by the natives to the accompaniment of much shouting and whistling. A native carrying a white flag ran in front of the leading animals and when half the distance had been covered, the chasing and shouting was taken over by a relay of natives. On the completed race the white flag was hoisted in the kraal of the winning animal. Dancing and beer drinking followed.

The natives trained their animals for this event by racing them to water and also from their grazing to the kraals.

The introduction of the cattle permit system put an end to this marathon race.

(c) *Hides.* Hides were used for clothing, the making of karosses and also as coffins. The women wore a two-piece garment, one in front and the other behind. Only black hides were used as coffins for the chiefs, but for ordinary natives any colour was suitable.

(d) *Sefala.* Containers for grain, known as *Sefala,* are still made by the natives from the dung of cattle. Fresh faeces are mixed with ash and worked like clay into conical or egg-shaped containers. When full, the containers are sealed with fresh faeces to keep out weevils and other insects.

Animal Management and Diseases.

The cattle of the Malaboch tribe were Bechuanas. The cows were milked twice a day, the calves being separated from their mothers during the day and night. Milk was plentiful and there was no seasonal shortage. Some cows gave up to 2 gallons per milking but the majority gave less. Milking was done by the adult natives and not by piccanins, as the cows were hard milkers . Wooden milking pails and the horns of young cattle were used as receptacles.

The oxen were used for riding and also as pack animals, being controlled by means of a *mohala.* The practice of riding oxen was discontinued about 1908 owing to the intervention of Europeans.

There were no hard and fast rules for the selection of bulls and owners used their own discretion on certain points. Size and fatness with thickness and length of horn were generally accepted as the most desired features. Colour depended on the particular choice of the owner; some preferred long tails with a good brush, others considered a long, loosely hanging sheath was very desirable as indicating a good milking strain and others again preferred a bull whose dam was a good milker.

Bulls were castrated at 1 to 2 years of age with a knife, which was of native manufacture. Younger bulls and small stock were castrated by crushing the testicles between two stones.

Quarter Evil (*Sorotsoane*) was known to the natives before the Malaboch War. When the disease made its appearance in a herd a witch doctor was called in and he prepared a mixture of *Modjana* root and blood from a hartebees. Two switches of a shrub, known as *maretla,* were smeared with this mixture. The owner with a smeared switch in each hand stood at the gate of the kraal and as each beast came past, he would pretend to hit with the left hand and then hit the animal over the body with the switch held in his right hand. There was no singing or chanting during this performance. When all the

animals had been treated in this way, the switches were placed on each side of the gate. This treatment was repeated daily until the right hand switch became too short; the left hand switch was not used at all for hitting.

In addition to this treatment, the animals were sometimes drenched with this mixture and on other occasions a claw from an animal that had died of Quarter Evil would be filled with the mixture and buried at the entrance to the kraal.

Anthrax (*Lebete*) was not known until after 1900. There was no treatment for this disease, Lungsickness (*Stokoano, Termanie*) or Rinderpest (*Mokoba*).

For a retained afterbirth the stems and bark of a shrub (*Molole*) were stamped and placed in cold water. The animal was drenched with this and in addition a lizard, which is found under the loose bark of certain trees was placed alive on the back of the cow's tongue to be swallowed.

In cases of dystocia the hands were smeared with the "Molole" extract and the calf removed by hand. This was undertaken only by certain natives who were considered experts.

Insurance Scheme.

An advertisement on another page announces that special facilities are now available to members S.A.V.M.A. in regard to insurances through the S.A. Mutual Life Assurance Society. Although not strictly a Group Insurance Scheme, this arrangement enables members to obtain insurance policies through the S.A.V.M.A., and with the S.A. Mutual Society members can pay their premiums monthly at the ordinary annual rates. This represents a saving of 7½% in addition to the Association profiting to the extent of the collection fee, as premiums must be paid through the Hon. Sec.-Treas., S.A.V.M.A.

Members who already have policies with the S.A. Mutual Life Assurance Society are also asked to communicate with the Hon. Sec.-Treas. S.A.V.M.A. in case they would wish to have their premiums paid through the S.A.V.M.A. and allow that body to benefit by the collecting fee.

We have just received an advance copy of "The Bloodless Phlebotomist," Vol. VIII No. 3, which is being mailed to every member of the medical and allied professions in South Africa.

This little journal published by the Denver Chemical Manufacturing Company of New York is replete with interesting articles written by physicians who are located in many different countries and while the purpose of the publication is to acquaint its medical readers with Antiphlogistine, the physicians will find a number of items and illustrations which will excite their curiosity and interest — altogether, the little journal is well worth reading. We note that 1,450,500 copies are printed in ten languages and distributed to every veterinarian in the world with a known address, excepting in the countries of Russia, Latvia and Bulgaria.

If you do not receive a copy write to the Denver Chemical Manufacturing Company, New York, who will place your name on their list. The journal will be supplied you free of all charges.

THE ASSOCIATION

Minutes of Council Meeting, S.A.V.M.A., held at Polley's Hotel, Pretoria, on 3rd December, 1935, at 7.45 p.m.

Present : Messrs. F. J. Carless, President; H. H. Curson, Vice-President; R. du Toit, Hon. Secr.-Treasurer; A. C. Kirkpatrick, P. J. J. Fourie, A. D. Thomas, C. J. van Heerden and M. H. V. Brown.

Apologies : P. J. du Toit. J. L. Dickson deputed M. H. V. Brown to act for him.

1. **Minutes of Council Meeting held on 11/9/'35.**

These were read, the omission of the President's apologies rectified, and confirmed.

2. **Matters arising out of these minutes.**

(a) *Members in arrears.*

Mr. van Heerden said that he had not yet seen Major Morton but hoped to do shortly, and the Secretary reported that he had asked Mr. Snyman to make inquiries as to the whereabouts of Mr. McKie. Dr. Curson stated that he had seen Major Morton, who had promised him to remit his arrear subscriptions.

(b) *Travelling allowances for G.V.O's.*

Dr. Curson asked Mr. van Heerden whether anything had yet been done departmentally in this connection as the veterinary profession was the only profession of which certain members were classified as District Travelling Officers.

Mr. van Heerden replied that a memorandum had been submitted to the Secretary for Agriculture in this connection and that he had every hope of success. No reply had as yet been received from the Secretary for Agriculture.

(c) *Reciprocity with Great Britain.*

The President mentioned that the principle of reciprocity for South African graduates with the Royal College of Veterinary Surgeons had been recognised by the Dominions Office and only certain details requiring an exchange of correspondence remained to be completed. Then, of course, the M.R.C.V.S. holder in Government employment could register in South Africa without payment of £10.

Dr. Curson mentioned that the Royal College of Vet. Surgeons had granted the privilege of taking only 3 months to obtain the M.R.C.V.S. diploma to one B.V.Sc. graduate. It was agreed to seek information on this point from the Faculty.

3. **Tenders for Veterinary Services called for by the S.A.R.**

The Secretary said that a member had drawn his attention to the fact that the S.A.R., Johannesburg, had for several years past called for

tenders for veterinary services at Kazerne. He had informed the S.A.R. that this procedure was out of order and had circularised members on the Reef pointing out that by submitting tenders they were contravening the regulations under the Act. A reply had been received from the S.A.R. informing him that no tenders had been received presumably due to his action.

The President said that the Veterinary Board had this matter under consideration.

Dr. Fourie moved that a sub-committee be appointed to take this matter up and ascertain from various private practitioners what system of payment would suit the private practitioner best, viz., an annual retaining fee, or specified fees for each attendance. Agreed. The following sub-committee was appointed : Drs. Curson, Fourie and the Secretary.

4. **Scales of Charges for Veterinarians.**

The Secretary produced a scale of charges drawn up by Drs. Curson and Quinlan. He disagreed with the principle of fixed charges for individual operations and thought that such a scale of charges should be drawn up on more general lines to serve only as a guide.

After some discussion it was decided that this list be submitted to certain selected private practitioners for their opinions.

5. **Group Insurance.**

The circular in which the scheme was outlined to all members was read and approved.

6. **Proposed salary scales—Public Servants Association.**

The Secretary said that he had thought the matter closed but that he had recently received a letter from the Chairman P.S.A. in which it was stated that according to a new scale which had been drawn up veterinary graduates would suffer no financial loss by being appointed on the new scale. The Secretary then stated that he had replied to the Chairman, P.S.A., and pointed out that the proposed alterations in scales of pay had been based upon certain assumptions for which no guarantee of their adoption had been received from the Public Service Commission, and that the S.A.V.M.A. regretted that it was unable to lend its support to the scheme.

This letter was approved.

7. **Captain Clapham—Report of Committee.**

Dr. Curson said that the sub-committee had been in touch with both Captain Clapham and the Chief of the General Staff. The replies received from the latter had been of such an unsatisfactory nature that the committee recommended that an appeal be made to higher authority, *viz.* the Minister for Defence.

Dr. Fourie suggested that in order to approach the Minister the

Secretary for Defence be requested to arrange an interview with him. This was agreed to and a deputation was nominated consisting of the following : Drs. Quinlan, de Kock, Quin, and the Secretary.

8. **S.P.C.A. proposed scheme for the treatment of animals in Cape Town.**

The Secretary read the letter received from this body in which it was proposed to issue their inspectors with hypodermic syringes and certain drugs for the free treatment of animals belonging to the poorer classes of the Cape Peninsula. He had replied to the effect that the Council S.A.V.M.A. was unable to endorse this proposal and suggested that private practitioners be approached by the S.A.V.M.A. with the object of establishing a free panel practice to meet the case.

Dr. Curson was deputed to interview the private practitioners of the Cape Peninsula in this connection and the Secretary was instructed to advise the S.P.C.A. that action was being taken.

9. **General.**

(a) *Registration of Badges Act.*

The Secretary indicated that the cost of registration of the S.A.V.M.A. Coat of Arms would be rather high and it was decided that the cost of registration was not justified.

(b) *Courtesy title of "Doctor" for veterinarians.*

The Secretary read a memorandum from Mr. N. F. Viljoen in which he stated the case for the acceptance of the courtesy title. A letter from Mr. Coles was read in which the writer objected to the above proposal and made certain counter proposals.

Dr. Fourie stated that the Faculty had interested itself in the matter and was considering the question of facilitating the acquisition of a doctorate especially with a view to field veterinarians. The concensus of opinion was that such a proposal as that of Mr. Viljoen should be left for the consideration of a General Meeting.

(c) *Expert Witness Fees.*

The Secretary read a letter from the Secretary for Justice in which it was stated that the special allowance to medical men was introduced in 1914 on representations made by the medical profession, but that due to the alteration in present day conditions the special allowance might have to be reconsidered in the near future.

It was decided that as veterinary practitioners were put to the same inconvenience as medical practitioners, the special allowance be pressed for.

The meeting then closed at 11 p.m.

BOOK REVIEWS.

Table of Veterinery Posology.

Of the many chapters in the 6th edition of this book [1] the most important to the veterinarian are those dealing with veterinary posology, therapeutical actions of medicines, dictionary of synonyms and trade names for drugs, table of diseases and suggested therapeutics, dictionary of incompatibles, table of parasites affecting animals, table of protozoan diseases and their transmitters, table of composition and nutritive values of feeding stuffs, drugs excreted by the mammary gland, plants which taint butter, milk and flesh, tables of dentition and identification of mange parasites.

This book contains in concise form a large amount of information which is of great value and it will certainly prove a most useful acquisition to the library, not only of veterinary students and practitioners but also of pharmacologists. D. G. S.

An Essay on Immunity. [2].

This review article by Professor J. Basset of the National Veterinary School at Lyons summarizes much of the work done in recent years on immunity, bringing it into line with the older views on this fascinating subject. Some of the views expressed are controversial and the fact that some of them are his own adds to the interest of the discussion.

After a short introduction in which the earliest attempts at immunization against diseases and the early work of Pasteur are referred to, the subject of natural immunity is broached. Basset asks the question as to why Pasteur chose to work on two diseases such as anthrax and hydrophobia out of the enormous number in need of study. He suggests that he was undoubtedly influenced by the earlier work of Toussaint on anthrax and Galtier on hydrophobia.

In discussing absolute natural immunity the author, after going over the usual theories put forward to explain this state, comes to the conclusion that even now there is no satisfactory explanation of it.

The question of relative natural immunity is intimately bound up with the individual resistance of animals and the virulence of the bacterial species involved. It is known that some individuals of a species have greater resistance than others and will stand higher doses of a bacterial infection. In guineapigs inoculated intraperitoneally with anthrax bacilli the resistance is greater than when they are inoculated subcutaneously.

(1) *Table of Veterinary Posology*, by George A. Banham and Wm. J. Young. 6th Edition, 1935. Baillière, Tindall & Cox, London. 8/6.

(2) *Essai sur l'Immunité* par J. Basset. 1936. In 8°. 88 pages. Fr. 8. Vigot Frères, 23, Rue de l'Ecole de Medicine, Paris (VIe).

The opposite is the case with the fowl cholera organism. In the case of anthrax the resistance is probably due to the powerful phagocytosis in the peritoneum, but it is difficult to explain the case of fowl cholera by negative chemotaxis or repulsion of leucocytes. The question of the latency of bacterial spores is of great interest. Spores may remain latent in the tissues in many diseases such as tetanus, anthrax, etc. The spore is a dehydrated organism and can only develop when suitable moisture conditions are present.

Another factor influencing relative natural immunity is the part played by endotoxins. Bacterial endotoxins damage the tissues and render the development of the bacteria which produce them easier.

If one attenuates a strain of the black quarter organism, one reduces its vegetative power at the same time. It is easy to reduce the virulence of an organism but not easy to make it more virulent. Basset has been unable to make avirulent cultures virulent by any method. This is in conflict with the work of Pasteur and his co-workers who claimed to be able to recreate virulence in avirulent strains of the anthrax bacillus. The sudden loss of virulence of organisms in nature and in consequence the disappearance of certain diseases such as fowl cholera from France, is very difficult to explain.

In discussing acquired immunity against diseases caused by bacteria producing exotoxins such as tetanus, diphtheria, etc., the author puts forward the generally accepted view that it is only necessary to immunize against the toxins, the organisms themselves having very little invasive power. The virulence of the toxin influences the degree of immunity and it is necessary to give at least two doses of anatoxin to get the same degree of immunity as would be produced by one dose of toxin.

The author makes the statement that in black quarter if antitoxin is inoculated into an animal seven days after inoculation with toxin, even if a local lesion developes, no active immunity results. In criticizing this observation one has to bear in mind the fact that Basset's toxins had to be given in large doses to produce any effect, so can hardly be compared with toxins such as that produced by the tetanus organism. The fact that antitoxins in hyperimmunized animals are produced for a long period suggests a cellular origin. It is of interest to note that the tissues most affected by the toxin do not necessarily produce the antitoxin. The author suggests that the leucocytes can excrete antitoxin. In the fixation abscesses which occur during tetanus immunization, large amounts of antitoxin are found in the abscess cavity. Ramon considers that antitoxins may be developed by the body fluids. The subject must be considered as still an open one.

Passive immunity only lasts about 10 to 12 days. A subsequent inoculation of antitoxin serum is of little value as the antiserum itself is antigenic. Inherited passive immunity lasts at most two months. In the mouse, guineapig ,rabbit and man the transference of the immunity is

placental, in the mare and ruminants by the milk particularly the colostrum. In birds the antibodies go to the yolk and none will be found in the albumen.

In acquired immunity against infectious septicaemic bacterial diseases the endotoxins are responsible for the production of resistance. Various methods have been and are being used for immunization against this type of disease. The soluble products of the bacteria may be used, such as filtrates, but if they are formolized one requires larger doses to produce immunity and usually more than one. The method of using dead organisms is employed on a large scale as in typhoid immunization. Two or three inoculations are necessary and better results are obtained if an oily substance be added to retard absorption, the so-called lipo-vaccine method. The poor immunity developed in fowl cholera after inoculation with killed cultures, suggests that the immunity in human plague vaccination is of doubtful value.

Living attenuated cultures are too dangerous to use for the human being. In explaining the fatalities which occasionally occur after anthrax vaccination, the theory of a negative phase with increased susceptibility has been put forward. Another theory is that vaccination may allow a latent infection to develop by temporarily depressing the resistance. Basset considers these ideas are probably wrong and that the bad results are due to the vaccine being too virulent. No immunity results from the inoculation of nonpathogenic organisms.

On the subject of local immunity, he considers that it probably does not exist as a separate entity and that one can only speak of a general immunity. It would follow, therefore, that the so-called entero-vaccines, such as those used for immunization against typhoid fever in the pill form taken by the mouth, are useless. The dose of bile taken before the plil, is too small to have any effect on the permeability of the intestine. In the infectious septicaemias, the phagocytes probably play a large part in the fight against the invading organism. If a fatal dose of anthrax bacilli is inoculated under the skin of a guineapig with the addition of a pyogenic organism, death does not result and a suppurating local lesion develops. In a pigeon inoculated intravenously with a non-fatal dose of a culture of the swine erysipelas bacillus, if one examines the bird several hours later, one will find the organisms in the Kupffer cells of the reticulo-endothelial system. In a fatal case one finds the leucocytes crammed with organisms which the cells have been unable to digest.

In discussing immunity against chronic bacterial diseases the author puts forward some interesting views and enters into the field as a critic of B.C.G. vaccine. One has to remember that in chronic bacterial diseases, not only does the animal body react against the invading organism, but the organism itself acquires resistance to the animal's defences. This resistance is accompanied by a sensitivity, or allergic condition, well developed in such diseases as tuberculosis or glanders for instance. This

sensitivity is not, of course, seen exclusively in chronic diseases and is characterized by the occurrence of local and systemic reactions to the introduction of extracts of the causal organism. These reactions may be so severe as to actually kill the animal. This allergic condition is not transferable to a normal animal, so cannot be directly compared with anaphylaxis.

In immunization against bacteria causing chronic infections one usually has to make use of living organisms and a state of premunition is set up comparable to that seen in infections with piroplasms or trypanosomes. In tuberculosis immunization as exemplified by von Behring's bovo-vaccine it is necessary to use a strain with a certain degree of pathogenicity and living bacteria have to be used, the immunity depending on the presence of the organisms in the tissues. Immunity only develops in about six weeks after inoculation and within a year of the disappearance of the organisms, it is lost. Allergy develops as a result of the presence of the bacteria.

In recent years the B.C.G. vaccine has been used on a large scale for immunization against tuberculosis in the human being, the vaccine being given per os in the first day of life. Calmette has recently admitted that contrary to his previous views penetration of the intestinal epithelium by bacteria after the fifteenth day of life is very difficult. It will be remembered that his theory of the development of tuberculosis was that it was always the result of intestinal infection even when no lesions were seen in the intestines.

The only evidence of infection, even per os, is the development of allergy. Children treated with B.C.G. vaccine and who escape accidental infection do not develop an allergic state in more than 50% of cases after six months. The objection has been raised that allergy is not an indication of immunity and it has been shown that dead bacteria will produce it. They do not, however, produce immunity to tuberculosis.

Calves treated with B.C.G. vaccine per os only develop an allergic condition in 50% of cases. It has been proved by inoculation and exposure experiments that one-third or more of calves inoculated with B.C.G. vaccine do not acquire any immunity. One should bear in mind that the B.C.G. strain is very attenuated and that even in vaccination against acute bacterial infections all the vaccinated animals do not develop resistance. Repeated inoculation may be necessary before immunity develops. There is a great variability in the natural resistance to tuberculosis. As a result of his personal experience Heimbeck, working in the tuberculosis hospital at Oslo, concludes that inoculation with B.C.G. vaccine has to be continued until allergy develops.

In the last section of the article, immunity acquired against diseases caused by the ultra or filterable viruses is discussed. The author considers it unfortunate that the filterable form of the tubercle bacillus has been included amongst the ultraviruses as it only adds to the confusion already existing.

For convenience sake the ultraviruses are divided into three groups : (1) the dermotropic, (2) the neurotropic, and (3) the haemotropic viruses. An absolute classification is impossible as a virus such as the variola one can produce encephalitis, the foot and mouth virus may attack the nervous system and the viruses of yellow fever and horsesickness can become neurotropic in mice. The third group has numerous sub-groups: (a) swine fever; rinderpest, equine typhoid and psittacosis; (b) yellow fever, pappataci fever, and dengue, in short diseases of man transmissible by insects in which the organism passes a portion of its life cycle; (c) exceptional diseases such as horsesickness and bluetongue on the one hand, which only confer a relative immunity not of long duration, and on the other infectious anaemia of the horse and pernicious anaemia of small ruminants, which are characterized by repeated attacks of illness with variable intervals between them.

In producing immunity against dermotropic ultraviruses, the use of the dead virus is valueless. The observations on killed foot and mouth virus in the immunization of cattle have never been confirmed. The resistance of a guineapig can be partially augmented by inoculation of killed virus, but one is dealing with a naturally resistant animal. In a very susceptible animal like the hedgehog, killed virus does not produce any immunity. One has to use a living and virulent virus for immunization. In the human being one can use the smallpox virus for immunization against the disease, but it is too dangerous and one only uses a related virus, that of cow pox. In the case of poultry, pigeon pox virus can be used for immunization against fowl pox. It has very little pathogenicity, and does not produce a sufficient immunity. Basset recommends the use of a virulent fowl pox virus in an exactly determined dose into a tissue such as the muscle where it cannot multiply. In this way one gets an inapparent generalized disease which results in a general immunity.

In the case of the neurotropic viruses one is far from being able to immunize against all the members of the group. It is chiefly against rabies that immunization is attempted and the so-called antirabic treatment is really an intensive immunization. In rabies the use of dead virus in massive doses has been tried but is of little value. In the case of the fixed virus from rabbits, the virus is not really attenuated, but owing to prolonged cultivation in the nerve centres it has acquired a neurotropism which enables it to be inoculated into the subcutaneous tissues more or less without danger. In the virus attenuated by ether (Rembenger) it is not really attenuated but the dissolution of the lipoids by the ether renders it more susceptible to the reactions of the animal body. It produces a very good immunity.

In the case of the haemotropic viruses, in yellow fever dead virus does not immunize. The pathogenicity of the virus is greatly diminished by passage through the brains of white mice and virus attenuated in this way is being used for the immunization of man. Sawyer and Findlay

have recommended the sero-vaccination, using attenuated virus and immune serum, but it would appear that the serum is an unnecessary complication of the method if one uses a virus which has been passaged many times.

Dead virus confers a certain degree of immunity in rinderpest, but it only lasts about four months and only two-thirds of the animals are immunized. Organs such as the glands, spleen, etc., are used as the source of virus, the blood which contains a lot of virus being useless for vaccine making. It is possible that the value of the blood destroying organs is due to the large quantities of dead virus which they must contain. It would be rational to expect that repeated large doses of dead virus would give a more regular and longer immunity.

A strong immunity can be obtained in rinderpest and swine fever by the serum virus method, but not without risk. In cattle one may have a 10% mortality, in pigs up to 20%.

In the infections caused by ultraviruses one usually gets an absolute and durable immunity, probably due to the large amount of virus which develops during the attack. In herpes, a very mild infection in man, no immunity develops. The best immunity is obtained where one can use living virulent virus for immunization without risk. The serum of recovered or even hyper-immunized animals is of very little value for immunization. In bacterial diseases the immunity is never absolute and one can break it down if a sufficiently large dose of virulent organisms is given.

It is probable that leucocytes play a part in immunity against viruses. In the tissues attacked by certain viruses one finds the lesions partially composed of collections of leucocytes usually mononuclears.

Virus diseases not accompanied by an absolute immunity constitute an exception to the general rule. Basset puts forward an ingenious theory to explain the recrudescences in diseases such as infectious anaemia of horses and pernicious anaemia of small animals. In these diseases it is the red corpuscles which are attacked. In mammals the red cells are only the carriers of haemoglobin, whose duty is to serve and to die. They are incapable of adaptation or reaction. The animal cannot acquire a cellular immunity and those red cells which supplant the old ones are as vulnerable as those of a susceptible animal. The virus remains in the body a long time and adapts itself, so the recrudescences are easily explained.

In this brief review the writer has attempted to summarize the more important points referred to in this ably written and concisely worded article. Not all immunologists will agree with the views put forward by Professor Basset, but they are stimulating and provide much food for thought. A perusal of the original article can be heartily recommended.

E.M.R.

City Council of Pretoria: 31st Annual Report of the Medical Officer of Health, 1934-1935.

The City Council and the Public Health Department of Pretoria are to be congratulated on the form and contents of their publication. The report is a comprehensive one and deals exhaustively with matters affecting the health of the population, and it is to be hoped that so useful an innovation will be continued. A number of interesting graphs and several useful tables are given and the record will be read with interest by those engaged in public health activities.

Strenuous efforts have been made to eliminate the typhoid menace from the city, but the relatively large number of carriers amongst the natives makes the problem a difficult one. Nevertheless, a worthy attempt has been made to control known native carriers by the institution of a native typhoid fever gang. The gang is kept under strict supervision as far as hygiene is concerned, and the natives are employed on work where they cannot endanger the community. It is unfortunate that the Council was not able to agree to the testing of all dairy employees, as at present most carriers can only be discovered when they have already done harm.

A matter of particular interest to veterinarians has been the regular veterinary examinations of dairy herds. This activity of the department is admittedly in its infancy, but the example is one that can be recommended to a number of other municipalities. The control of tuberculosis, mastitis and contagious abortion is of great importance to the well-being of the human population. Apart from clinical examinations, regular bacteriological examinations of milk samples were carried out.

An interesting investigation arose out of a case of suspected chronic arsenical poisoning in a child. The milk which this child had drunk was incriminated and an examination of the dairy supplying the milk showed that a number of cows were suffering from arsenical poisoning and that the grazing had been badly contaminated from a leaky dipping tank. Unfortunately the diagnosis in the case of the child was based on clinical observations alone, so that there must be an element of doubt as to the etiology, and the case against the milk cannot be regarded as proven. In view of the widespread use of arsenic compounds in South Africa the above observation, if correct, is rather perturbing. The close interrelation between human and animal health was again stressed, if stress were needed, by an outbreak of myiasis due to *Cordylobia anthropophaga*. The outbreak was controlled and measures taken against the infection found in pets as a means of controlling the incidence of cases in human beings.

M. S.

The danger of secondary infections following the inoculation of vaccines.

Several cases have recently been brought to our notice where heavy mortality has occurred in sheep during the first few days after inoculation against bluetongue. This mortality has been due, in the majority of cases, to blackquarter.

As these infections might possibly have been avoided by taking proper precautions, it is important that farmers should be impressed with the necessity for careful disinfection of the site of inoculation. There seems to be evidence that blackquarter organisms may be present on the skins of sheep. On one farm in the Pretoria district where mortality followed twenty-four hours after bluetongue inoculation, heavy losses had previously occurred from blackquarter as a result of infection of shearing wounds. The shearing or inoculation of sheep on or near hides of cattle or sheep skins is to be avoided especially on farms where blackquarter exists.

The site of inoculation should be carefully cleaned with a disinfectant such as 2½% Jeyes Fluid, Hycol or any other suitable agent. Methylated spirits has a very good cleansing effect where greasy material is present.

Where losses have occurred from blackquarter after shearing or inoculation in sheds or kraals, it is advisable to avoid using them for further operations of this type. Where the presence of dust, as in kraals, makes it difficult to avoid infection of a vaccine when poured out into a cup (even when covered over), it is recommended that vaccine should be drawn from the bottle directly into the syringe. This can be done by pushing a spare needle through the stopper of the bottle. The needle is left in place and the vaccine drawn through it with the syringe until the bottle is empty.

Syringes and needles should be sterilized by boiling for 15 minutes, taking the time from the moment the water boils. The wax on the vaccine bottle should be removed with a clean instrument and the needle in the stopper should be protected against dust and dirt.

The symptoms and lesions of accidental blackquarter after inoculation with bluetongue or any other vaccine are essentially the same as those seen after shearing. A markedly haemorrhagic oedema is almost constantly present in the subcutaneous tissues and may even be the only change noticed.

In carrying out an investigation it is advisable to skin carcases as one may otherwise miss the lesions in some cases. Recently a case has come to our notice where unless the animal had been skinned the lesions would have been missed as they were between the shoulder blades. In

this case the inoculation had been carried out behind the shoulder. This site should not be utilized for the injection. Rather should the inside of the thigh where there is a better opportunity of cleaning and disinfecting be chosen for inoculation. On badly infected blackquarter farms, lesions may occur on any portion of the body as the result of tick bites or any other traumatic injuries.

Ninth Annual Scientific Meeting of the Medical Association of South Africa.

The Ninth Annual Scientific Meeting of the above Association will be held at Pietermaritzburg from Monday, June 29th, to Friday, July 3rd, 1936, in the Natal University College Buildings.

During the week preceding the Congress the Royal Agricultural Show will be held in Pietermaritzburg, while on Saturday, July 4th, the July Handicap will be run in Durban.

The President of the Natal Branch of the S.A.V.M.A. is an Hon. Vice-President of the Congress, and the following abstract from a letter received by the Hon. Sec.-Treasurer is self explanatory :—

> The Organising Committee has agreed that Veterinary Surgeons may register as members of the Congress for the fee of £1 1s., which will, we hope, attract a good number of them to be present, and to take part particularly in the Special Diseases Section.

Further particulars and circulars may be obtained by request to the Hon. Organising Secretary, Dr. C. C. P. Anning, P.O. Box 285, Pietermaritzburg.

It is sincerely hoped that as many of our members as possible will attend. Those of us who have had the privilege of attending past Congresses can only speak of them with the highest praise. Not only is the scientific program interesting and instructive in itself, but the opportunity of meeting our Medical Confrères socially and professionally and of discussing common problems with them should not be missed and can only result in good to all concerned.

Extension of the "Parc National Albert."

In view of our own large game sanctuaries in South Africa, *viz.*, Kruger National Park, Gemsbok, Addo, Bontebok, Mkuzi, Hluhluwe and Umfolosi Reserves, it is of interest to note that other countries are alive to the importance of reserving adequate tracts of country in Africa

in which both the fauna and flora are to be fully protected and preserved in their natural state.

By a decree dated November 12th, 1935, the existing *Parc National Albert* in the Belgium Congo, measuring some 390,000 hectares, has been practically doubled in area to 856,790 hectares (roughly 270 km. long by 40 km. wide).

This unique park is situated on the equator between Lakes Kivu and Edward, it comprises a high mountainous region, Mt. Ruwenzori with snow-clad peaks and a chain of active volcanoes, primary equatorial forests, vast plains, and the shores and waters of the two great lakes mentioned.

Needless to say that the fauna and flora thus preserved is of the richest both in quantity and variety, since it combines within the same park climatic conditions varying from equatorial to high alpine (perpetual snow) and from the rich aquatic life of the lakes to that of the volcanic region.

The economic, educational and aesthetic value of these sanctuaries is only beginning to be realised by the public at large and at home. Does the Veterinary Profession likewise realise their potentialities as avenues of scientific research and possibly permanent employment ?

Members will be pleased to learn that in addition to the many honours already conferred on him, Sir Arnold Theiler has recently been elected an Associate Member of the *Societé de Biologie de France.*

We congratulate him warmly on this well-deserved distinction. Sir Arnold and Lady Theiler will leave South Africa for Europe in April, where amongst other things he hopes to attend the International Microbiological Congress in London.

Jl. S.A.V.M.A.,
VII (2) 1936.

The Vitamin Requirements of Farm Animals.

By J. H. KELLERMANN, M.Sc. (Agric.), Ph.D., Animal Nutritionist, Onderstepoort.

Up to twenty-five years ago scientific studies of animal nutrition concerned themselves almost wholly with the exchanges of matter or energy or of both. Even the present day feeding standards define only the protein, carbohydrate and fat requirements of the animal, but it is now known that minerals and vitamins play a very important role in nutrition. The following remarks indicate the importance of vitamins in the nutrition of farm animals and attention is drawn to the conditions prevailing in South Africa.

VITAMIN A.

Vitamin A is essential to all domestic animals and man. It is fat-soluble and occurs in cod-liver oil, milk, cheese, butter, eggs, and all fresh fruits, vegetables, grass, and hays.

Vitamin A in Relation to Cattle.

It was first pointed out by Hart and co-workers (1917) at the Wisconsin Agricultural Experiment Station that there were other important considerations in compounding a ration besides the total digestible nutrients or the available energy contained in it. They found that bovines, fed rations comparably balanced in regard to digestible organic nutrients and energy value, but from different plant sources, were not alike in respect to the maintenance of general vigor, vigor of offspring, or in their capacity for milk production. Rations composed solely of products of the wheat plant proved inadequate for growth or reproduction while one from the yellow maize plant was satisfactory. The symptoms shown by animals on the all wheat ration included nervousness and blindness, indicating nerve degeneration, a condition often found in animals on a vitamin A deficient ration. Later experiments showed that even if a wheat ration was fortified with a calcium salt, normal growth or reproduction did not ensue, whereas when yellow maize was substituted for the wheat grain, normal growth and reproduction resulted, indicating that yellow maize contained one or more substances essential for growth and reproduction, that were absent from the wheat plant. It was found later on that yellow maize contains a carotenoid that can be converted by the animal body into vitamin A. However, according to the recent work of Kuhn and Grundman (1934) the vitamin A activity of yellow maize appears to be due, after all, not to carotene itself but to a related pigment, cryptoxanthin.

Still later results are reported in 1924 with the use of the original wheat plant ration made up of 8.0 lb. wheat meal, 0.3 lb. wheat gluten, 5.3 lb. wheat straw, supplemented (in the light of later knowledge of nutrition) with 2 per cent of bone meal, 2 per cent of cod-liver oil, and 1 per cent of sodium chloride. Two mature cows fed this ration for 9 to 10 months before parturition produced normal healthy calves carried full time. After birth the calves gained rapidly on the mothers' milk and when the calves were removed the cows continued to give a good flow of milk for several months. It is evident, therefore, that both yellow maize and cod-liver oil contain a substance necessary for good health and reproduction that is absent from wheat.

Bechdel, Honeywell, and Dutcher (1928) fed a low vitamin A ration to five dairy heifers; all without exception showed certain characteristic symptoms, after 6 to 7 months. The symptoms included oedema, difficulty in walking, oily exudates on legs, rapid respiration, poor appetite, blindness, spasms, and reproductive failure. Post-mortem examination showed no bone deficiency or nerve degeneration. .Cod-liver oil (vitamin A) treatment brought about rapid improvement and complete cure in two cases.

Jones, Eckles, and Palmer (1926) used the following ration deficient in vitamin A. Treated skim milk (i.e. in a manner suitable for oxidation of vitamin A), white maize, dried beet pulp, lemon juice, calcium carbonate, and calcium phosphate (Ca : P ratio=1.5 : 1). The ingredients of the ration were proved free from vitamin A by tests on rats. Six animals were fed the basal ration and three control animals received in addition 20 ml. of cod-liver oil per head daily. All experimental animals showed grave symptoms after 4 to 6 months, while the control animals, after nine months on experiment, were normal in all respects. The symptoms exhibited by the animals on the deficient diet included failure to grow, xerophthalmia, respiratory trouble, and diarrhoea, and in some cases death ensued. Cod-liver oil feeding caused resumption of growth and disappearance of the symptoms.

These observations showed without a doubt that vitamin A is essential for the well-being and reproduction of cattle. Furthermore they, no doubt, paved the way for Hart, Mead, and Guilbert (1933) and Guilbert and Hart (1934), of the California Experimental Station, to show that range cattle in California are subject to low vitamin A intake during the dry season. The length of the drought period varies from year to year, with a corresponding variation in the manifestations of vitamin A deficiency. Under natural conditions a single deficiency uncomplicated by other factors rarely occurs, since long droughts also bring about undernutrition and mineral deficiency in range cattle. The three most important manifestations of vitamin A deficiency are expulsion of the foetus prematurely or dead at term, severe diarrhoea in new-born

calves, and ophthalmia in young growing animals. In view of the fact that our range conditions in South Afrcia are so similar to those in California, it would not be surprising if our range sheep and cattle also suffer and die from vitamin A deficiency during prolonged droughts. In 1932, when we experienced a severe drought, it was reported in the *Rand Daily Mail* that thousands of sheep had died in the Southern Free State from a peculiar and unknown disease. The sheep, it was stated, although in very poor condition, did not die from starvation but from a disease the main manifestation of which was diarrhoea. As mentioned before, diarrhoea is one of the first and chief manifestations of vitamin A deficiency, and it is suggested that when next we experience another prolonged drought, the Experimental Stations should bear in mind a probable vitamin A deficiency amongst range sheep and cattle and treat some of those showing symptoms with cod-liver oil. If the symptoms disappear and a general improvement in condition results, it will be almost certain that the cause of the trouble was vitamin A deficiency.

Vitamin A is not only present in all green grass and hays but also in the well-cured dry forms. It is, however, slowly oxidized and finally completely destroyed by long exposure to air and the warm rays of the sun. Nevertheless, being a fat soluble vitamin, it is stored in the animal body, especially in the liver, and it should therefore be quite possible during a long drought to save most of the stock from an untimely death due to vitamin A deficiency and undernutrition by giving the animals an occasional feed of preserved hay or grass.

Vitamin A in Relation to Swine.

Work concerning the vitamin A requirements of swine received its impetus from the work of Steenbock and Boutwell (1920) who demonstrated that yellow maize contained enough vitamin A for normal physiological function in rats while white maize did not contain any demonstrable amount of this vitamin. Similar results were obtained by Rice and Mitchell (1926) with pigs. These authors found that about 1 oz. per pig per day of ground lucerne or 1 per cent of cod-liver oil adequately supplemented the white maize ration. Lamb and Evvard (1923) found that one teaspoonful of butter fat daily, fed to slow growing pigs on a white maize and meat meal ration, greatly improved the thrift and growth of the pigs. They found that pigs of approximately 125 lb. weight could be fed a white maize ration for short periods (90 days) of fattening with as satisfactory results as with a yellow maize ration.

Hughes *et al* (1928) fed to pigs a ration very low in vitamin A, consisting of 87 per cent white maize, 10 per cent meat meal and 3 per cent bone ash. The pigs received sunlight. Very characteristic symptoms developed in all lots, including inco-ordination, spasms, poor reproduction, impaired vision, and nerve degeneration after an average feeding period

of 129 days. Five per cent butter and also 10 per cent lucerne meal in the ration gave complete protection. Similar experiments with pigs by Orr and Crichton (1924), Zilva (1921), and others all showed the need of pigs for vitamin A. We can, therefore, safely say that in our dry South African climate, especially where pigs are kept under intensive conditions without any green pasture, it will always be advisable to include either yellow maize or lucerne meal in the ration.

Vitamin A in Relation to Poultry.

In 1921, Beach of California reported a disease which had occurred in epidemics among chickens during two previous years in which pustule-like patches were found in the mouth and pharynx and in which the mucous membranes of the eyes and nasal passages were involved. On post-mortem examinations the kidneys were found to be seriously involved, with accumulation of urates in the tubules. He found that the condition was not infectious, but could be controlled by feeding; and later (in 1924) he reported that the disease resulted from a lack of green feed in the diet and was due specifically to vitamin A deficiency.

During the next few years a large number of investigators, inspired by the observations of Beach, and including men such as Hart, Steenbock, and associates (1924), Emmett and Peacock (1923), Sugiura and Benedict (1923), all showed by laboratory experiments that vitamin A was essential for the chicken and corroborated the findings of Beach. Their observations can be summarised as follows : Apparently vitamin A is necessary for chickens and plays a part in egg production. A deficiency of this vitamin leads to a diseased condition of the mucous membranes of the mouth, pharynx, and nasal passages and may or may not affect the eyes. There is some evidence of kidney involvement, and apparently there is nerve degeneration. Including yellow maize in the ration prevents deficiency of vitamin A even when no green feed is given.

The conditions in the grain belt in the Western Province are very similar to those in California, and as a boy on a farm in the Western Province the author still remembers several late summer epidemics among chickens, the chief external manifestations of which were sore eyes and diarrhoea, now suggesting to him that they were vitamin A deficiency epidemics. Most probably vitamin A plays an important role in the nutrition of farm animals; however, it should be mentioned that the Division of Veterinary Services is investigating at present the problem of vitamin A deficiency in ruminants.

VITAMIN B.

Vitamin B occurs in all grains, grasses, and hays. It is water-soluble and not stored to any appreciable extent in the animal body.

Vitamin B in Relation to Cattle and Swine.

Vitamin B studies for cattle and swine are centred mainly on the following investigations :—

(1) Do cattle and swine require vitamin B ?
(2) Would it be a good practice to make additions of vitamin B to common rations ?

Eckles *et al* (1924) have presented data in which they demonstrated that calves can be grown to maturity on a ration which, whilst being satisfactory in other respects, will produce characteristic vitamin B deficiencies in rats. Additions of 40 gm. of yeast daily to their basal ration did not affect growth or health of calves. Heifers fed on this ration from 7—8 months of age to over two years, bred, conceived, and dropped normal calves.

Damon (1921), in an attempt to demonstrate that certain bacteria produced vitamin B, found that there were three types of acid-fast organisms which produced vitamin B : they are *B. timothy* 213, *B. smegmatis* 246, and *B. moelleri* 627. Bechdel, Honeywell, Dutcher, and Knutsen (1928) then investigated the synthesis of vitamin B in the rumen of cattle as suggested by Damon in the United States and Sir Arnold Theiler (1915) in South Africa.

Through a permanent fistula (3½ inches in diameter) into the rumen of a heifer raised on a vitamin B deficient diet, the ruminal contents were removed, extracted with alcohol and evaporated at 50° C.; and dextrin was added so that 1 gm. of extract represented 25.4 gm. or original rumen material. Rats were then given this ruminal-content extract as a supplement to their vitamin B-free basal ration and it was found that the rats receiving the extract gained an average of 5.2 gm. per week over their control mates. Bacterial study of ruminal microflora by means of stained smears revealed the presence of an organism which in number averaged 90 per cent of all organisms present. This organism, named by Knutsen, *Flavobacterium vitarumen,* was present to the extent of 2,225,000 in a 1 gm. sample. When this organism was fed to young rats on a vitamin B-free diet, these rats grew much better than others on the vitamin B-free ration alone. It is evident, therefore, that cattle and probably all ruminants can synthesise vitamin B in their rumen and that extra feeding of this vitamin would therefore be unnecessary.

Data on requirements of swine for vitamin B are not available. Addition of yeast to swine rations at Wisconsin, Ohio (1927) and Michigan Experimental Stations did not prove to be an economical practice. Some gains in weight resulted but this may have been due to palatability and the stimulating effect of yeast.

Vitamin B in Relation to Poultry.

In 1890 Eijkman found that fowls fed exclusively on over-milled

rice developed a rapidly fatal paralysis analogous to beri-beri in man. When the birds were given whole rice they were protected or cured of the disease. Similar results were obtained by Plimmer, Rosedale *et al* (1922; 1923). According to these investigations the amount of vitamin B complex depends upon the caloric value of the diet. The higher the caloric value, the more vitamin B was necessary for complete assimilation. Diets consisting of polished rice have been found by Dutcher and Wilkins (1921) to cause atrophy or under-development of testicular tissue in cockerels, but when lucerne in 2 gm. lots was added to rice diets on the 36th day of the experiment the atrophied testes increased in weight. When the lucerne was omitted from the diet of cockerels which had previously received it, marked atrophy and cessation of testicular growth took place. Dutcher attributed these findings to the vitamin content of the lucerne.

Hamilton, Card, and Kick (1927) of Illinois have found that a ration of 60 per cent of ground whole grain (maize, oats and wheat) and 20 per cent of wheat bran and soy bean meal, with fat soluble vitamin supplements, is not deficient in vitamin B complex for growing chicks. Ten per cent of lucerne leaves substituted for wheat bran and ten per cent of dried yeast used in place of soy bean meal failed to improve the growth-promoting value of the diet for chickens raised outdoors. It is evident, therefore, that the ordinary mash and grain rations contain more than enough vitamin B complex for chickens kept under the intensive system and it is very doubtful whether vitamin B deficiency ever occurs in chickens under natural outdoor conditions without any additional food.

VITAMIN C.

Vitamin C is very widely distributed in nature, occurring in all fresh vegetables, fruits, fresh grass, and hays. It is water-soluble and very easily destroyed by heat and oxidation. Vitamin C is necessary in the diet of man, monkey, and guinea pig, but unnecessary for the rat, rabbit, chicken, hog, and cow; and is probably not necessary for the horse and sheep.

Vitamin C in Relation to Cattle.

The requirements of cattle for vitamin C is very low, possibly even nil. Thurston, Eckles, and Palmer (1926) reported trials with dairy cattle that are fairly conclusive. Four calves were started at about two weeks of age on a scorbutic ration consisting of grain, linseed oil meal, cod-liver oil, and a salt mixture; for roughage timothy hay autoclaved for 30 minutes at 15 lb. pressure was used. The ration was also fed to guinea pigs causing death in three weeks. Two of the calves as controls received tomato juice. No abnormal symptoms developed and the experimental calves made slightly better growth than the controls. It is concluded that calves do not require vitamin C in quantities that can be measured by

the present methods of testing food materials for antiscorbutic potency. In a later study Thurston *et al* (1929) showed that cattle could synthesise vitamin C inasmuch as the livers of calves on a vitamin C-free ration contained vitamin C as did also the milk from a heifer which had never received any demonstrable amount of vitamin C.

Hart, Steenbock, and Ellis (1920) fed cows on air-dried roughages and grains over a long period of time and still found vitamin C in the milk. Hughes and associates (1928) likewise reported good milk production with a good vitamin C content when they fed a low vitamin C ration to cows over a long period of time.

Vitamin C in Relation to Swine.

A similar experiment from the Wisconsin Agricultural Experiment Station showed that the liver from swine on a ration deficient in vitamin C cured scurvy in guinea pigs. Furthermore, Orr and Crichton (1924) have shown that on diets deficient in vitamin C no signs of malnutrition developed in pigs which could be ascribed to a deficiency of that factor; and Hughes and associates (1928) report good growth and reproduction in swine fed a low vitamin C ration over a long period of time.

Vitamin C in Relation to Poultry.

At Wisconsin, Hart and co-workers (1925 b) fed a group of chickens on a ration which was vitamin C-free but complete in all other respects and after 73 days the chickens did not show any ill effects. They were killed and their livers fed to guinea pigs on a scorbutic diet. One gram of liver daily did not supply enough vitamin C for the guinea pigs, but 3 gm. of liver gave full protection. This work agreed with that of Carrick and Hauge (1925) who fed livers from chickens that had been on a scorbutic diet for over three months to six guinea pigs at 5, 10, and 15 gm. levels. Cures were effected in all cases. It is evident, therefore, that chickens can synthesise vitamin C and that their livers are a good source of this vitamin.

VITAMIN D.

The distribution of vitamin D is quite limited, the most potent natural source being cod-liver oil. Vegetable foods in general do not contain appreciable amounts, but it has been shown by Hart and Steenbock that lucerne and clover hays dried in the sun without excessive weathering do contain considerable amounts of vitamin D. Vitamin D is quite stable to heat and to oxidation by the air; it is fat-soluble and can be stored to some extent in the animal body. It is essential to all domestic animals.

Steenbock (1924 a) of Wisconsin and A. F. Hess (1924) of New York discovered independently that foods can be rendered antirachitic by irradiation with ultra-violet light. It was at first thought that cholesterol

became activated because preparations of cholesterol and phytosterol could be activated by irradiation, but work by a number of investigators indicated that the cholesterol contained an impurity. It remained for Windaus (1928) to show that the active impurity in the cholesterol was the ergosterol. Ergosterol is present in the skins of all animals, where it can be activated by the ultra-violet rays of the sun and whence it is transported to the various tissues of the body. For that reason we can consider ourselves fortunate in this country in that we need never fear a vitamin D deficiency.

Relation of Vitamin D to Cattle.

The effect of irradiation on the antirachitic properties of milk was demonstrated in 1925 by Steenbock and Hart of the Wisconsin Station. Irradiation (by a mercury quartz lamp) of cow's milk for 30 minutes increased its antirachitic value eight times, and of goat's milk 24 times. This increase in activity could also be obtained after direct irradiation of the goat. The antirachitic value of the milk was tested by supplementing the basal ration for production of rickets in rats with varying amounts of the milk. Calcium deposition was studied by examination of the distal ends of their radii and ulnae, after the bones had been split and stained with silver nitrate. The following amounts of milk were required for satisfactory calcium deposition :

12 cc. of the control milk;
2.0 cc. after irradiation of the goat;
0.5 cc. after irradiation of the goat's milk.

In later experiments the same authors found that the antirachitic value of milk could not be increased by feeding of cod-liver oil to the cow, and only to a slight extent by feeding of irradiated yeast. Irradiating the cow did not increase the anti-rachitic property of the milk.

Influence of Dietary Factors on Calcium Metabolism.

Many studies have been made in the past to find rations by which calcium equilibrium could be attained in cows furnishing liberal quantities of milk. In addition to the mineral content of the diet, the amount of vitamin D was thought to be an important factor in determining the calcium balance.

A series of experiments to find a practical way of administering sufficient vitamin D to lactating cows in order to attain calcium equilibrium was carried out at the Wisconsin Agricultural Experimental Station by Steenbock, and others (1930a; 1930b; 1930c).

The first attempt to supply vitamin D in the form of cod-liver oil failed to produce any improvement in calcium metabolism. One half pound of cod-liver oil (medical grade) was fed per cow per day. Extraction of the faeces with ether and feeding this extract to rachitic baby chicks

indicated that the cow was unable to absorb the vitamin D from this source.

As mentioned before, these investigators (1925) observed that the antirachitic property of hay was increased by the amount of exposure to sunlight during curing. In order to ascertain the possible influence of hays cured with varying exposures to sunshine on the calcium equilibrium in milking cows, further metabolism experiments were carried out. In this study some hays (lucerne) were included that had had a maximum of exposure to sunlight, but it was found that none of these, when fed at a level of about 10 lb. daily, maintained calcium equilibrium in a cow during the milking period.

In later experiments, feeding of irradiated yeast was tried as a means of administering vitamin D. This was fed at a level of 200 gm. daily, supplementing a ration which consisted of 10 lb. lucerne hay, 25 lb. maize silage, and 1 lb. grain mixture to approximately each 3 lb. of milk produced. Each cow also received half a pound of calcium carbonate per day. The Ca : P ratio of this ration was 1.3 : 1. The optimum ratio for dairy cattle is not known, but in some instances it had been found possible to obtain a positive balance when calcium and phosphorus were furnished in this proportion. The best results and a positive balance with a heavily milking cow had been obtained by feeding fresh green feed and some calcium salt in addition.

Feeding of irradiated yeast in the above experiment was found to have no beneficial effect on calcium assimilation, although in this case some of the vitamin D was absorbed into the blood, as indicated by the enrichment of the milk in antirachitic value. No effect was noted on the calcium and inorganic phosphorus of the blood; also the ratio of Ca : P in the milk was not altered.

These observations may be taken as an indication that some factor other than vitamin D and mineral matter is present in fresh green feed and determines the calcium metabolism in cows.

Vitamin D in Relation to Calves.

In 1933 Rupel, Hart, and others published a series of experiments in which they showed that calves have need of vitamin D in some form and develop rickets when this vitamin is lacking. Twenty-four grade Holstein heifers divided into six lots, as nearly similar as possible in respect of age, weight, condition and probable results, were started on experiment when the group averaged 21 days in age. Lot 1 was fed a basal ration containing pro-vitamin A in the form of yellow maize but no vitamin D. The remaining five lots received the same ration supplemented with either vitamin A or D or with both A and D. The animals were weighed weekly and after the experiment had continued for 280 days they were slaughtered and certain bones dissected for analysis. The

results showed that deficiency of vitamin D is manifested by a reduction in growth, by stiffness, progressive emaciation, deformity of the bones, and enlargement of the joints; by a reduction in the level of blood serum inorganic phosphorus and calcium, and by a reduction in the percentage of total ash in the dry fat-free bone.

Oxidized (vitamin A-free) cod-liver oil, ultra-violet radiation and sunlight are effective antirachitic factors when adequate dosages are provided. A liberal amount of sun-cured hay, of the kind and grade suitable for calf-raising, supplies an abundance of vitamin D in the ration.

Vitamin D in Relation to Swine.

Very similar results were obtained with swine by Steenbock, Hart, and Jones (1924b) who showed that stiffness and rheumatism in young pigs in the Middle West of the United States are due to vitamin D deficiency.

Vitamin D in Relation to Poultry.

The discovery of the significance of vitamin D in poultry nutrition has had a profound effect on this industry in America and Europe. This knowledge has permitted intensive production under artificial conditions by showing a causal relationship between a deficiency of vitamin D or sunlight and leg-weakness and low hatchability during the winter season. Formerly it was thought that under conditions of confinement a roughage factor would aid in avoiding leg-weakness, and paper was used as a roughage with some apparent degree of success. Hart, Halpin, and Steenbock (1922) reported some failures when paper was used, but found that the factor of primary importance in the successful rearing of chicks under confinement was an ample supply of the fat-soluble vitamin D. When cod-liver oil was omitted from the diet the chicks died in from 4 to 6 weeks.

With the discovery of Huldschinsky (1919) of the relation of light to the prevention and cure of rickets was opened up a new field of research in poultry husbandry. It was found by Hart *et al* (1923) that half-an-hour's daily exposure to direct sunlight was much more potent in furnishing the antirachitic equivalent than was 5 per cent of a synthetic ration fed as fresh green clover, calculated on the basis of the dry weight of the clover.

The chick is extremely susceptible to rickets, while the egg may possess distinct antirachitic properties. It is a common observation of poultrymen that the hatchability of winter-produced eggs is relatively low. Hart and co-workers (1925 a) considered that this might be due to the eggs during late autumn, winter, and early spring being poorly endowed with antirachitic properties, and that a deficiency of this factor might cause " nutritional abortion," as they called it. These workers showed

that the exposure of the bird to ultra-violet radiation will markedly improve the production and sustain hatchability (60—70 per cent) of eggs. With ultra-violet radiation more antirachitic factor is produced; the assimilation of Ca and P is increased, and a smaller number of deaths in the shell occurs. The shells of the eggs of the irradiated birds were on the whole distinctly heavier and contained more total calcium than those not receiving ultra-violet light. The antirachitic potency of egg yolks from irradiated hens was approximately ten times that of those from non-irradiated hens when tested on rats. However, it is not to be inferred that the amount of anti-rachitic substance in the diet is the primary cause of lowered egg production during the winter months. Fertility of the eggs was not consistently influenced by a deficiency or abundance of the antirachitic factor.

No antirachitic effect could be induced by irradiating the eggs; apparently the egg-shell is too thick to allow penetration of the rays. Irradiation of the male bird may give increased hatchability.

In order not to mislead, it should be mentioned again that, whereas vitamin D, no doubt, eclipses all the other vitamins in its practical importance in countries with long, severe winters accompanied by foggy weather, it is of very little practical importance in countries (like South Africa) with abundance of sunshine.

VITAMIN E.

Vitamin E was first detected in Evans' laboratory (1922) in California as a specific fat-soluble vitamin essential for the normality of reproduction in mammals. This vitamin is distributed very widely in nature, being present in all vegetables, grains, and meats. It is stable to heat, light, air, and many of the ordinary chemical reactions. Hence there should be no danger of any deficiency arising.

A large amount of work has already been done on vitamin E with white rats but, so far as the writer is aware, no real scientific work has as yet been carried out regarding its significance for any of the farm animals.

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A Note on Onchocerciasis as observed at the Municipal Abattoir, Pietermaritzburg.

By L. STONIER, B.V.Sc., Pietermaritzburg.

The following observations are based on an examination during February, 1935, at the Municipal Abattoir, Pietermaritzburg of four bovine carcasses affected by onchocerciasis; two of the subjects had also been seen prior to slaughter and in these (as shown in fig. 1) subcutaneous nodules could be observed from a distance on inspection. The cattle had come from the farm "Nkasim," on which numerous animals had been reported to be affected by Government Veterinary Officer V. Cooper.

In all four cases the infection was extensive, the numerous nodules

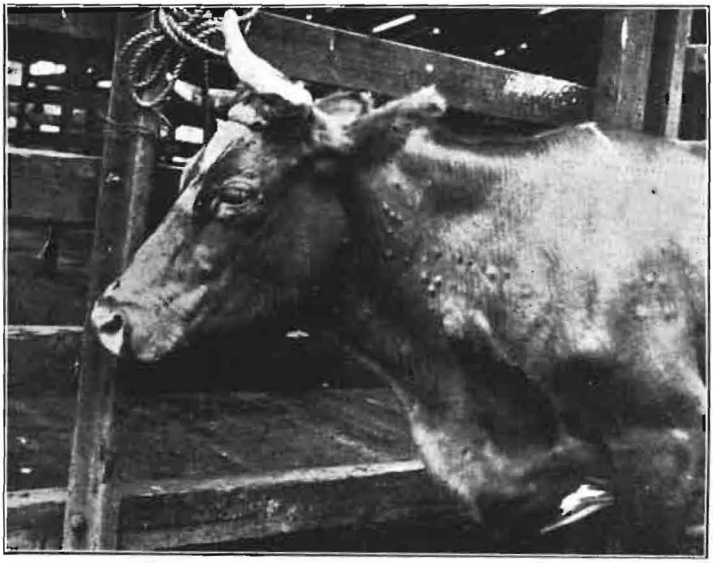

Fig. 1.
Onchocerca nodules as seen on skin of the neck and shoulder.

in the subcutaneous fascia being distributed over the head, neck, shoulder, forearm, thorax, abdomen, and hind limbs as far down as the hocks. The infection was not confined to the V-shaped area on the brisket described by de Kock and Snyman (1928). On the trunk the nodules were most numerous ventrally and extended dorsally on both sides to a line joining the tuber of the scapular spine to a point midway between the *tuber coxae* and the stifle. In two cases a fair number of the cysts

were observed on the udders and they were also more numerous on the hind quarters than in the case of the other two carcasses.

According to their location, the nodules could be grouped as follows : superficial nodules, varying from 4 mm. to 1 cm. in diameter (average 7.5 mm.); partially embedded nodules, from 5 by 4 mm. to 10 by 6 mm. (average 7 by 5 mm.); deeply embedded nodules—i.e., situated in the internal perimysium (see fig. 2) from 3 by 3 mm. to 6 by 4.5 mm. (average 5 by 4 mm.).

The superficial nodules were chiefly button-shaped, having the form of spheres with polar flattening; some were irregular in outline. The partly and the deeply embedded nodules were slightly elongated in the direction of the muscle fibres; and as mentioned above the deep nodules were considerably smaller than the superficial and the partly embedded ones.

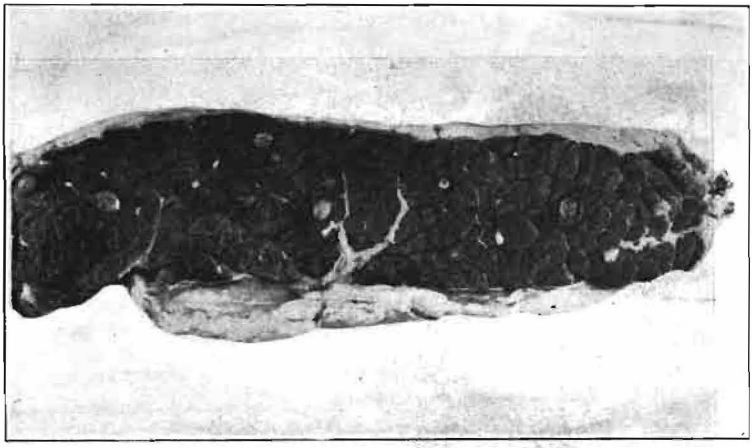

Fig. 2.
Onchocerca nodules in portion of a muscle.

The nodules have a creamy yellow colour. Their surface is smooth. Their convoluted contents (the "worm nucleus") are visible through the capsule, giving a granulated appearance. The superficial nodules had a spongy consistence with a firm centre, the capsule not being distended. The partially and the deeply embedded nodules although also spongy, were firmer in consistence because the cysts were more distended.

The cutaneous muscle was heavily infected with cysts having the distribution previously described. The other muscles affected were as follows :—

Head : *zygomaticus, depressor labii inferioris,* masseter, and *parotido-auricularis.* The last two muscles were heavily infected. In addition, odd cysts were scattered all over the head. *Forelimbs* : triceps, flexors and extensors of the carpus; superficial pectoral (heavily infected), deep

pectoral (not quite so heavily infected). *Trunk* : The cutaneous muscle, including the fold of the flank, was heavily infected and all the muscles of the thoracic and abdominal walls were fairly heavily infected. *Hind-limbs* : a fair number of nodules were found in the *tensor fasciae latae biceps femoris,* and the extensors and flexors; the infection was not nearly so heavy as in other parts, although nodules were found up to a depth of 2 inches beneath the surface of the musculature.

The microscopic appearance of the nodules has been fully described by de Kock and Snyman (1928). According to Mönnig (1934) some of the nodules may become calcified; but usually the appearance is as described. A nodule is easily removed from the tissue surrounding it but owing to its peculiar structure is enucleated with difficulty. For diagnosis the contents of a nodule should be teased out on a slide in a drop of saline or tap water and examined while wet: the microfilaria liberated from the broken female are easily seen wriggling in the solution amongst the trabeculae and broken portions of the adult. To make stained preparations the contents of a nodule should be teased on a dry slide and when dry fixed with alcohol and stained with 10% Giemsa for 20 minutes.

My thanks are due to Mr. Hill of Allerton Laboratory for taking the photographs and to the Manager of the local abattoir for reporting the cases and providing facilities for investigation.

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Gousiekte in the Waterberg District.

By T. F. ADELAAR, B.V.Sc., Potgietersrust.

History.—Towards the end of December, 1935, severe mortality among cattle was reported to me in the Vaalwater area of the Waterberg district. The history was that in all cases the animals had died very suddenly without previous symptoms of illness; they emitted one bellow and dropped dead. Protrusion of the tongue was a fairly constant post-mortem appearance and the abdomen became markedly distended within a short interval after death. Some cattle had dropped dead after drinking water, while others had died miles away from water. The animals affected varied in age from two to five years. Very often pregnant cows were found dead in the kraal or after having been driven out in the morning; trek-oxen died in the yoke or immediately after outspanning or during inoculation.

The climate was very dry after a few spasmodic showers and much veld-burning had occurred.

On a ranch where out of some 3,000 cattle about 400 head had died, a definite history was obtained of movement of animals into a certain camp: on the commencement of mortality they had been transferred into another camp where they had continued to die. Other mobs of cattle placed in the original camp also started dying after an interval of three to four weeks in each case. Gousiektebossie (*Pachystigma pygmaeum*, Schl. Robyns) was found in this camp.

The farmers maintained that anthrax was the cause of death and considerable difficulty was experienced in dissuading them from this opinion, in support of which they urged that mortality had ceased after inoculation with anthrax vaccine. This was true in the case of some farms, while on others a similar cessation or amelioration was observed to follow the use of blackquarter vaccine. In some cases mortality ceased after good rains or after a change of camps.

An observation of interest was that cattle often died immediately following the exertion of walking up a steep gradient after drinking.

In spite of the death of more than a thousand head of cattle, no blood-smears had been submitted.

Personal Investigation.—On my first visit no fresh carcasses were available for post-mortem; however, one autopsy was made at which anthrax, arsenical poisoning and prussic acid poisoning were excluded. The history supplied by the owner fostered suspicions of gifblaar or poisoning or gousiekte, but the information was very unreliable and conflicting. At a second visit an autopsy conducted on a fresh carcass gave similar results. Shortly after this an investigation was made in collaboration with Dr. D. G. Steyn of Onderstepoort.

Post-mortem Appearances.—These comprised chiefly signs of heart failure, viz. general cyanosis and passive hyperaemia of all organs; dark blood flowed from the surface of carcasses flayed soon after death. In some cases flabbiness of the heart was noticed. The abdomen was markedly distended soon after death. Hydrothorax was present in some cases.

Differential Diagnosis.—The symptoms to some extent resembled those of peracute arsenical poisoning, which was excluded by tests for arsenic carried out on the spot. Prussic acid poisoning was excluded by inability to detect this poison in samplse take from the centre of the ruminal contents of animals which had died a few hours previously. The post-mortem appearances and smear examination excluded anthrax.

The fact that some of the animals died after drinking and that portions of gifblaar leaves were recovered from the ruminal contents con-

firmed the suspicion that a small percentage of the deaths was due to gifblaar poisoning. Important in this connection is the additional strain placed on the heart through the ingestion of about 100 lb. weight of water and the solubility of the active principle of gifblaar in water. In these cases the post-mortem appearances much resembled those of gousiekte, except that in the more protracted cases of the latter disease dark greyish foci (myocarditis) were detectable in the heart-muscle.

Treatment of gousiekte is impossible, since death is preceded by no premonitory symptoms.

Prevention.—Prophylactic measures must consist in the eradication of the plant from one or more camps and the practising of rotational grazing.

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Clinical Notes.

By F. A. VERNEY, F.R.C.V.S., Kokstad.

(1) INDIGESTION IN A BULL.

The subject was a South African bred pedigree Ayrshire bull, 5 years old. For no apparent reason this bull suddenly developed all the usual symptoms of a serious digestive disturbance. After the owner had treated the animal without success I was called in.

The temperature was normal, the coat staring; the animal occasionally grunted; there was complete loss of appetite and moderate tympanitis.

Although there was no history enabling one to arrive at a definite aetiological diagnosis, the case appeared to be an ordinary one of acute indigestion. I passed the Dutch probang and removed some of the gas and then gave per probang the usual drugs successfully employed in such cases. On the following day the bull certainly appeared better, but not as well as one would expect. I then employed stimulant treatment, contemplating a recovery in the course of a few days. After a week I was again called in, the owner stating that the animal had shown evidence of recovery but had since suffered a recrudescence of the original symptoms without any apparent reason as only a little good teff had been consumed.

This relapse at once suggested the possibility of a foreign body working through the reticulum; but clinically there was certainly no evidence of this, especially since I observed that the bull stretched himself when he arose.

This bull never completely recovered although at times he ruminated and gave one the impression of improvement. The symptoms of indigestion continued in greater or lesser degree for three months with varying intensity, resulting in a great debilitation. It became quite evident that without radical measures he would succumb. I decided to explore the rumen and reticulum and made all preparations for this operation when the patient was found dead. The post-mortem revealed a stenosis of the pyloric orifice of the abomasum resulting in extensive ballooning of the stomach. There was no foreign body of any description.

(2) Bovine Tetanus.

I was called in by a local farmer to visit a number of sick cattle said to be suffering from "gallsickness," some of which had already died. These cattle existed on two separate farms in the same ownership. The owner stated that the disease started simultaneously in both herds and he was at a loss to understand this coincidence. On examination it was quite clear that I had not to deal with anaplasmosis.

On the first farm there were six sick oxen, none of which showed any appreciable rise in temperature. All showed varying degrees of stiffness in their gait and the advanced cases were difficult to move. Most of the animals were tympanitic and from the evidence of the farm manager it appeared that this symptom had contributed to the death of two animals. Constipation was a prominent symptom. All the animals showed varying degrees of erection of the tail and on examination it was difficult or even impossible to open the mouth.

On visiting the second farm I found six sick animals, all young heifers. The symptoms were very similar to those described but perhaps more defined.

On investigating the history of these animals I learned that they had all been dehorned on the same day at the same place. Exactly 21 days afterwards the first animal showed evidence of sickness and cases continued to develop to the 30th day; altogether 10 animals died and a number recovered.

Fortunately the tetanus bacillus has not a wide distribution in South Africa and although I have seen tetanus in horses in Natal and Basutoland, this is the first time I have seen it in bovines. I invited the Government Veterinary Officer, Mr. Barnard, and Dr. Mönnig, who was visiting this locality, to inspect the cases.

I have no doubt that these animals were infected by the dehorner. This instrument is very heavy and it is probable that the operator unconsciously allowed it to rest on the earth in the intervals between the dehorning. This case is another demonstration of the importance of rigidly adhering to antiseptic methods.

During the day 96 animals were dehorned and I think in the circumstances the owner was lucky to escape with so few losses.

(3) Parturient Paresis.

The subject was a twelve years old Kerry Jersey cow with a history of a previous attack of parturient paresis three years ago. The cow was found staggering about very badly at the 48th hour after calving. She was given two ounces of calcium gluconate in a pint of water, administered subcutaneously as there was no assistance available. The cow very soon became semicomatose and finally developed into a " text-book " case of the disease. As she showed no evidence of recovery 5 hours after the injection I thought it wise to give her oxygen per udder. I waited another five hours and as the patient was obviously more comatose and had to be kept up on her brisket, I gave her intravenously a further 2 ozs. of calcium gluconate and certainly expected some immediate improvement; but at the 16th hour from commencement of treatment she appeared worse than ever and was completely comatose. Anxious not to lose her, I administered a further udder inflation and hoped for the best. It was not until the 20th hour from the commencement of the treatment that the patient showed any real improvement and she staggered up at the 21st hour. This cow belonged to me and I feel that had I not been in constant attendance I would have lost her. I have never experienced a case so refractory to what is usually a certain curative treatment.

Another interesting factor in this case is that this cow had received 2 ozs. calcium phosphate daily for the last 12 months; it is quite clear this is no reliable prophylactic against the disease.

The cow finally made a complete recovery and has given 4½ gallons of milk in the 24 hours despite her age.

BOOK REVIEW.

Orgaanziekten bij de Groote Huisdieren.

In writing this book on internal medicine *) Prof. Wester, who is Chief of the Department of Medicine in the Veterinary Faculty of the Utrecht University, has drawn largely on his rich clinical experience in the extensive University clinic and elsewhere. The book is divided into 15 chapters dealing with (1) organs of respiration, (2) circulation, (3) digestion; (4) liver, (5) pancreas, (6) spleen, (7) peritoneum; (8) urinary apparatus, (9) nervous system; (10) disturbances in metabolism, including deficiency diseases, (11) udder, including the clinical examination of milk, (12) male genital organs, (13) lymphatic glands, (14) skin, and (15) blood.

The book is very concise in that trivial and theoretical details have been omitted and all the material of practical value has been included. It is a book in which almost every conceivable condition the practitioner is likely to meet is dealt with as regards its aetiology, symptomatology and treatment, in a simple, direct and forceful manner. A large amount of pathological physiology is included, which will assist practitioners in forming a clear conception of the symptomatology and pathogenesis of the conditions dealt with. The book will be of great value to all veterinarians; even in cases where one disagrees with the author, the subject matter will be found instructive and stimulating.

With the exception of purely surgical conditions the only organs, the diseases of which are not discussed, are the uterus and the ovaries. Whilst inclusion of the diseases of these organs would have added to the completeness of the book, its value to the practitioner is not thereby seriously affected as sterility and other related conditions form such a vast problem that the practitioner should in any case consult specialised works thereon.

The Nederlands of Prof. Wester is simple and to the point, so that anybody having a working knowledge of Afrikaans will find no difficulty in reading and understanding the subject matter.

In prescribing treatment the symbol *gr.* is used to indicate the dose. This stands for grammes and not grains.

P. J. F.

*) Orgaanziekten bij de Groote Huisdieren, by J. Wester (1935), Utrecht. Published by J. van Boekhoven, Utrecht. pp. 800, illustr. Price 15 gld.

THE ASSOCIATION.

Minutes of the Council Meeting held at Polley's Hotel, Pretoria, at 7.45 p.m. on 31st March, 1936.

The following members attended: Drs. Curson, Fourie, Steyn, Thomas, Messrs. Kirkpatrick, van Heerden, van der Vyver (acting for Mr. Diesel), and R. du Toit.

1. **Confirmation of Minutes of Council Meeting, 11 - 9 - 35.**

These were taken as read—having been published in the Journal—and were confirmed.

2. **Matters arising out of minutes:—**

(a) *Scales of Charges for veterinarians.*

The Secretary read the reports received from four private practitioners in response to the circular letter sent to a number of members in private practice. These reports varied considerably and from them no definite scale could be arrived at.

Dr. Fourie suggested that information be sought from the R.C.V.S. This was agreed to.

Dr. Thomas proposed that Faculty be approached, when sufficient information had been obtained, with the view to students of veterinary science, failing adequate opportunities for seeing private practice, being given some guide as to reasonable scales of charges for services rendered. This was seconded by Mr. van Heerden and carried.

(b) *S. & T. Rates.*

On an enquiry from the Chairman re subsistence allowance, Mr. van Heerden explained that a memorandum had been sent to the Public Service Commission from the Division wherein a strong case had been made out for the abolition of the designation District Travelling Officer which applies at present to G.V.O's. The P.S.C. had agreed to reopen the whole question as it affects all officers in the Service at present classed as D.T.O's. No definite information had been received as yet and it was not expected to have any reply until after the present session of Parliament.

Transport Allowances. The Secretary had a letter from a G.V.O. complaining of the present rates of pay applicable to subsidised cars. Mr. van Heerden replied that this matter had been brought to the notice of the P.S.C. on several occasions in the past but that, on account of the lack of co-operation on the part of G.V.O's. so far as assisting in the collection of reliable figures (i.e. actual running expenses as shown

in the official log book, proving the officers concerned to be running their cars at a loss) was concerned, no convincing arguments could be put forward in the face of the figures in the hands of the P.S.C. based on the log books of all officers in the Civil Service running subsidised cars. He stated further that there appeared to be very little use in fighting this case with the P.S.C. unless reliable figures could be produced. It was felt that those who have actually sustained losses should get together actual proof of this, when the matter could be taken up with the proper authority.

(c) *Captain Clapham.*

The Secretary read the draft of a letter addressed to the Minister for Defence wherein it was suggested that the Minister agree to meet a small deputation with the object of discussing the granting of a professional allowance to Capt. Clapham and also other matter regarding the military organisation of veterinary science.

Dr. Steyn proposed that this letter be sent to the Minister, seconded by Mr. van der Vyver. After some discussion this was agreed to.

(d) *Members in arrears.*

The Secretary pointed out that a large number of members had not yet paid their subscriptions and that it seemed advisable that drastic action be taken regarding a few members who were several years in arrears. It was agreed that in the case of two members registered letters be sent requesting payment of arrear subscriptions. In the event of no replies being received or these replies not being satisfactory, Rule 7 (b) of the Constitution be applied and the members concerned be deprived of membership.

In the case of the other arrear subscriptions it was decided to leave these matters in the hands of the Secretary, but the attitude of these members was to be deplored in view of the numerous reminders sent during the course of the year.

(e) *Expert Witness Fees.*

The Secretary read a letter from the Secretary of Justice wherein was stated in reply to a previous communication it was regretted that veterinarians could not be placed on an equal footing with medical practitioners in this matter of expert witness fees.

It was agreed that the Secretary keep this matter open by replying in general terms and that in the meantime information be obtained from the R.C.V.S. and other Veterinary Associations as to what the position was regarding the payment of expert witness fees to veterinarians in England and Holland for instance.

3. **Tendering for veterinary services, S.A.R.**

The Secretary explained that this matter had been handed over to the Veterinary Board for attention and read the copy of a letter sent

by the Veterinary Board to the S.A.R. wherein the irregularity of the procedure was emphasised and suggesting a means of overcoming the objection.

4. **S.P.C.A. Free Veterinary Panel—Cape Town.**

The Secretary read extracts from correspondence dealing with this matter. It appeared that a panel service had been established for the free treatment of the animals of the poor of the Cape Peninsula. Major Keppel has been the person chiefly concerned and several registered qualified practitioners have volunteered to attend free of charge.

Dr. Fourie raised an objection regarding the exclusion of the registered unqualified practitioners of the Cape and the way in which this panel had been arranged.

Mr. van Heerden proposed that information regarding the initiation of the panel and its organisation be obtained from Major Keppel direct. Agreed.

5. **Witwatersrand Agricultural Society.**

The Secretary read letters received from this Society containing requests for an expression of opinion from the Association regarding what constitutes an unsoundness in a horse with particular reference to roaring, whistling and "tubed" horses. It was explained that information on these points had been obtained from Dr. Quinlan, Mr. S. T. A. Amos and Major Verney; the letters from these gentlemen were read.

It was agreed to appoint a committee with powers to act and communicate its decision direct to the Witwatersrand Agricultural Society before Wednesday, the 8th April. The following members of this committee were appointed: Dr. Quinlan (convenor), Major Verney, Mr. Amos, Mr. Kirkpatrick, Mr. McNae, Mr. Runciman and any other person this committee may desire to co-opt.

6. **New Members.**

The Secretary read the names of several gentlemen who had applied for membership. It was agreed to lay these names before the General Meeting for final approval.

7. **Adoption of Courtesy Title.**

The Secretary read a memorandum received from a member in Bloemfontein wherein it was suggested that veterinarians adopt the courtesy title of "Doctor," thereby following the lead given by the medical and dental professions.

On a suggestion from the Chairman following upon a lengthy discussion Dr. Steyn, seconded by Dr. Fourie, proposed that the matter be decided upon by referendum of all members in good standing. This was agreed to.

8. **General.**

1. Mr. Kirkpatrick stated that Dr. Martinaglia had been approached by the Medical Officer of Health of the Germiston Municipality who appeared anxious that a veterinarian be appointed to undertake veterinary work for the Municipality in a part-time capacity. The veterinarian so appointed would have the opportunity of doing private work as well, not only in Germiston but also along the East Rand. It was agreed that the M.O.H. be approached by the Council and that the necessary information regarding such an appointment be obtained.

2. The Chairman pointed out that Dr. Schulz had approached him and expressed his appreciation of the facilities and help granted him by the Dept. of Agriculture in connection with the medical treatment received by him in England.

It was decided that the Secretary write to the Secretary for Agriculture expressing the appreciation of Council for the treatment meted out to Dr. Schulz by the Dept. of Agriculture.

There being no further business the meeting closed at 10.30 p.m.

Minutes of the 30th General Meeting of the S.A.V.M.A. held at the Agricultural Show Grounds, Johannesburg, on 11th April, 1936.

Present : Dr. H. H. Curson, Vice-President, in the Chair; J. G. Boswell, W. P. Hamlyn, E. C. Nelson, F. A. Verney, B. Runciman, W. S. B. Clapham, M. C. Robinson, G. Martinaglia, A. C. Kirkpatrick, B. Young, J. Quinlan, S. T. Amos, P. S. Snyman, P. J. Fourie, P. L. le Roux, R. du Toit, and A. McNae.

The Chairman in opening the meeting expressed his pleasure at seeing Mr. P. L. le Roux of Mazabuka, who had just returned from a visit overseas. He also presented Mr. C. J. van Heerden's apologies who found himself unable to attend the meeting, and read a letter from the President, Mr. F. J. Carless, who apologised for his unavoidable absence.

1. **Confirmation of minutes of the 29th General Meeting held at Onderstepoort on Sept. 12th and 13th, 1935.**

Dr. Fourie proposed that these minutes be taken as read and confirmed as they had already been published in the Journal. This was agreed.

2. **New Members.**

The following names were placed before the meeting for consideration for membership : Messrs. H. Theiler, G. F. van der Merwe, N. H. Boardman, J. H. B. Viljoen, A. F. Tarr, C. J. Erasmus, S. G. Wilson (Nyasaland).

Dr. Martinaglia, seconded by Mr. Snyman, moved that they be accepted, and these gentlemen were then duly elected members.

3. **Presidential Address.**

In the absence of the President, Dr. H. H. Curson read the presidential address forwarded by Mr. Carless. Dr. Fourie proposed a vote of thanks and moved the adoption of this report and its inclusion in the minutes. This was seconded by Dr. Quinlan. Agreed.

PRESIDENT'S ADDRESS.

The Secretary's Report, added to regular publication of Minutes of Council Meetings throughout the year, will have kept members well informed on the work of your Executive and the various Sub-Committees, so I propose to select one or two items on which to make a few supplementary comments.

One of the most important matters the Council has had to deal with for several years is the position of the veterinarian in private practice, or contemplating such.

Various proposals recommended by the Status Committee, and approved by Council, have been submitted to the Secretary for Agriculture, but do not appear to have received the amount of consideration one would expect. One of these proposals was a request for the appointment of a Commission on which the Department, the Profession and the Stock Farmer should be represented and whose duties would be to examine thoroughly the facilities for veterinary aid throughout the Union and to report to the Minister. The Secretary for Agriculture has replied "That it is impractical to introduce any of our proposals at the moment owing to shortage of staff." It is obvious to everyone that under present conditions the private practitioner, outside of the large towns, cannot make a living. The stock farmer has so long been accustomed to have veterinary service supplied free by the State that he expects and demands that this free service shall continue. In December last a revised regulation appeared in the Gazette prescribing the conditions under which G.V.O's. in possession of motor transport may render assistance with non-scheduled diseases. The revised regulation lays it down that in rural areas where a private veterinarian is in practice the G.V.O. may only render first-aid in emergency cases to stock suffering from non-scheduled diseases, injuries, etc., and that a charge of 9d. per mile shall be made for such service with a minimum of 5s. The private veterinarian cannot compete on those conditions and the " first-aid " clause makes it almost impossible for the G.V.O. to refuse to attend. To have any chance whatever the P.P. will hope for a sympathetic G.V.O. who will exercise all his tact in excusing himself and recommending the P.P. However, the revised regulation makes it clear that a payment is now required for the services of G.V.O's. in the case of non-scheduled diseases, etc. This may gradu-

ally accustom the farmer to paying in future for what he has hitherto received free at State expense.

I would briefly refer to the utter inadequacy of the Veterinary Act to protect the registered man against the quack—or the Veterinary Chemist, so styled. A case recently considered by the Veterinary Board will best illustrate my meaning. A chemist was reported for having made an examination, diagnosed (wrongly), prescribed and treated the animal, clearly giving the owner to understand that he was qualified and experienced, but was not a registered Veterinary Surgeon. The Law Advisors referred the evidence to the Attorney General of the Province concerned, who in turn refused to prosecute "as the person had not stated, or held himself out to be a Veterinarian."

It would therefore appear that to contravene Sec. 17 of the Act an unregistered person must falsely claim to be a Registered Veterinarian and in the presence of witnesses. I hope that the Veterinary Board will give its attention to the desirability of amending the Act as soon as possible.

The position of home-born members of the R.C.V.S. now practising in the Union, but who cannot register under the Act, will I trust shortly be set in order by the establishment of a measure of reciprocity with the R.C.V.S. I am asking Dr. P. J. du Toit as Chairman of the Board to kindly make a statement on this important subject to-day.

I must regret, owing to results of an accident, that I must be absent from the Annual Meeting, but I desire on my own behalf to place on record the excellent spirit of co-operation and team work of the Council. It has been a singular pleasure to be associated with such a body of gentlemen who one and all have taken their responsibilities seriously and given all questions their closest attention. I must not omit the Editor of the Journal and his assistants. We are greatly indebted to Dr. Thomas for the production of the Journal and for its continued popularity. Mr. Rene du Toit's work as Hon. Sec. has been excellent and I am very glad that he has been reappointed. The new President will find him, as I have done, an efficient and enthusiastic Secretary.

In conclusion I welcome Mr. Amos and feel sure he will receive the same generous support from the Council and profession which I have enjoyed for some six years. Mr. Amos needs no introduction to the majority of you. He was at one time in Government service, but for many years he has been engaged in private practice. He has all the necessary qualifications for a successful president, having devoted a good deal of his time and attention to public work in his adopted town. I think you have made an admirable choice and I wish him every success.

(Signed) F. J. CARLESS.

Mooi River,
Natal, 8 - 4 - 36.

Dr. Fourie proposed that the appointment of a commission of enquiry into veterinary services, mentioned in the President's address be pressed for and the matter referred to the Council for attention. This was seconded by Capt. Clapham.

4 (a). **Election of Office Bearers for 1936 - 37.**

The Chairman read the names of the office bearers for 1936 - 37 resulting from the general election as follows :—

President : S. T. A. Amos.
Vice-President : C. J. van Heerden.
Hon. Sec.-Treas. : R. du Toit.
Council Members : A. D. Thomas, C. Jackson, F. J. Carless, H. O. Mönnig, A. M. Diesel, P. J. du Toit, H. H. Curson, A. C. Kirkpatrick.

(b) Election of members of Veterinary Board.

F. J. Carless, A. C. Kirkpatrick.

At this stage Dr. Curson relinquished the Chair to Mr. Amos, the newly elected President, who conducted the remainder of the business of the meeting.

5. **Reports of Standing Committees :**

I. *Finance.*: The Secretary read the report of the Finance Committee which revealed a debit balance as at 31 - 3 - 36 of £22 15s. It was explained that the expenditure on the Journal had been unavoidably heavy over the past year, but that the estimated expenditure for the current year would have a credit balance of between £60 and £70.

II. *Editorial* : The report of the Managing Editor was placed before the meeting. The expenditure on the Journal for the period 1 - 4 - 35 to 31 - 3 - 36 indicated a charge on the funds of the Association of £218 19s. 3d. It was explained that this expenditure was considerably more than in previous years but was due in part to a series of articles of Dr. Curson which were profusely illustrated. The report shows further the very appreciable advances made by the Journal over the past five years both in size, printing and circulation.

Dr. Fourie thought that the Editorial Committee should obtain permission from Council for any abnormal expenditure. The President, in seconding this motion, moved that the matter be referred to Council.

III. *Library* : The report of the Hon. Librarian revealed the fact that there was no longer sufficient accommodation available for the library in view of the increase in the number of books, etc., now in the possession of the Association. The following proposals were made :

(1) That the Library be loaned for an indefinite period to the Students' Hostel at Onderstepoort.

(2) That a condition of the loan be that one or more cadet members be appointed to care for the library and continue the indexing and lending activities under the supervision of :

(3) A Joint Library Committee composed of members and cadet members who would each year appoint one or more students as Hon. Librarians.

Dr. Fourie moved that the proposals contained in the Librarian's Report be placed before Council for consideration. This was seconded by Dr. Curson. Agreed.

IV. *Secretary's Report.*—This report, wherein a resumé of the activities of the year was given, was read by the Secretary.

Dr. Quinlan proposed that this report be adopted. Seconded by Dr. Martinaglia.

Captain Clapham stated that, in connection with the remarks made in the above report re the sale of Akiron to registered veterinarians only, he had been able to procure the drug in Potchefstroom from a chemist without being asked for his authority for such purchase.

Mr. Boswell cited a similar instance in Johannesburg.

Dr. Fourie proposed that the matter be referred to the manufacturers.

6. **Motion by Mr. Ben Runciman :**

The motion by Mr. Runciman relating to the unregistered importation of horses suffering from hereditary unsoundness chiefly of a respiratory nature, seconded by Mr. Gavin, and previously brought to the attention of members in the notice of the meeting, was read.

Dr. Quinlan proposed that the motion be postponed until the Spring General Meeting, when it could be laid before a more representative gathering. This was seconded by Mr. Nelson.

Dr. Fourie proposed that the report of the Committee appointed to go into the question of unsoundness in horses, with particular reference to roaring and whistling and the advisability or otherwise of their admission to the Witwatersrand Agricultural Show, be made available when Mr. Runciman's motion is brought up. Dr. Quinlan could not agree with this.

It was suggested that the Secretary enquire from the N.V.M.A., Irish Free State Veterinary Medical Association, Amsterdam Veterinary Medical Association, The Veterinary Advisor of the Royal Agricultural Society of Great Britain and the Imperial Bureau of Animal Genetics, what legislation or local rules existed in connection with this question.

A committee consisting of Dr. Quinlan and the Secretary was appointed for this purpose.

7. **Parliamentary Committee :**

Dr. Curson enquired why no report of the Parliamentary Committee had been drawn up.

8. **Resignations :**

The Secretary read a letter from Mr. Chase in which he formally tendered his resignation from the Association.

The Secretary proposed that this resignation be accepted. Seconded by Dr. Fourie.

9. **Date of Autumn General Meeting.**

Dr. Quinlan stated that the present attendance was no credit to the Association and proposed that the meeting be held during the evening at some hotel when a better attendance was more likely.

Dr. Fourie suggested that the Autumn General Meeting be dispensed with entirely and thought that the Spring General Meeting, extended if necessary, should be quite sufficient. Mr. Hamlyn seconded this proposal.

The Chairman, in agreeing with the statement of Dr. Quinlan, stated that this was a constitutional point and notice of motion regarding the discontinuance of the Autumn General Meeting would have to be lodged with the Secretary for discussion at the Spring General Meeting.

There being no other business the meeting was closed at 11.50 a.m.

"Journees Medicales de Paris," Third Session, June 26th to 30th, 1937.

The standing committee of the *Journées Médicales de Paris* has decided to arrange during the course of the 1937 International Exhibition a course of meetings on the general lines of those of the first two series (1926 and 1929). These meetings will bring together Doctors in Civil practice, Doctors of the Army and the Air Force, Pharmacists, Veterinary Surgeons, Biologists, Physicists and Chemists—both French and foreign.

They will be held under the Presidency of Prof. Carnot.

The Vice-Presidents will be : Drs. Rouvillois and Morvan (Médicins Généraux Inspecteurs), Profs. Perrot and Goris, and Profs. Leclainche and Nicolas.

General Secretary : Dr. Henri Godlewski.

Assistant General Secretary : Dr. Pierre-Bourgeois, under the patronage and assistance of the Abstracting Committee of *La Revue Médicale Francaise*.

The organization of the usual exhibition will be undertaken as before by the "Comité francais des Expositions," under the direction of Jean Faure.

The mornings will be given up as usual to practical demonstrations in the Civil or Military Hospitals as well as in schools and institutes of biology; all branches of medical work will be touched on.

The afternoon meetings will be devoted to practical study of the following subject :

1st day : Pituitary gland;
2nd day : Glands of the Genital Organs;
3rd day : Thyroid, Parathyroid and Adrenal glands;
4th day : Liver, Pancreas and Thymus glands.

The afternoon meetings will take place within the International Exhibition near the stands occupied by the organizations showing at the " Journées Médicales."

A programme of celebrations on a scale equal to those of the 1926 and 1929 meetings is being arranged; details will be published later.

All who wish to attend the 1937 " Journées Médicales de Paris "— Students, Doctors, Chemists, Veterinary Surgeons, Biologists and others are asked to write to : Service des Journées Médicales : Revue Médicale Francaise, 18, Rue de Verneuil, Paris 7ème. Subscription : 50 Francs, or, for Students or members of families of those attending the meetings, 30 Francs.

Sir Arnold Theiler.

With sorrow we record the death, in London on July 24th, of Sir Arnold Theiler.

It is proposed that the next issue of the Journal should be a memorial number to Sir Arnold, and in this a full biography will appear.

To Lady Theiler and her sons and daughters the Profession extends its deepest sympathy.

Jl. S.A.V.M.A.
VII (3) 1936.

Essays on the Cancer Problem.*

IV.—Neoplastic Diseases in Poultry.

By CECIL JACKSON, Onderstepoort.

Introduction.

With the exception of a few special cases (*e.g.* melanoma of grey horses, conjunctival acanthoma of white-faced cattle, skin epitheliomata of Angora goats, and the contagious venereal tumour of the dog) neoplasia of domesticated mammals cannot be regarded as of general economic importance. In the domesticated birds, on the other hand, the incidence of neoplasia is high; and tumours and tumour-like diseases constitute so common a cause of mortality as to demand serious consideration from an economic standpoint. While precise figures in terms of the poultry population are not available, American statistics indicate that the tumour-rate among heavily laying hens may on occasions actually reach as high a figure as 10%. Such a high incidence is doubtless very exceptional, but it seems safe to say that among domesticated species it is only in avians that the tumour-rate approaches that in man.

Not only on this account, but also because in the past the investigation of avian tumours has played an historic rôle in the attempt to elucidate the cancer problem and because at the present time this work is proceding more actively than ever, the subject of tumours in birds deserves the attention of veterinarians.

History.

Although as early a worker as Siedamgrotsky (1876 and 1877) had briefly reported what he considered to be hepatic and ovarian carcinomas in the fowl, trustworthy reports of malignant avian tumours (*i.e.* with satisfactory histological confirmation) are confined to the present century: Koch (1903) and Pick (1904) both described cases of squamous-celled carcinoma (acanthoma) of the buccal cavity. Not long after this, Ehrenreich and Michaelis (1906) published a more comprehensive description of avian tumours encountered by them, comprising

* The previous contributions in this series are represented by—

I. The Veterinarian and Cancer Research. *Jl. S.A.V.M.A.* III (3) : 126—132 (1932).

II. Modern Thought on the Aetiology of Neoplasms. *Ibid.* IV (3) : 131—148 (1933).

III. Neoplasms in Domestic Animals. *S.A. Med. Jl.* IX (14) : 481—484 (1935).

reports of some five different kinds of benign and malignant neoplasms, not all of which they were at that time in a position definitely to classify. In 1909 Tyzzer and Ordway gave a much better pathological account of nine cases of neoplasia, most of the tumours being lymphocytomas.

In 1910 Peyton Rous gave a full pathological and histological description of a sarcoma which occurred in the pectoral musculature of a Plymouth Rock hen and which he was able to transmit from fowl to fowl; in the following year he proved that this transmission could occur even if the tumour juice was rendered cell-free by filtration. This demonstration that an entity which was separable from and capable of multiplying in the cells could set up neoplasia was the foundation of the " virus theory " of tumours. Work on the Rous sarcoma (*i.e.* on tumour tissue composed of cells whose " cancerization " has been accomplished by the injection of the filterable causal entity first obtained from the original Plymouth Rock hen) has continued steadily till the present day and many famous names are associated with the investigation especially of (a) the nature (*viz.* " virus " or " enzymic ") of the filter-passing principle, (b) immunity phenomena, and (c) the biological characters (resistance, survival, attenuation, etc.). Although because Rous and his coworkers for long failed to encounter another spontaneous case of transmissible avian neoplasm they were inclined to consider the Rous sarcoma as unique, other filterable avian tumours have been reported by Tytler (1913—osteochondrosarcoma, Fujinami (1908)—myxosarcoma, and Begg (1927 and 1929)—fibrosarcoma.

In 1916 both Joest and Ernesti and Pentimalli published the first comprehensive reviews of tumours in birds, and as late as 1930 Malke continues the practice, scarcely longer necessary, of giving a detailed description of every tumour encountered by him.

The study of leucotic neoplasias of fowls was first placed on a satisfactory basis by Ellerman and Bang (1908) and this work has been continued especially by Engelbreth-Holm and coworkers in Denmark, Furth and coworkers in America, and McGowan in Scotland. Many of the older works on avian tumours mentioned above concern themselves largely with the description of cases of the common " round-celled sarcoma " which we now prefer to call lymphocytoma (lymphoblastoma) or lymphoid leucosis.

The shortcomings which one observes in much of the literature on avian neoplasms are often merely reflections of the imperfect nature of our knowledge of avian histology and histopathology in general.

Incidence.

As has been mentioned precise general statistics of the incidence of neoplasia in birds are not available. About 35% of all tumour specimens submitted for pathological diagnosis in this country are from poultry;

but in considering this statement it is necessary to bear in mind that in general fowls which have died from natural causes are probably submitted to autopsy with considerably less frequency than are the domesticated mammals. Among 4000 adult slaughtered hens Ehrenreich found 7 malignant tumours (*ca.* 0.18%), while among 3000 pullets (under one year) he found none; as in the case of mammals the influence of age on the incidence of tumours is a well-established fact in fowls. Malke encountered 33 cases of tumours among 858 fowls over 3 months of age (3.8%) or 4.2% of birds that had reached the laying stage. Joest and Ernesti give a figure of 4%. Among heavily laying hens even higher figures are given and a large proportion of cases of tumours investigated in this country have emanated from birds engaged in the Central Egg Laying Tests at Glen. At Onderstepoort, recent experience indicates that among adult hens in a scientifically managed and hygienically controlled poultry plant, 50% of deaths over a limited period may be due to neoplasia. Such a high incidence of tumours, as in human populations, is a tribute to the health of the group of birds concerned.

COMPARATIVE INCIDENCE OF NEOPLASTIC DISEASES IN DOMESTICATED AVIANS AND MAMMALS IN SOUTH AFRICA.

Tumour.	Avian, %.	Mammalian, %.
Lymphocytoma	45	2.5
Carcinoma	23	38.8
(Gland-cell carcinoma	22	11)
Sarcoma (excluding "melanotic sarcoma")	11	3
Leiomyoma	7	0.25
Teratoid Embryonal Tumours	4.5	4.5
(Embryonal nephroma	3.5	2.5)
Erythroleucosis	2.5	—
Myelocytoma (Myeloid leucosis)	1.5	0
Glioma	1	0
(Epithelioma	1	27.8)
Angiogenous Tumours	0	4
Melanotic Tumours	0	9.5
All Benign Tumours	9	31.5
All Malignant Tumours	91	68.5

Note.—Figures based on a study of 203 avian and 390 mammalian cases, and given as percentages of these respective totals. They must not be taken as representing anything more than the numbers of pathological specimens received at Onderstepoort.

Aetiology.

Apart from the facts that both certain sarcomatous tumours and certain leucotic diseases are transmissible experimentally by filter-passing principles, we are as ignorant of the cause of spontaneous avian tumours as of that of mammalian tumours. There is little or no indication that the

experimentally transmissible diseases arise by contagion under natural conditions. The extremely high incidence of tumours of the reproductive tract in highly productive hens suggests that the strain of heavy egg-laying plays a predisposing rôle in the cause of ovarian and oviducal neoplasms. Embryonal tumours of the kidney, common in fowls, are to be ascribed basically to a persistence of rests of embryonic tissue (cf. Cohnheim's theory); but of what determines the assumption of proliferative activity by such rests we have no knowledge. A general virus theory of malignant tumours has more prospects of establishing itself than in the case of mammals, but proof is still lacking. A most important recent observation has been the production of sarcomata by means of a chemical irritant (tar) the resulting tumours being thereafter transmissible by cell-free filtrates (Mackintosh, 1933). This would seem to imply that if we postulate a "virus" as a cause of such tumours, we must allow that this "virus" can be endogenously produced by the cells of the body under the influence of appropriate stimulation. Can such a principle correctly be termed a virus?

Benign Tumours.

The great majority of avian tumours fall into the malignant category. Among 203 cases of avian neoplasia investigated at Onderstepoort only 18 were benign tumours (less than 9%). By far the most frequent of these benign growths is leiomyoma, constituting 83% of benign tumours encountered in this country. These tumours usually affect the oviducal ligament and on account of their strict circumscription and their structure of closely-packed bundles of pale pinkish-white fibres are easily recognisable with the naked eye. The stroma of many of these leiomyomas carries a rich supply of blood-vessels, among which dilated, thin-walled vessels of venous type are conspicuous (*L. haemangiomatosum;* they are not mixed tumours and should preferably not be termed "haemangioleiomyoma"). A less common variety is the *L. fibrosum* (also termed fibromyoma) in which a large amount of fibrous tissue is admixed with the smooth muscle tissue; these may attain very large dimensions and thus have a serious affect on health : one such tumour studied at Onderstepoort affected the ovary, weighed over 2 lb., and filled most of the abdominal cavity. Other kinds of benign tumours do not appear to be common, although there are a fair number of reports of fibroma and haemangioma and much fewer of chondroma, osteoma, and myxoma; satisfactory reports of lipoma in fowls are not to be found. Papillomata have also been reported on occasion. The older literature contains many reports of "adenoma" (especially of the ovary). In reality these tumours are probably all carcinomas (*qq. v.*).

Under the heading of benign tumours it is convenient to mention a condition which so far has been observed only in this country and which may well cause considerable difficulty in diagnosis. This is cutaneous

neurofibromatosis of fowls. In this condition the whole skin (but especially that in the cervical region) may become covered by rounded, somewhat flattened nodules of tough consistence which surround the mouths of the feather follicles. Severe elephantiasis may result in parts from confluence of the nodules to form thick flattened plaques. Microscopically is seen the typical picture of whorled proliferations of fibroblasts, derived from the endo- and perineurium of the cutaneous nerves, similar to the lesions of Recklinghausen's disease of man. The only known cases of the disease proved fatal and clinically the first sign noticed was a persistent erection of the neck feathers.

Malignant Tumours.

Nearly all the types of malignant tumours of mammals are represented in poultry; but notable exceptions (so far at least as reliable reports are concerned) are liposarcoma, myosarcomata, neuroblastoma, hypernephroma, thymoma, and endothelioma.

1. Connective-tissue tumours — sarcomata.

Sarcomata constitute the third commonest malignant tumours of the fowl, being exceeded in frequency only by carcinoma and by lymphocytoma. The majority fall into the category of "mixed-celled" sarcomas, which are approximately twice as frequent as fibroblastic sarcomas (fibrosarcomas). The original Rous sarcoma was decribed as a fibrosarcoma; but it is debatable whether it should not rather be regarded as a mixed-celled type: the question is difficult because intergrades occur between the two types. Most sarcomas affect the superficial parts of the body (subcutaneous tissue or voluntary musculature, perhaps more especially in the breast region) or the ovary. Regarding the former, recognition without resort to section cutting offers little difficulty since almost all infiltrating and ulcerating tumours of the surface parts are either sarcoma or lymphocytoma: the latter may be distinguished by the absence of those gross characteristics which result from the production of specific intercellular matrices by sarcomata (bony spicules in osteoplastic, cartilage in chondroplastic, mucin in myxoplastic, collagen in fibroplastic sarcomas); further, because as a rule the lymphoid tumours are less highly invasive in these parts and do not therefore contain naked-eye haemorrhages which result from such high invasive propensity; the appearance of apparent primary multiplicity is also in favour of lymphocytoma; lastly a Giemsa-stained smear enables one easily and with certainty to distinguish in cases of doubt.

Single bulky lymphocytomata usually occur in the cloacal region, not usually in the breast or other musculature unless there has been a direct spread from an intrathoracic position (as may occur in the case of lymphocytoma of the lung).

Sarcoma of the ovary is to be distinguished from carcinoma on somewhat similar lines, especially on the basis of a haemorrhagic appearance seen with the naked eye even without incising the tissue. Carcinomas of the reproductive organs usually have a more opaque, sarcomas a more translucent appearance. The production of peritoneal implantations is no differential criterion, although haematogenous metastases are far more characteristic of sarcoma.

Microscopically, the typical fibroblastic sarcoma (fibrosarcoma) consists, as in mammals, of spindle-shaped cells between which collagen is deposited. In mixed-celled sarcoma, in addition to the spindle cells, there are areas, especially dispersed as indistinct foci, composed mainly or purely of free-lying, irregularly rounded, large phagocytic elements and of stellate cells associated with a fibrillar reticulum (not with collagen!) : these represent the neoplastic counterparts of the free histiocyte (macrophage) and the fixed histiocyte ("r-e" cell) respectively. Reflecting the ordinary potentialities of the (non-neoplastic) avian fibroblast, transitional forms between the histiocyte and the fibroblast types are frequent. Tumours which are composed almost exclusively of elements inclining more to the fibroblastic type and whose cells show only a few histiocytic transformations (*e.g.* the Rous sarcoma) are of course difficult to assign definitely to either the fibroblastic or the mixed-celled sarcomas. As a more explicit term for "mixed-celled" sarcoma the name "fibroblastic and histiocytic" sarcoma has been proposed. These tumours often contain a certain amount of mucinous matrix in their histiocytic portions, but should preferably not be confused with myxosarcomas, as sometimes occurs in the literature.

The phagocytic activity of the neoplastic macrophages is displayed especially by the phagocytosing of necrosed cells and of infiltrating leucocytes; or by the phagocytosing of yolk globules in the invaded ovary or of fat globules when the tumour is infiltrating adipose tissue (*e.g.* the subserosae). Tumours having heavily fat-laden neoplastic macrophages should not be mistaken microscopically for liposarcomata, in which the fat is an essential—not a secondary—constituent of the cells. More especially in the metastases of mixed-celled sarcomata (*e.g.* in the haematogenous secondaries which are common in the liver and the spleen) the neoplastic macrophages and fixed histiocytic elements may reach very large dimensions (*e.g.* 50 to 150 μ) and present a most bizarre appearance with which it is advisable to be familiar if one is not to make mistakes in microscopic diagnosis.

It is quite possible that many of these spontaneous mixed-celled sarcomata would prove transmissible if subinoculations were more often attempted. There has also accumulated certain evidence which suggests the possibility that such sarcomas in fowls are not rigidly distinct from

the leucoses and that transformation to leucotic lesions may occur in subgenerations. This problem is not yet settled. But it is no great rarity to find tumours which consist of a mixture of sarcomatous and myelocytomatous tissues and it is probable that such lesions represent the result of a " collision " of two neoplastic foci originating close together possibly under the same aetiological influence but from different cell-types.

2. EPITHELIAL TUMOURS.

A. *Epithelioma.*

Acanthoma (squamous-celled carcinoma, cancroid) is not a frequent tumour of birds, constituting only 1.5% of all fowl tumours in South Africa. It is known to occur in the mouth, but in this country has only been seen affecting the tarso-metarsal region (*i.e.* below where the feathered skin gives place to a scaly epidermis). These acanthomas of the leg have a characteristic irregularly conical form and are covered by a thick outer crust of neoplastic horn. They have been considered as representing a " malignant *cornu cutaneum* " and they correspond to a similar tumour, found in ruminants, which is likewise characterised by excessive keratinisation and likewise arises at a site where normally the epidermis has enhanced powers of horn-production, viz. the frontoparietal region of the head. Metastasis has not been observed, but the tumours show marked local invasive powers.

No tumour corresponding to the basal-cell epithelioma of mammals is known in birds, as would be expected assuming the accuracy of the theory that this neoplasm arises from sebaceous glands.

B. *Carcinoma* (*Gland-cell carcinoma*).

Apart from lymphocytoma, carcinoma is the commonest neoplastic disease of fowls (22% of all neoplastic diseases of fowls in South Africa). The vast majority of carcinomata affect the female reproductive tract, only 6% of carcinomata in this country occurring elsewhere; while in America it has been estimated that 50% of all tumours affect these organs. Many carcinomas of the female reproductive organs are described in the literature as " adenoma " : this is erroneous and it is very doubtful whether a true adenoma of these organs occurs. The misconception arises from the circumstance that the limited development of the lymphatic system in birds does not favour lymphogenous metastasis, while on the other hand avian carcinomata (like mammalian) have no great tendency to metastasize via the bloodstream : for this reason true metastases are not common and the tumours are erroneously assessed as benign. Actually, however, their malignant nature is attested by the regularity with which, in their more advanced stages, they give rise to transcoelomic metastases (" implantations ") to the abdominal serosae, to do which

they must first have penetrated the ovarian or oviducal serosa : such penetrative growth stamps a tumour as malignant, according to modern conceptions, whether or not embolic metastases occur.

In the mechanism of trancoelomic metastasis gravity plays an important part, for which reason most of the secondaries occur on the serosae lying ventral to the reproductive organs, especially the mesentery. There is a notable tendency for the attached border of the bowel to become most severely involved, probably because the angle between the bowel wall and the mesentery forms a ledge on which the tumour fragments become arrested as they glide down the mesentery and further because the lodgement of tumour cells in this niche protects them against being displaced by the peristaltic movements of the bowel during that critical period in the establishment of any secondary tumour which intervenes between its coming to rest and its acquiring of a vascular nutritive supply.

Implantations may also occur on the oviducal serosa from a primary in the ovary or elsewhere in the oviduct itself, and on the ovary from an oviducal tumour : in such cases one must be careful to distinguish the primary tumour from the secondaries—often no easy task. Less often implantations occur on the liver or on the parietal peritoneum : it is probable that such parts offer less ready chances of effective vascularisation to tumour fragments. Haematogenous metastases (to the liver and lungs, etc.) are comparatively seldom seen in carcinoma of the reproductive tract : such secondaries tend to arouse a suspicion that one is dealing with sarcoma.

The structure of these carcinomas is largely adenomatoid, viz. tubular acini of columnar epithelial cells, but lumen-formation may fail wholly or in part : in other words there is a graded series from an " adenocarcinomatous " to a " carcinomatous " structure. Mitoses may be frequent or infrequent. In cases where, on account of the absence of clearly adenomatoid arrangement of the neoplastic tissue, doubt may arise as to whether one is dealing with carcinoma or sarcoma, the application of fibrillar stains may become essential in order to detect whether or not intercellular fibrils are present : such fibrils are never found in carcinoma.

In many of these tumours, not only in the primary but also in the secondaries, the stroma is in large part of smooth muscular nature : the muscle fibres of the ovary, oviduct, or bowel-wall proliferate to give support to the neoplastic glands, just as in other carcinomata the stroma is derived from a proliferation of the pre-existing connective tissue of the organ invaded. Further, just as in other carcinomata excessive stromal response results in a " scirrhous," so this muscular stroma may become so abundant as greatly to predominate over the epithelial parenchyma. Thus, macroscopically, a leiomyomatous tumour may be simulated. Even

on microscopic examination the parenchyma may be found to be so squeezed out of existence or perhaps even completely obliterated in parts, that confusion with leiomyoma may arise. In cases of carcinoma, nodules on the abdominal serosae having a muscular structure should therefore be suspected as representing metastases and not hastily dismissed as primary leiomyomata. The term *carcinoma leiomyomatosum* is preferred to " leiomyocarcinoma " to describe such tumours.

It should be remembered that not all cases of mesenteric and bowel implantations are carcinoma : ovarian sarcoma can and often does produce equally if not even more extensive implantations.

One fairly often encounters cases of implantation carcinosis in which the primary is not readily detectable at autopsy. In this connection it is well to remember (a) that in a lobulated, irregularly-shaped organ like the ovary, a small tumour may easily escape detection: thorough examination and even sections should be resorted to in case of doubt; (b) that a primary in the oviduct may still more easily be overlooked. These oviducal tumours often grow intramurally and produce little obvious external enlargement of the duct : the whole organ should be straightened out and opened from end to end. Even from the internal aspect, visual inspection may fail to disclose such tumours as have not to a pronounced degree ulcerated through the mucosa : palpation with the fingers and a search for evidence of stenosis are to be resorted to. One should not rest satisfied, except after most exhaustive examination, to diagnose " abdominal carcinosis" and so confess failure to trace the primary lesion. There is of course such a thing as regression of a tumour (with persistence of its secondaries), but only as a last resort is it desirable to seek refuge in such an explanation.

Carcinoma of Other Organs.—Primary carcinoma of the gastro-intestinal tract is uncommon. Secondary bowel-implantations should never be described as " carcinoma of the intestine ", as is done in some text-books. Carcinoma of the liver is likewise uncommon : only the hepatocellular variety is known. (Here again it is important to distinguish both from blood-borne metastases in the substance of the liver and from implantations on the surface of the organ from a primary tumour elsewhere. In cases of doubt the microscopic structure of hepatocellular carcinoma will be found to be quite specific, the cells and their pattern of arrangement clearly disclosing the liver-like character and hepatic derivation of the neoplastic tissue.) Carcinoma of the pharynx may be of the leiomyomatous type. Primary carcinoma of the lung has been reported. Reports of " carcinoma of the kidney " should be looked at askance : primary renal neoplasms are almost invariably embryonal mixed tumours.

3. GLIOMA.

Glioma of the domestic fowl has been observed only in South Africa, but it is quite possible that more cases of this tumour would be observed if it were a more common practice to make a thorough examination of the brain at autopsy. Birds affected by this neoplasm have been observed to exhibit pronounced nervous symptoms, such as running in circles, falling, and finally paralysis, and gliomatosis of the brain is therefore an important differential diagnosis in other diseases characterised by such symptoms.

The tumour appears usually as multiple foci which are indistinctly demarcated from the surrounding brain tissue and which contrast with the latter on account of their softer consistence and whiter colour. They vary from a couple of millimetres to nearly a centimetre in diameter and have been seen in the cerebrum, the optic lobes, and in the cerebellum.

Microscopically, the tumour foci are unencapsulated, invade progressively the brain substance, and consist of neoplastic glia cells (spongioblasts) characterised by prolongations of their cytoplasm into glia fibrils which form an intricate feltwork between the individual cells and react specifically with the special neuroglia staining methods. The stroma is composed of blood-vessels having many round cells in their adventitiae, and collagenous fibres are absent, thus differentiating from sarcoma. Some of these tumours are apparently slowly growing, others more rapidly ("gliosarcoma"). The occurrence of metastasis has not been established with certainty.

MIXED NEOPLASMS.

These play a fairly important part in fowls, because one type in particular is quite common. This is the embryonal nephroma, a tumour which is often erroneously diagnosed. The embryonal nephromas are large malignant neoplasms which may either invade and replace the kidney substance itself or may, depending from the sublumbar region by a peritoneal fold, actually be situated at some distance ventral to the kidney. They are conceived as arising from persistent rests of the nephrogenic mesoderm (*i.e.* mesoderm which did not become completely "used up" in forming the metanephros). Microscopically they are seen to have an "adenosarcomatous" structure, *viz.*, epithelial-lined tubules alternating with tracts of spindle-shaped cells associated with fibril production : these bundles of fibroplastic elements must not be mistaken for a stroma—they are an integral part of the neoplastic parenchyma, are themselves invasive in growth, and show frequent transitions to the epithelial elements. The dual character of the neoplastic parenchyma is to be regarded as a reflection of the embryonic potentialities of the mesoderm from which is arises; and the evidence which is seen of the transformation of the more indifferent

cells into a columnar epithelium is similarly an imitation, in post-embryonic life, of the differentiation undergone by the cells of that portion of the mesoderm which forms the kidney under normal conditions. Embryonal nephroma is thus considered as a typical example of "false" mixed neoplasms.

Concerning naked-eye diagnosis, one can be reasonably certain that any non-leucotic primary tumour which either invades the kidney, or is suspended from the roof of the abdomen without apparent association with any particular organ, is an embryonal nephroma. The majority of these tumours occur on the left side of the body. The tumour tissue usually has a markedly haemorrhagic character and large blood-filled cysts result from haemorrahge into the neoplastic tubules. The disease often affects young birds (*cf.* its pathogenesis). Blood-borne metastases are quite often seen.

Teratomatoid tumours occur in birds of both sexes in connection with the gonads and may be tridermic or didermic in structure.

The Avian Leucoses.

The problem of the leucotic diseases of birds is inseparably bound up with that of tumours, for the following reasons :—

(a) Between discrete neoplasms or tumours (lymphocytomata, myelocytomata) and more diffuse proliferations of unripe haemic elements in the organs (lymphoid leucosis, myeloid leucosis) there are all intergrades, so that a distinction, which would have to be based purely on the size and distribution of the lesions, must necessarily be a somewhat artificial one.

(b) Both histologically and cytologically the structure of lymphocytoma ("round-celled sarcoma") is identical with that of the focal infiltrations of lymphoid leucosis; and similarly the structure of myelocytoma is the same as that of the infiltrations of myeloid leucosis.

(c) Although the disease known as erythroleucosis does not give rise to discrete tumour-like foci, its aetiological identity (from the experimental point of view) with myeloid leucosis makes it impossible to place it in a different category.

(d) Many eminent pathologists incline strongly to regard leucotic diseases of all species, including even the pure leucaemias, as neoplasias : it is pointed out that, like malignant tumours, they consist of uncontrolled proliferations of the body cells themselves in the absence of any apparent cause and to the detriment of the organism as a whole; further it is only to be expected that neoplastic proliferations of haemic elements, especially within the bloodstream, could not result in the production of an actual "tumour", because the neoplastic cells by their nature have no means

of cohering together and no stroma to support them : indeed, it is not unreasonable to argue that leucaemia is a tumour of the blood, of which the proliferating cells constitute the parenchyma and the blood-plasma the stroma, the remaining normal blood-cells corresponding to the tissue that is being invaded and suffering a similar obliteration or destruction. This concept is a corollary of that which regards the normal blood itself as a tissue, *viz.* a connective tissue comprising, like other connective tissues, cells dispersed in a matrix (the plasma). It is not as yet universally accepted, but there seems nothing harmful in it, and, on the contrary, much that clarifies and unifies our ideas on the subject.

(e) Some workers believe that by means of the injection of cell-free filtrates of avian " mixed-celled " sarcomata it is sometimes possible to set up leucosis and *vice versa*. This would indicate a definite relationship to lesions whose neoplastic nature is undoubted. More proof of this is being demanded.

(f) By injecting into the bone-marrow an agent like tar, which is known to be carcinogenic when applied to the skin and which may be sarcomatogenic when injected subcutaneously, it has recently been shown possible to cause myeloid leucosis. On the principle that like causes produce like effects, this suggests that leucosis is essentially a neoplasia.

VARIETIES OF LEUCOSIS.

Under the term leucosis are included three diseases which—at least in their typical forms—are pathologically distinct, but which aetiologically appear to be related. The degree of this relationship is variously assessed by different authorities : although it is generally admitted that two forms, erythroleucosis and myeloid leucosis, are merly different manifestations of what is aetiologically one and the same disease, grave doubt has been cast on their relationship to a third form, lymphoid leucosis, which previously was claimed possible of production by the injection of the same aetiological agent.

1. *Lymphoid Leucosis.*

Lymphoid leucosis is the commonest neoplastic disease of fowls in South Africa (50% of all neoplastic diseases) and in most other countries, and is of serious economic importance. The disease is characterised by the appearance of non-encapsulated, infiltrating white nodules or foci in one or (more usually) more of the haemopoietic organs; and it is to be remembered that by haemopoietic organs in birds is understood a considerably greater variety of tissues than in mammals : the liver, kidney, skin, bone-marrow, and ovary, as well as the gastro-intestinal tract and the lungs, may be affected. When, instead of many small foci, which have a marked tendency to confluence causing diffuse replacements of the substance of the organ affected, one encounters a single large tumour

of the same histological nature and with or without multiple smaller foci which may be regarded as metastases, it is customary to speak of lymphocytoma or lymphoblastoma (old terminology : " round-celled sarcoma ", *sarcoma globocellulare*). Between these two extremes there are, as has already been mentioned, intergrades, so that it may be hard to know whether one has to deal with a primary multiplicity or whether one of the foci is primary and the others secondary : the wide distribution in birds of tissue which in post-embryonic life remains either actively or at least potentially haemopoietic renders it not essential to explain the presence of lymphocytomatous foci, in most of the organs affected, as the result of metastasis. Metastasis does, however, occur and probably plays an important part in the spread of the lesions at least to organs like the heart (in which case the haematogenous mode of spread may quite definitely be detected) and the abdominal serosae (on which implantations may occur).

Microscopically, the tumours or the foci consist of proliferations, outside the blood-vascular system, of the cells known as lymphoid haemoblasts (lymphoblasts, large lymphocytes) and considered to represent the common stem-cell of the elements of the blood. In lymphoid leucosis, however, the neoplastic lymphoid elements have only a proliferative activity, not any differentiation-potentialities.

In sections of an organ such as the liver, one sees the hepatic tissue invaded and replaced by confluent foci of rather large round cells having a non-granular basophilic cytoplasm and fairly prominent nucleoli. The proliferation is located extravascularly, *i.e.* in the space between the hepatic sinusoids and the liver-cell trabeculae; later the sinusoids become obliterated by compression and the hepatic trabeculae by invasion, and in the advanced stages surprisingly little liver tissue may remain. The blood may be grossly invaded and actual leucaemia produced, but this is quite exceptional; more often one sees evidence of local invasions of individual vessels with discharge of the tumour cells into the bloodstream : as a rule these cells do not resume multiplication until impacted in an organ suitable for further development. Similar proliferations may be seen in the interstitial tissue of the kidneys, in the bone-marrow and in the spleen, etc.

The disease may affect birds of any age, but is seldom seen in fowls younger than 4 months. The symptoms are those of anaemia (pale comb), loss of appetite, wasting, and cessation of laying, and are scarcely pathognomonic. It may be possible to detect the hepatic enlargement clinically. The usually negative results of examination of the blood, apart from (secondary) anaemia are valuable in the differential diagnosis from the other forms of leucosis, in which marked morphological alterations in the blood are apparent. The red count may fall to 1,000,000 and the Hb

to 15% (normals : 3,000,000 and 50-60%, respectively), and the coagulability of the blood is stated to be decreased. The disease may run a course of two months duration; there may be periods of remission, but ultimately death ensues. Owing to the marked enlargement of the organs, there may be an actual increase in body-weight in spite of wasting.

Regarding the transmissibility of lymphoid leucosis the weight of evidence is that this disease cannot be set up by the injection of cell-free filtrates of the affected organs. For this reason, most authorities are inclined to distinguish the condition sharply from the other forms of leucosis. On account of the high spontaneous incidence of this disease, the results of transmission experiments are most often inconclusive. The questions both of transmissibility and of the relationship to the other leucoses cannot be regarded as finally settled. Ellerman and Bang definitely claimed that lymphoid leucosis, like the other two leucoses, was transmissible and caused apparently by the same agent; and recently Furth has again claimed convincing transmission experiments.

Finally, it must be mentioned that some authorities are inclined to believe in a relationship between lymphoid leucosis and neurolymphomatosis : they are impressed by the similarity of the lesions from the histopathological standpoint; in both cases there is an invasive proliferation of lymphocytic cells, the only difference being in the localisation. To the histopathologist, neurolymphomatosis is simply lymphocytomatosis localised to the nervous tissues. Whether we are to regard it as "lymphoid leucosis of the nervous system" future research must decide.

2. *Myeloid Leucosis.*

This disease is definitely transmissible by means of intravenous or intraperitoneal injections of cell-free filtrates and furthermore it may be set up by injection of material derived from cases of erythroleucosis as well. It is not common in South Africa. In this case again, we encounter the difficulty of treating separately discrete tumours (myelocytomata, leucochloromata) and more diffuse proliferations (myeloid leucosis).

The typical disease talkes the following course :—The bird's activity decreases and the comb becomes somewhat pale; this stage may last for many weeks and during it the blood changes are only slight. Or the disease may commence more suddenly and the white count may abruptly rise to as much as 600,000 (normal : *ca.* 25,000). The course is usually 8–10 days and the termination is fatal. In experimental transmissions, the incubation period is about 1 to 2 months and the morbidity is about 40%. Birds which contract the disease naturally are usually more than 1 year old, seldom less than 9 months.

On post mortem is observed a most striking enlargement of the liver and the spleen (which may be more than twice their normal size) and a

greyish red discoloration of the marrow of the long bones. Less constantly there are foci in the kidneys, intestine, pancreas, heart, lungs, etc. The ovary is often involved. Mathews, in the disease described by him as leucochloroma, observed definite tumours in connection with the skeleton (sternum and ribs) and similar tumours have been observed in connection with the periosteum of the ventral aspect of the ilia. Apart from the actual tumours, which macroscopically consist of friable, white to greyish white tissue, the infiltrations in various organs usually take the form of pin-point-sized, opaque, white foci, *e.g.* in the kidney and the heart, while similar focal accumulations may be observed in the less completely replaced parts of the liver tissue. In the case of actual tumour formation, *e.g.* in the ovary or in connection with the skeleton, it is possible to speak of primary tumour and metastases. Otherwise it is difficult to assess the relationship between the various foci, although the disease is generally reckoned to be primary in the bone-marrow with secondary foci in all the other organs.

Microscopically one sees, especially in the liver, sometimes in the kidneys, rarely in the spleen, invasive proliferations composed of chiefly neoplastic myelocytes and to a lesser degree of myeloblasts. These myelocytes have large rounded granules, the majority of which are eosinophilic and the minority basophilic : these cells are the neoplastic counterparts of the precursors of the pseudoeosinophilic leucocytes of the blood (*i.e.* those leucocytes which have rod-shaped granules *). The myeloblasts appear as a smaller number of non-granular cells having the general appearance of lymphocytic elements. About half of the liver substance may be replaced by the proliferating cells, among which mitotic figures are frequent. A similar picture is seen in the interstitial tissue of the renal cortex, where the proliferations tend to be more definitely focal in distribution. In the spleen the changes are usually entirely within the sinusoids. The sinusoids of the liver may also be seen to contain many myeloblasts. These intravascular changes are usually markedly reflected in the blood itself on smear examination, but in some cases the involment of the blood may be slight or even absent.

3. *Erythroleucosis.*

This disease, like myeloid leucosis, is not very common in South Africa. Clinically, it commences with signs of anaemia : the bird is dull, the comb yellowish, and the Hb. rapidly falls to 20—25%. A blood count will show that the erythrocytes are reduced to *ca.* one-third of their normal number, while smear examination discloses a primary anaemia

* The granulations of the pseudoeosinophilic myelocytes are at first basophilic, later becoming eosinophilic. In the early stages they are also rounded, only later becoming rod-shaped. They are distinguishable from the granulations of the true eosinophilic cells by their larger size.

recognised by the presence of many polychromatic erythrocytes, erythroblasts, lymphoid haemoblasts and all intermediate stages in the red-cell lineage. This anaemia always terminates fatally, but in less severe cases remissions occur.

At post mortem one sees enlargement of the liver (to as much as four times its normal size) and of the spleen, as well as reddening of the bone morrow. Macroscopically, focal changes are absent.

The lesions, on microscopic examination, are seen to consist of *intravascular* proliferations in the various organs (spleen, liver, kidney, bone-marrow), where the capillaries are evenly distended with lymphoid cells (with stages of differentiation in the direction of red cells) which crowd out the other blood-cells and preponderate over the erythrocytes. In the bone-marrow, the myeloid trabeculae are virtually obliterated on account of the pressure within the confining bony boundaries.

The disease is transmissible by cell-free filtrates, and in the subgenerations it is not possible to predict whether the lesions of erythroleucosis or those of myeloid leucosis will appear.

Mixed Leucosis.

Cases of leucosis in which the lesions are intermediate in character between those described (*e.g.* erythroleucotic plus myeloid lesions) are known to occur. The occurrence of lesions comprising a mixture of sarcomatous and myeloid proliferations has already been mentioned.

CONTROL.

The leucosis problem, especially from the standpoint of control is in just as unsatisfactory a state as is the cancer problem. In our present ignorance we are probably justified, on the basis of the occurrence of enzootics of leucosis, in recommending isolation and slaughter of affected birds, as well as advising the discontinuance of breeding from strains which show a high incidence of these diseases; this suspicion that heredity plays a part and may even explain the occurrence of apparent enzootics is quite justified, although as yet not proven.

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Preliminary Report on the Artificial Insemination of Merino Sheep in South Africa.

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Within recent years the economic possibilities of artificial insemination for normal breeding have been brought forward by Russian workers appointed to investigate breeding problems amongst domestic animals at the Institute for Artificial Insemination, Moscow. Artificial insemination was not new to science. It had been used for a number of years by veterinarians and stud-masters to try to combat infertility in females. It is still used by thoroughbred breeders in the British Isles and South Africa for mares which show difficulty in conception. Recent advances in the knowledge of the aetiology of difficult breeding, however, are leading to its gradual disuse and the substitution of more rational methods of treatment of pathological lesions of the genitalia.

The necessity for rehabilitation of livestock in Russia, subsequent to the termination of the Great War, suggested the necessity for the utmost use of the best sires if successful development of the livestock industry in that country was to be achieved within a reasonable time. Consequently the Soviet Government founded a Central Experimental Breeding Station at Moscow in 1919. However, intensive work on artificial insemination was not actually begun until 1923; the work was under the direction of Prof. Ivanov.

Prior to the work of the Russian research workers, who undertook experimentation on artificial insemination for its practical value in the reproduction of livestock, it had been proved that the artificial introduction of semen into the vagina was sufficient for conception.

Apparently Spallanzani (1785) successfully impregnated the bitch by artificial insemination. Heape (1897, 1898) advocated the use of artificial insemination for certain pathological conditions associated with sterility. Ivanov (1907) showed the possibility of artificial insemination in normal animals. The work was begun successfully on mares and was later extended to ewes and cows. Ivanov (1922) successfully inseminated about 40 per cent. of mares, but was able to increase the foaling percentage to nearly 90 per cent. when healthy mares were inseminated with the semen of normal stallions. The better results were obtained when the insemination was repeated at intervals during oestrus. Since that time

this method of impregnating animals has been tremendously extended and the technique of the operation improved by the workers at the Institute for Artificial Insemination. Ivanov (1926) extended his studies to the spermatozoon and showed that it retained its vitality better in a cold medium. He showed that the sperms of the rabbit and guinea pig, within the isolated epididymis, retained their vitality for upwards of seven days when kept just above freezing point. In the meantime workers in other countries had undertaken the study of the vitality of spermatozoa. Sato (1916), Ochi (1916), Yamane (1921), Wolf (1921), Hammond (1930), Walton (1930), Quinlan, Mare and Roux (1932, 1933), Gunn (1936), and others have all advanced knowledge of the behaviour of the spermatozoa of various species of animals both outside and inside the male and female genitalia.

It is not intended to go into all the relevant literature in detail. It would be out of place in a preliminary report such as this, but since the literature already referred to bears the hall-mark of pioneer work on this important aspect of sex physiology it is considered relevant.

Ivanov (1930), Kusnetzova, Milovanov, Nagaev, Neuman, and Skatkin (1932), and Goetze (1933) have given details of improved methods of technique for semen collection and semen dilution. Recently Gunn (1936) indicated a further advance by causing ejaculation in the ram by means of a simple electrical apparatus, which method allows the collection of semen without danger of contamination.

Prior to the recent advances in the methods of obtaining semen, collection from the vagina after normal copulation was employed. Lately various types of sperm collectors were tried (McKenzie 1931, Kusnetzova *et al.* 1932, Gunn 1936). This was a big advance on the methods of collection previously used, as semen uncontaminated by vaginal secretions could be obtained. From the work conducted in South Africa, the electric ejaculator appears to be very suitable for the ram. It has not yet been tried on larger animals. It has the disadvantage, however, that the application actually distresses the ram during the passage of the electrical current; but this action quickly passes off and repeated applications do not appear to have a permanent effect (Gunn, 1936, and personal experience).

Considerable advance has been made in the dilution of semen and preservation of life of the spermatozoa outside the genital tract (Yamane 1921, Baker 1930, Redenz 1933, Milovanov and Selivanov 1932, Walton 1926, 1927, 1933 and Milavanov 1933).

The dilution and the preservation of spermatozoa have opened tremendous possibilities in the number of the progeny which it is possible to obtain from one male. Walton (1933) speaking of the Russian work says : "There is no technical obstacles to prevent 1200—1500 calves

being sired by a single bull during a 60 days' service season. The obstacle which exists is organisation."

The possibility with sheep is even greater. Walton states, again speaking of the Russian workers : " New methods of collecting semen and of preparing dilutors open up new possibilities. In 1928 the average number of ewes inseminated from a single mating was 3.6 and the maximum from one ram during the season 220; in 1930 the figures were respectively 5.6 and 670. At present it is possible to inseminate with sperms from a single mating of the best imported rams no fewer than 50 ewes (1 c.c. of sperm x 10 through dilution, the dose being 0.2 c.c.) or 4,000 ewes for a season of 40 days, taking two matings per day . . . . In 1930 the organisation known as the Ovtzevod (Sheep Breeding Trust) subjected 96,000 ewes to artificial insemination." Panyseva (1934) has shown the enormous possibilities of the number of offspring capable of being produced by artificial insemination with diluted semen from a single ram. He estimates that with semen in a dilution of x8 - 16, it is possible to inseminate 1200—1400 ewes in a 16 days' breeding season, and according to his results from 69 to 73 per cent. will be fertilised.

The resulting percentages of pregnancies from artificial insemination are extraordinary good : in cattle up to 87.6 per cent. and in sheep up to 92.7 per cent.

This is far higher than that experienced under natural conditions in South Africa. However, one must remember that South African data are available only for the Merino, a notoriously bad breeder (Quinlan, Maré and Roux 1932, Gunn 1936). Perhaps general environmental conditions, such as intense heat, experienced in subtropical climates, influence breeding in this country.

Before proceeding to a survey of the limited observations carried out in South Africa on the artificial insemination of sheep, it would perhaps be advisable to indicate the advantages and disadvantages of artificial insemination for practical purposes. Several females can be inseminated by the semen obtained from a single ejaculate. This number can be greatly increased by the use of suitable dilutors and the ability to preserve the impregnating power of spermatozoa kept *in vitro*. Knowing the time of ovulation in relation to the duration of oestrus and the optimum time for mating during oestrus in relation to conception, it should be possible to obtain greater fertility than by haphazard mating as practised by breeders. [The importance of time of mating during oestrus has been indicated by Walton and Hammond (1934) for the mare and Quinlan, Maré and Roux (1932) for the sheep.] The best males could be used on the largest possible number of females, so that the improvement in livestock would be more uniform and more rapid. The transport of semen would allow of progeny being obtained from a desirable sire at a distance from his

stud quarters, so that the danger and cost of transporting pregnant females or their newly-born offspring would be obviated. Artificial insemination could be used with advantage in cases of contagious venereal disease transmissible by coitus.

Artificial insemination would appear to be of limited economic advantage for normal breeding in most countries. In a country like South Africa, if the operation were universally adopted, the stud-breeder would definitely suffer, as less males would be sold annually. The average breeder is in a position to replace males which become undesirable for breeding purposes by as good or a better sire from a stud-breeder. The technique of the operation is so complicated that it is not likely to be successfully employed by the average breeder, even if he had the available time and labour to test several hundred females daily for oestrus.

The modern technique for artificial insemination as carried out by the Russian workers has been fully described by Goetze (1933) and by Walton (1933), and since the latter work contains an excellent bibliography, discussion of the relevant literature in an article such as this is unnecessary. The literature produced by the workers in the Institute for Artificial Insemination, Moscow, is forwarded to the authors by the courtesy of the Director, but unfortunately this language is not known amongst research workers at Onderstepoort so that direct reference cannot be made to it. Many references are taken from the article of Walton (1933) or from Animal Breeding Abstracts. It seems rather a pity that the interesting work being done in Russia is not available to research workers in this field in some more commonly spoken language than Russian. The more recent work of Gunn (1936) discusses a method of obtaining semen by means of electric stimulation of the male genitalia. The latter work also contains an extensive literature in which, amongst other important facts, the importance of a thorough knowledge of ovine genital physiology is stressed.

For the purpose of artificial insemination it is necessary that the female should be in heat. Further, recent advances in sex physiology of sheep have shown that ovulation takes place at a more or less definite time during oestrus. There would appear to be some deviation in the hour of ovulation in different breeds of sheep, as well as in the duration of oestrus, under different environmental conditions (Gunn 1936, McKenzie and Phillips 1930, Quinlan and Maré 1931, Grant 1935, Cale and Miller 1935, Marshall and Hammond 1926, McKenzie *et al.* 1933, and others). In considering artificial insemination from a practical point of view in normal breeding, it is desirable that the time of ovulation in the breed of sheep in which the work is being done under the given environment should be known if the highest percentage fertility is to be obtained. Quinlan, Maré and Roux (1932) showed that under South African conditions there was a lowered fertility if sheep were mated after the thirtieth

hour of oestrus. McKenzie and Phillips (1930), however, obtained somewhat contrasting results when working under the environmental conditions prevailing in Missouri.

Since the post-ovulation duration of life of the ovum also seems to be limited to a few hours (Quinlan, Maré and Roux, 1932) it is highly desirable that the sperms should be introduced into the female genital tract at the most suitable time (Kufarev, 1935). The life of the ovine sperm in the female genital tract is also limited (Quinlan, Maré and Roux, 1932, 1933). Further, it appears that sperms live longer in the cervix than in other divisions of the female genital tract (Kozlova 1935, Quinlan, Maré and Roux 1933). The latter authors suggest that the cervix of the sheep acts as a reservoir for the spermatozoa pending the arrival of an ovum available for fertilisation. There is a constant issue of vital sperms from the cervix. This conclusion, resulting from observations carried out on the behaviour of spermatozoa in the genital tract of the ewe, is strongly supported by the work of the Russian workers. Walton (1933) says : ". . . . . the Russian workers have found additional evidence against the penetration of semen in bulk, since they find that the artificial injection of semen into the uterus results in severe pain often amounting to convulsions. The most favourable results with artificial insemination have been obtained by the injection of a small volume of semen into the lumen of the cervix, but not beyond." Quinlan, Maré and Roux (1932) obtained the highest fertility by mating sheep between the sixth and eighteenth hours of oestrus. It is desirable therefore that the sperm should be introduced into the cervix between the sixth and the eighteenth hours following the onset of heat.

Experiment 1.

Prior to the commencement of the present work on the artificial insemination of sheep, a preliminary experiment was conducted, during October, 1932, at the Grootfontein School of Agriculture, Middelburg, Cape Province; that was before the literature on the technique employed by the Russian workers was available at Onderstepoort.

The ewes used for the work were mature Merinos selected from the Grootfontein flock. The rams (505, gr. 5, and Dandy) were known to be highly fertile.

The ewes were tested for oestrus daily by using vasectomised teasers. Those showing oestrus were separated for artificial insemination at a definite period (Tables 1—7).

Semen was obtained by allowing the ram to serve a donor ewe once or several times, depending on the quantity of semen ejaculated. The semen was withdrawn from the vagina by means of a sterile glass pipette. Immediately on withdrawal it was transferred to a bottle containing sterile Tyrode solution, in a dilution of 1—2 c.c. of semen to 7—8 c.c. of Tyrode.

[Tyrode solution : NaCl, 8.0 grams, KCl, 0.2 gram, $CaCl_2$, 0.2 gram, $MgCl_2$, 0.1 gram, NaH_2PO_4, 0.05 gram, $NaHCO_3$, 1.0 gram, Glucose, 1.0 gram, H_2O(dest.), 1 litre, (PH, 7.6).]

The spermatozoa were examined for motility from 10 to 15 minutes after withdrawal and again, in the case of stored semen, just prior to insemination. The semen was stored at a temperature varying from 8°C. to 13°C. (Table 9.)

The ewes were inseminated by introducing the diluted semen deeply into the vagina by means of a strong glass pipette; 1 c.c. was used in each case. No attempt was made to insert the semen into the cervical canal. After insemination the sheep were returned to their usual camps, but they were kept under observation for oestrus. Those that did not show oestrus were observed until lambing dates were available.

The results are set out in the following tables :—

Table 1.

Group 1. Semen stored for 0 hours.

Ewe No.	Maximum period of oestrus when served.	Served Date	Served Hour	Donors Ram	Donors Ewe	Recurrence of Oestrus	Date lambed	Result
A6	36 hours	13/10/32	10.30 a.m.	505	A1		12/3/33	+
A5	,, ,,	,,	,,	,,	,,		,,	+
WH4	,, ,,	,,	,,	,,	,,	11/11	—	–
MBA80	,, ,,	,,	,,	,,	,,		10/3/33	+
MBA76	,, ,,	,,	,,	,,	,,		9/3/33	+
A10	25 ,,	14/10/32	,,	Gr. 5	A13		12/3/33	+
A9	,, ,,	,,	,,	,,	,,		14/3/33	+
A7	,, ,,	,,	,,	,,	,,		13/3/33	+
18714	,, ,,	,,	,,	,,	,,	1/11	—	–
B12	,, ,,	,,	,,	,,	,,	1/11	—	–
18707	,, ,,	15/10/32	10 a.m.	Gr. 5	A14		18/3/33	–
MBA443	,, ,,	,,	,,	,,	,,		17/3/33	+
A16	,, ,,	,,	,,	,,	,,	1/11	—	–
A17	,, ,,	,,	,,	,,	,,	1/11	—	–
A18	,, ,,	,,	,,	,,	,,		13/3/33	–
W37	31 ,,	13/10/32	2 p.m.	Gr. 5	DB86		11/3/33	+
DB313	,, ,,	,,	,,	,,	,,		—	–
DB407	29 ,,	19/10/32	12 noon	Dandy	DB369*		–	–
DB63	,, ,,	,,	,,	,,	,,	5/11	—	–
DB66	,, ,,	,,	,,	,,	,,	7/11	—	–
DB95	,, ,,	,,	,,	505	Gen. 24		18/3/33	+ twins
Wa374	,, ,,	,,	,,	,,	,,		21/3/33	+
BD350	27 ,,	20/10/32	10 a.m.	Dandy	DB254	7/11	—	–
DB345	,, ,,	,,	,,	,,	,,		17/3/33	+
DB379	,, ,,	,,	,,	,,	,,		—	–

Note : * Donor did not conceive.
+ Lambed.
– Did not lamb.

Table 2.

Group 2. Semen stored for 3 hours.

Ewe No.	Maximum period of oestrus when served.	Served Date	Hour	Donors Ram	Donors Ewe	Recurrence of Oestrus	Date lambed	Result
D75	28 hours	16/10/32	12.15 a.m.	505	B19		14/3/33	+
O203	,, ,,	,,	,,	,,	,,		14/3/33	+
A21	,, ,,	,,	,,	,,	,,	31/10	—	–
A22	,, ,,	,,	,,	,,	,,		26/3/33	+
A23	,, ,,	,,	,,	,,	,,		13/3/33	+
A24	,, ,,	,,	,,	,,	,,	2/11	—	–
B29	,, ,,	,,	,,	,,	,,	1/11	—	–
A34	,, ,,	19/10/32	3 p.m.	Gr. 5	DB470*	6/11	—	–
A35	,, ,,	,,	,,	,,	,,	6/11	—	–
A36	,, ,,	,,	,,	,,	,,	5/11	—	–
A37	,, ,,	,,	,,	,,	,,	5/11	—	–
A38	,, ,,	,,	,,	,,	,,	7/11	—	–

* Donor ewe did not conceive.

Table 3.

Group 3. Semen stored for 6 hours.

A42	31 hours	20/10/32	4 p.m.	Gr. 5	DB324	6/11	—	–
DB813	,, ,,	,,	,,	,,	,,	6/11	—	–
L22	,, ,,	,,	,,	,,	,,	6/11	—	–
O185	,, ,,	,,	,,	,,	,,		—	–
A39	,, ,,	,,	,,	,,	DB28	7/11	—	–
A40	,, ,,	,,	,,	,,	,,	5/11	—	–
A41	,, ,,	,,	,,	,,	,,	6/11	—	–
MBA87	,, ,,	,,	,,	,,	,,	5/11	—	–

Table 4.

Group 4. Semen stored for 9 hours.

A46	37 hours	20/10/32	7 p.m.	Gr. 5	DB157	8/11	—	–
A47	,, ,,	,,	,,	,,	,,	8/11	—	–
A50	,, ,,	,,	,,	,,	,,	7/11	—	–

Table 5.

Group 5. Semen in vitro for 12 hours.

DB332	25 hours	22/10/32	10 a.m.	505	A52	8/11	—	–
MBA3635	,, ,,	,,	,,	,,	,,	8/11	—	–
D73	,, ,,	,,	,,	,,	,,	8/11	—	–
A53	,, ,,	,,	,,	,,	,,	9/11	—	–
A54	,, ,,	,,	,,	,,	,,	8/11	—	–
A55	,, ,,	,,	,,	,,	,,	9/11	—	–
A56	,, ,,	,,	,,	,,	,,	7/11	—	–
A57	,, ,,	,,	,,	,,	,,	9/11	—	–

Donor ewe did not conceive.

Table 6.

Group 6. Semen in vitro for 24 hours.

Ewe No.	Maximum period of oestrus when served.	Served Date	Served Hour	Donors Ram	Donors Ewe	Recurrence of Oestrus	Date lambed	Result
MBA062	25 hours	23/10/32	10 a.m.	Gr. 5	DB231	9/11	—	—
MX10	,, ,,	,,	,,	,,	,,	10/11	—	—
A62	,, ,,	,,	,,	,,	,,	9/11	—	—
A63	,, ,,	,,	,,	,,	,,	8/11	—	
O201	,, ,,	24/10/32	10.30 a.m.	Three rams	DB5	10/11	-	—
A58	,, ,,	,,	,,	,,	,,	10/11	—	—
A59	,, ,,	,,	,,	,,	,,	11/11	—	-
A60	,, ,,	,,	,,	,,	,,	11/11	—	—
A61	,, ,,	,,	,,	,,	,,	10/11	—	—

Table 7.

Group 7. Semen in vitro for 4 days and 9 hours.

K49	37 hours	21/10/32	7 p.m.	Gr. 5	A26	7/11	—	—
A43	,, ,,	,,	,,	,,	,,	7/11	—	—
A44	,, ,,	,,	,,	,,	,,	7/11	—	—
A45	,, ,,	,,	,,	,,	,,	6/11	—	—
A51	,, ,,	,,	,,	,,	,,	8/11	—	—

Donor ewe did not conceive.

Table 8.

Resumé of Results contained in Tables 1—7.

Semen in vitro (hours)	No. of ewes served	No. of ewes pregnant	Percentage pregnancy
0	25	14	56
3	12	4	33⅓
6	8	0	0
9	3	0	0
12	8	0	0
24	0	0	0
105	5	0	0

There were 16 donor ewes. Four of these were not fertilised.

In Table 9 estimates are given of the motility of the spermatozoa at the time of injection as well as of the temperature at which the sperms were kept.

Table 9.

Sperms in vitro	Percentage active motility	Temperature at which kept (degrees centigrade)
0	100	—
3	50	13
6	25	10
9	10	8
12	15	8
24	38	10
105	40	8—10

It will be observed that out of 25 ewes inseminated a few minutes after withdrawal of the semen from the donor ewe, 14 (or 56 per cent.) became pregnant and lambed, while 4 out of 12 (or $33\frac{1}{3}$ per cent.) inseminated with semen stored 3 hours became pregnant and lambed. Inseminations carried out with semen stored 6, 9, 12, 24 and 105 hours failed to produce pregnancy. There were 16 ewes used as donors; four of these were not fertilised.

EXPERIMENT 2.

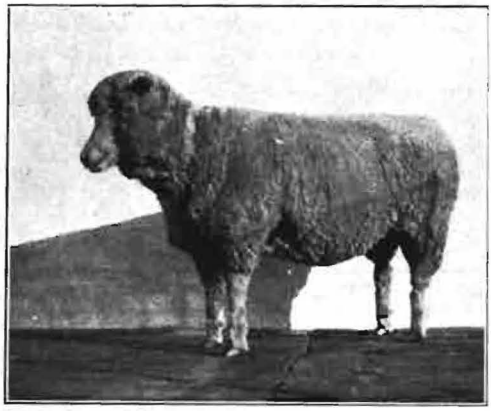

Fig. 1. Dummy ewe.

(Photograph, Dr. L. L. Roux.)

The technique employed during these observations was practically the same as that recommended by Walton (1933) in his review of the work done by the Russian workers at the Institute for Artificial Insemination, Moscow. Semen was obtained by means of the artificial vagina (Fig. 10c), which was placed in a dummy sheep (Figs. 1, 2). The artificial vagina was of the type used at Cambridge by Drs. Hammond and Walton. It was obtained from the Holborn Instrument Company, Holborn Circus, London.

It was found that most of the rams which were used for "hand-service" served the dummy ewe without difficulty (Figs. 3, 4, 5, 6). Some rams, however, were disinclined to copulate or did so only with the

greatest difficulty, and rams which copulated apparently normally failed to ejaculate until several attempts had been made.

At first the artificial vagina was heated by warm water up to a temperature of 102°F—103°F, which is the normal midday temperature of the Merino ewe showing oestrus in the Karroo (Quinlan and Maré, 1932). Later during the work, heating of the artificial vagina was not done; it was brought up to the correct pressure by pumping air into the jacket.

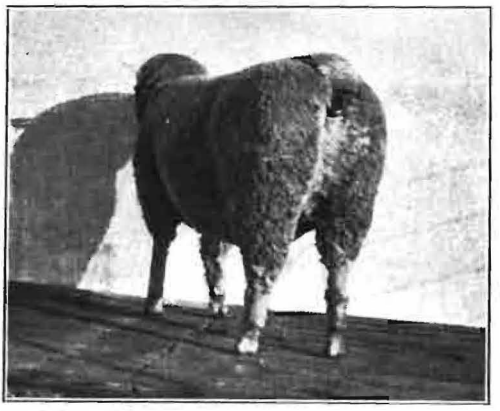

Fig. 2. Dummy ewe showing artificial vagina in position.
(Photograph. Dr. L. L. Roux.)

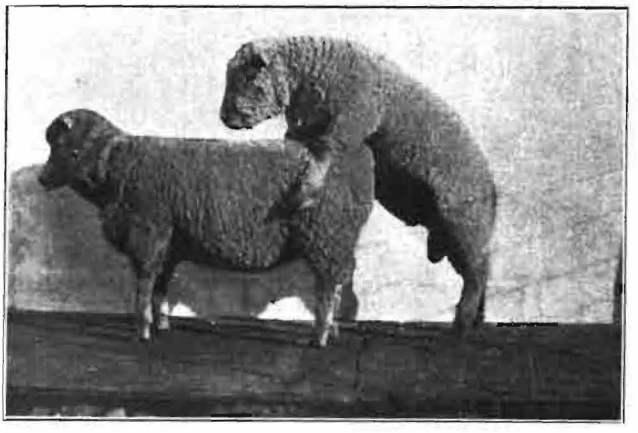

Fig. 3. South-Down ram copulating with dummy ewe.
(Photograph. Dr. L. L. Roux.)

Experience on the infuence of temperature on ejaculation when using the artificial vagina; in South Africa, is very limited, but it was observed that rams which failed to ejaculate with the heated vagina also failed to ejaculate with the non-heated, air-filled instrument. However, Rodin (1934) has shown the importance of temperature on ejaculation. In a study of the influence of the temperature of the artificial vagina on 199

ejaculations in 4 rams he says that ejaculation does not occur below 20°C, and that 40°—65°C is the most favourable. At higher temperatures—up to 85°C—ejaculation occurs, though not regularly. The physical characters of the semen were not changed when ejaculated at varying temperatures.

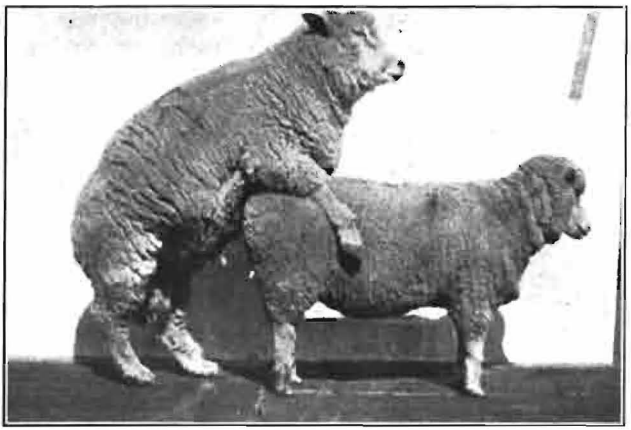

Fig. 4. Ryeland ram copulating with dummy ewe.
(Photograph, Dr. L. L. Roux.)

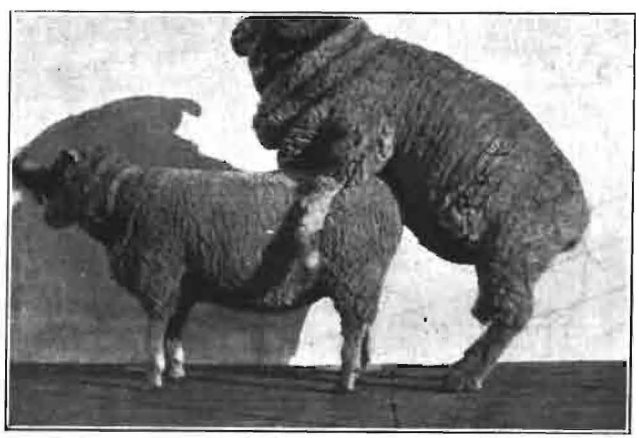

Fig. 5. Merino ram copulating with dummy ewe.
(Photograph, Dr. L. L. Roux.)

The ejaculate from each successful service varied from 0.5 cc. to 1.8 cc., with an average of about 0.9 cc. The semen was diluted 1 in 3 with G.P.S.—8, as indicated by Walton (1933). The diluted semen was taken from the mating pen into a room about 30 yards distant, where the inseminations were carried out. No attempt was made to cool the mixture. All inseminations were carried out within half-an-hour after the ejaculate had been collected at room temperature, which averages 80°F to 90°F during November and December.

The external genitalia of the ewes were cleansed with sterile gauze swabs moistened with normal saline. The ewes were placed in an insemination box (Figs. 7, 8), at a convenient height, which prevented undue

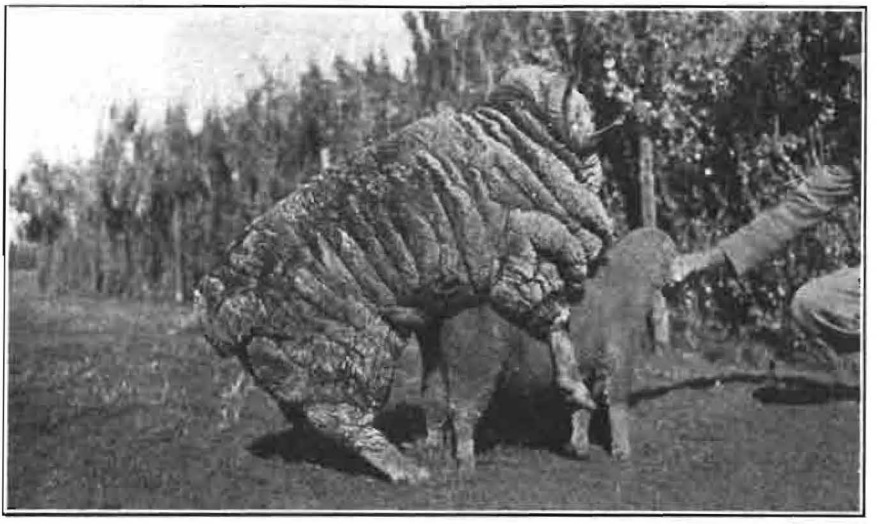

Fig. 6. Merino ram, large size, copulating with dummy ewe.
(Photograph, Mr. C. C. Claassens.)

Fig. 7. Insemination box, lateral view.
(Photograph, Mr. C. C. Claassens.)

At the commencement of the experiment it was intended to inseminate 250 ewes with the semen of a ram that was known to be highly fertile. A flock of 400 ewes was selected, 150 being intended as controls by

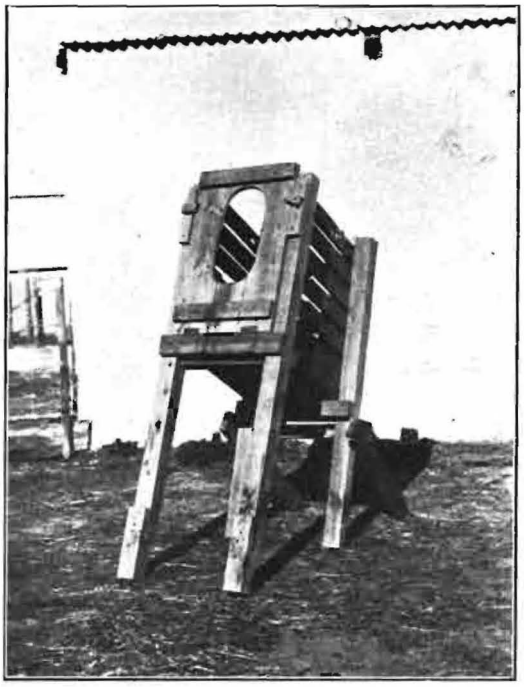

Fig. 8. Insemination box, posterior end view.
(Photograph, Mr. C. C. Claassens.)

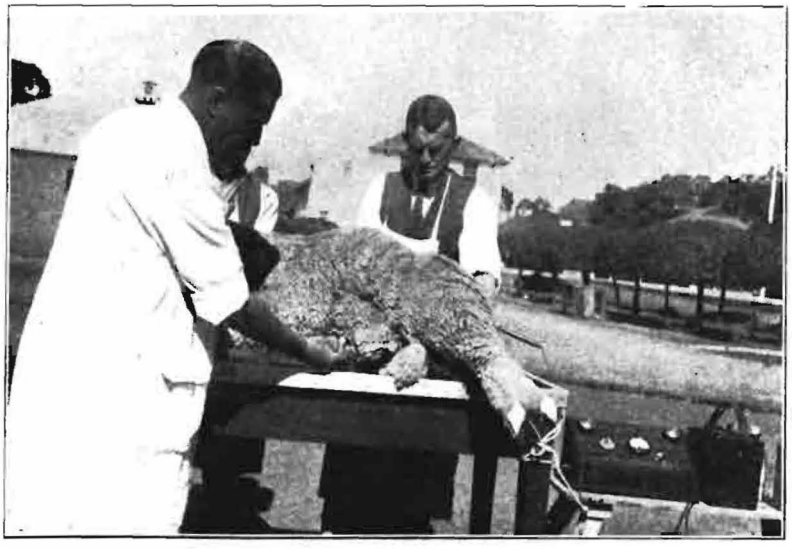

Fig. 9. Electric ejaculator and battery used for field work.

movement. The hind extremity was raised some 6 inches higher than the fore extremity. A vaginal speculum (Fig. 10b) was used to open the genital passage until the *pars vagina* of the cervix was visible. The passage was illuminated by the operator using a surgeon's forehead-lamp. Long glass pipettes were used to introduce the semen into the cervix. The pipette containing 0.5 cc. of the diluted semen was introduced through the external os for a distance of about 0.5 cm. and the contents blown into the canal. A separate pipette was used for each sheep. All the instruments were sterilised in the autoclave prior to use. The artificial vagina and the speculum were swabbed with 65 per cent. alcohol and afterwards with the dilutor G.P.S.—8. The dilutor was freshly mixed immediately prior to use. as Walton (1933) indicates that stored mixtures

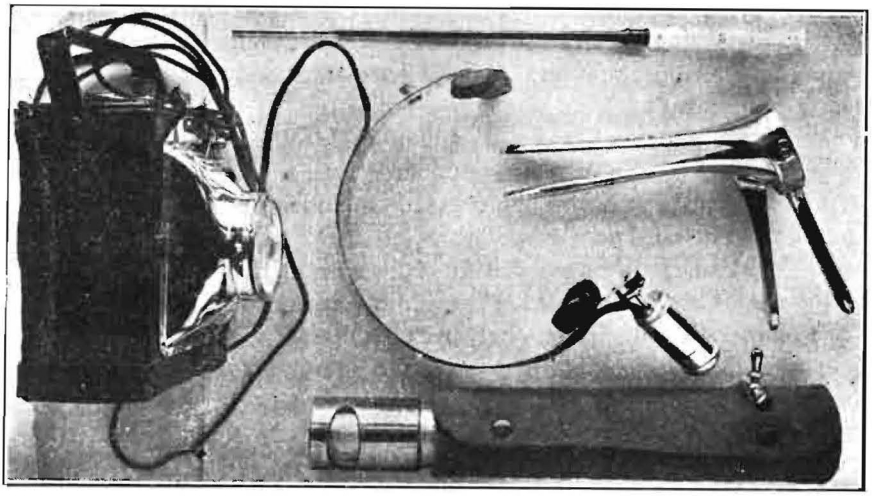

Fig. 10. Instruments used for artificial insemination of ewes ·
Above · Glass syringe and ebonite cervical catheter.
Right Vaginal speculum.
Below Artificial vagina.
Left : Forehead lamp and battery.

of glucose and phosphate are unstable. The dilutor was made strictly in accordance with that recommended by Milovanov (1933) and described by Walton ,1933, page 49), having a pH of 7.8 :—

	Anhydrous glucose	Na_2HPO_4 $12H_2O$	KH_2PO_4	Calcium lactate	H_2O (dest.)
G.P.S.—8	50.4 gm.	6.78 gm.	0.15 gm.	1.91 gm.	1 L.

At the present time, in conducting a more extensive series of experiment, ebonite catheters and glass syringes (Fig. 10a) are used. The syringes are of 2 cc. capacity, graduated in one-tenths. These instruments were obtained from the Holborn Instrument Company. They are very suitable for the work, but are far too fragile for employment on an extensive scale when large numbers of sheep must be inseminated under field conditions.

hand-service; and testing for oestrus, by using vasectomised teasers, was begun on November 1st, 1934. Due to very poor grazing at that time the occurrences of oestrus were very rare, so that the stud flock were also brought under observation for oestrus as they were on better grazing. This unforeseen circumstance made the use of the semen of several rams necessary, as the ewes to be mated to different stud rams had previously been selected. Although several hundred ewes were under daily observation for oestrus, only 44 of those selected for the experiment showed oestrus during early December.

In Table 10 the results of artificial insemination with semen from 10 rams are shown. The ewes are grouped under the headings "Flock", "Experimental" and "Stud", as they were running under somewhat different conditions. The flock ewes were running in a camp some 4 miles from the sheep sheds and those showing heat had to be driven that distance prior to insemination. The experimental and stud ewes had only about a mile to walk. This fact may account for the relatively poor results obtained with the flock ewes. Quinlan and Maré (1932) have shown that a progressive rise of temperature takes place when sheep are driven 200 to 1600 yards at a walking pace of 3.4 miles per hour under Karroo conditions. At a shade-temperature of 81° F, the rise in temperature varied from 0.3° F in sheep driven 200 yards, to 2.8° F in sheep driven 1600 yards. This is possibly highly significant in the case of insemination, as the temperature of driven sheep reaches 104.8° F to 105.2° F. In view of the influence of elevated temperature on spermatozoa, it is a point which must be cleared up in considering artificial insemination for practical purposes in tropical and sub-tropical countries.

Table 10.

Analysis of the Results of Artificial Insemination with semen from different rams.

Sire.	Flock Ewes.		Experimental Ewes.		Stud Ewes.		Percentage Fertility.
	No. insemi-nated.	No. lambed.	No. insemi-nated.	No. lambed.	No. insemi-nated.	No. lambed.	
1. D.B. 272			1				0
2. D.B. 486					2	2	100
3. D.B. 577	2	1					50
4. D.B. 606	4	2					50
5. Gr. 5	6	0			7	4	30.8
6. R. 101			2	1			50
7. My Rag			6	3			50
8. Dandy					5	4	80
9. P. Dandy					6	2	33.3
10. Nik*					3	0	0
	12	3	9	4	23	12	43.2

* The ram 10 (Nik) showed an unsatisfactory sperm test.

Of the six flock ewes inseminated with semen from Gr. 5, in one case the semen was stored for 24 hours, and in two cases for 48 hours at 8°—12° C before insemination. The three ewes concerned did not become pregnant. Of the two ewes inseminated with semen from ram D.B. 577, the one that did not become pregnant was treated 24 hours after she was found on heat; at this time she would not allow normal copulation with a vasectomised teaser.

For the sake of comparison it is interesting to observe the results of artificial insemination and hand-serving with the individual ram used. These results are shown in Table 11.

Table 11.

Comparison of the results obtained with artificial insemination and hand-serving in Merino sheep under similar environmental conditions.

Sire.	No. of ewes inseminated, Dec., 1934.	No. lambed.	Percentage Fertilised.	No. of ewes hand-served, Dec., 1934.	No. lambed.	Percentage Fertilised.
1. D.B. 272	1	0	0	12	6	50
2. D.B. 486	2	2	100	5	2	40
3. D.B. 577	2	1	50	—*	—	—
4. D.B. 606	4	1	50	—*	—	—
5. Gr. 5	13	4	30.8	23	17	73.9
6. R. 141	2	1	50	10	8	80
7. My Rag	6	3	50	16	9	56.25
8. Dandy	5	4	80	35	22	62.9
9. P. Dandy	6	2	33.3	9	6	66.7
10. Nik	3	0	0	17	3	17.6
	44	19	43.2	127	73	approx. 57.5

* Rams D.B. 577 and D.B. 606 did not hand-serve, but were allowed to run with the flock : data are, therefore, not available.

Although there is a difference of 14.3 per cent. in favour of hand-serving, it is pointed out that 4 out of the 44 artificially inseminated ewes received unfavourable treatment, in that 3 of them were inseminated with stored semen, while another was inseminated when oestrus had passed off. These 4 sheep should, perhaps, not be included when calculating the percentage fertilised by artificial insemination. If these were excluded the results would be 19 fertilised out of 40 inseminated, or 47.5 per cent.

Attention is drawn to the fact that insemination and hand-serving were carried out once only at one oestrus period. It will also be observed that the ram " Nik " was definitely unsatisfactory. Flock ewes inseminated with semen from ram Gr. 5 (Table 10) did not become impregnated, although 4 of the 7 stud ewes inseminated were fertilised. It has previously been suggested that this poor result may be due to over-heating. The results of insemination of flock ewes with semen obtained from other rams, however, do not confirm this view.

Conclusions.

Experiment 1.

1. Twenty-five ewes were inseminated with diluted semen, using tyrode solution as a diluent : fourteen ewes became pregnant and lambed —56 per cent.

2. Twelve ewes were inseminated with diluted semen stored for 3 hours at approximately 13° C : four became pregnant and lambed—$33\frac{1}{3}$ per cent.

Experiment 2.

1. Forty-four ewes were inseminated with diluted semen, using GPS—8 as a diluent : nineteen ewes became pregnant and lambed—43.2 per cent. Four inseminated ewes received unfavourable treatment. If these four are eliminated the percentage becomes 47.5.

2. One hundred and twenty-seven ewes kept under similar environmental conditions were hand-served by the same rams and 73 lambed—approximately 57.5 per cent.

3. There is a difference of 14.3 per cent.—or of 10 per cent. if the 4 unfavourably treated ewes are excluded—in favour of hand-serving.

4. It is suggested that a higher percentage of pregnancies would have resulted if the inseminated sheep had not been driven prior to insemination, on account of the rise in temperature which is caused by driving.

General.

1. More satisfactory results were obtained with the use of tyrode solution than GPS—8 as a semen diluent, 56 per cent. against 43.2 or 47.5 per cent. These results, however, are not comparable, as the conditions were not similar, one experiment being conducted in October, 1932, and the other in December, 1934.

2. Under subtropical conditions insemination with semen, diluted 1—4 with tyrode solution or GPS—8, will give satisfactory impregnation when done within fifteen minutes to half-an-hour after ejaculation. The insemination must be repeated in case of recurrences of oestrus to obtain normal Merino birth-rate.

3. Insemination will give almost as satisfactory impregnation as hand-service and at least four times as many females can be impregnated from the same number of ejaculations.

4. The economic aspect of the insemination of ewes in a country like South Africa, where at the present time it is possible to replace rams which become unsuitable through age, etc., at a reasonable figure, is discussed.

5. The modern technique of artificial insemination, using diluted semen, is so complicated that it is unlikely to be of economic value to the rural population of South Africa in the normal breeding of domestic animals; but in large stud-flocks more intensive use may be made of exceptional sires and the services of an experienced technician will be warranted.

ACKNOWLEDGEMENT.

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Food Poisoning Caused by Substances other than Bacteria and their Products. *

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CONTENTS.

* Paper read at 30th South African Medical Congress, 1936, held at Pietermaritzburg from 29/6/36 to 3/7/36.

I. INTRODUCTION.

I would like to make use of this opportunity of expressing my appreciation of the honour done Onderstepoort by the Medical Profession of South Africa in inviting the Director of this Institution to present at this congress a paper on this most vital question to human health. I also wish to thank Dr. P. J. du Toit, Director of Veterinary Services, for having asked me to prepare this paper.

It appeared to me that it would be more profitable to you to discuss briefly the entire problem of non-bacterial food poisoning than to present a detailed discussion on a few of the most important poisons which may find their way into our food and beverages.

As the problem is such a vast one and the space allotted to each paper very limited, it is impossible to discuss fully each poison and I shall therefore only mention the most important points in regard to each substance. A more detailed discussion dealing with all the poisons mentioned in this abstract will be published at a later date.

Cases of acute poisoning with poisons contained in our food and water are comparatively speaking easily diagnosed. The problem in the case of chronic poisoning with such poisons is however entirely different and much more complicated as, firstly, the symptoms exhibited in chronic poisoning are most varied, may resemble a host of other diseases, and are by no means constant in cases of poisoning with the same substance; and, secondly, the available information concerning chronic poisoning (quantities of poisons and periods of ingestion necessary to induce chronic poisoning, symtomatology, pathology and treatment) in the human being is very scanty. For the gathering of this information we have to rely almost solely upon animal experiments. Apart from the fact that the experiments which have been conducted upon animals, in an attempt to elucidate the possibilities of chronic poisoning in human beings, are very unsatisfactory especially in so far as the periods of administration of the poisons are concerned, it is questionable whether the results of animal experiments are directly applicable to the human being. This point is more fully referred to under " Discussion " at the conclusion of this paper.

A fact that should be appreciated is that chronic poisoning may occur not only through accumulation of a poison (or poisons) in the body but also through a summation of its (or their) actions. It is clear that chronic poisoning may also be caused even though the poison has been excreted by the time a fresh quantity is ingested, as the detrimental effects of each previous quantity of poison may not have been repaired by the time a fresh amount is again taken in.

II. Food Poisoning due to the Presence of Minerals in our Foodstuffs.

A. *Aluminium.*

There is no consensus of opinion as to whether it is possible that such amounts of aluminium as would be dangerous to health are likely to be absorbed by foods prepared in aluminium cooking utensils. We must however admit that the evidence brought forward by the school who maintain that there is no possibility of aluminium poisoning through the use of aluminium utensils is by no means conclusive. This view is based on the results of experiments which were conducted in a very unsatisfactory manner.

A number of cases of aluminium poisoning through the use of aluminium utensils are described in the literature and the investigations conducted by some authors certainly indicate such a possibility. The amounts of aluminium dissolved from aluminium utensils are determined by the following factors : (a) acidity or alkalinity of the food or drink prepared, (b) length of period during which the food or drink was in contact with aluminium, (c) the temperature at which the food or drink was prepared, (d) degree of hardness of the water (hard waters corrode aluminium), (e) whether the aluminium vessels consist of impure or pure aluminium, and are stained or not, and (f) the addition of sugar to the food cooked (sugar inhibits the passing of aluminium into foods).

Acid and alkaline foods and drinks should not be prepared and stored in aluminium vessels. Hard waters also corrode aluminium vessels. The amount of phosphate in the food prepared, or in the diet, determines, to a certain extent, the quantity of aluminium that will be absorbed.

B. *Antimony.*

Enamel-ware containing antimony should not be used in the preparation and storage of food and beverages, as the use of such ware may cause antimony poisoning.

The sale of enamel-ware containing antimony should be prohibited unless all receptacles concerned bear labels indicating that antimony is present in enamel.

Due care should also be exercised in the use of rubber tubing in apparatus and machinery concerned in the preparation and conveying of beverages, especially those which are acid.

C. *Arsenic.*

Insecticidal sprays containing arsenic, copper and lead are very extensively used on fruit-trees and vegetables, with the result that many cases of poisoning, especially with lead and arsenic and possibly copper, have occurred in human beings in many countries.

Arsenic has also been found in many kindergarten materials, in samples of American cod-liver oil, and in tobacco.

As it is impossible to exercise any control over the conducting of the spraying operations, it would seem that the only way to protect the public would be to take a large number of samples from consignments of fruit and vegetables offered for sale on markets and by fruit-hawkers and to analyse these for arsenic.

Under the existing conditions it would not seem unreasonable to suggest that some of the cases commonly termed " apricot disease " may be due to arsenical poisoning as a result of eating fruit and perhaps also vegetables containing excessive amounts of arsenic.

D. *Common Salt.*

Some authors are of the opinion that too much salt in our diet may have detrimental effects on our health and constitution and is the cause of many chronic kidney affections. This may be true, but we have at present no experimental evidence to support this view.

E. *Copper.*

Copper poisoning may occur through the eating of (a) fruit and vegetables sprayed with insecticides containing copper, (b) food prepared in copper vessels (acids and alkalies corrode copper), and (c) the artificial " greening " of vegetables. At high temperatures milk may also corrode copper vessels.

F. *Fluorine.*

Fluorine is very widely distributed in nature, hence its presence in traces in practically all our vegetables and waters. It is from these sources that we derive the traces of fluorine in our bodies.

Injurious amounts of fluorine in drinking water have been the cause of serious disturbances in health of man and animal in different parts of the world.

Lactating animals ingesting licks (rock phosphate) containing fluorine partly excrete this poison in their milk.

Sodium fluosilicate is used as an insecticide on vegetable and fruit trees and in some countries to clarify and preserve wines, with the result that these substances may contain such amounts of fluorine as to constitute a danger to health.

In view of the fact that it is considered by some authorities that goitre and cretinism may be caused by a superabundance of fluorine, it would be of special interest to analyse the drinking water in those areas in South Africa where goitre and bad teeth are endemic and where no iodine

deficiency is detectable in the food and water taken by the affected people. An investigation of this possibility in the Hoeree, Klein River and Kougha River valleys (Humansdorp district) will be both interesting and valuable. Children born and brought up in these valleys suffer to an alarming extent from bad teeth while both adults and children are badly affected by goitre. Foodstuffs collected by the author and other investigators and analysed at Onderstepoort by Blom were found not to contain less iodine than in areas where goitre does not occur.

G. *Iron.*

The information we have at our disposal does not allow of definite conclusions being drawn as to the injuriousness of abnormal amounts of iron in our food and water. It would, however, appear that the danger of iron poisoning is much less than that of arsenic, lead, copper and fluorine.

H. *Lead.*

Lanza (*Jour. Amer. Med. Assoc.*, Vol. 104, 1935, pp. 85—87) states very appropriately : "The use of lead is so widespread throughout all civilised countries that lead poisoning continues to be a matter of concern to the physician and the public health official"; and "like syphilis it is a contributing cause of many a death for which it does not receive its rightful share of blame". He further states that many cases of lead poisoning escape diagnosis and are reported as nephritis or other organic diseases with no mention of the causative agent. Some cases of lead poisoning have been diagnosed as chronic appendicitis or gall-bladder disease, and operations performed.

One cannot but agree with Lanza's statements if the extensive occurrence of lead in our foods (vegetables, fruit, sardines), water, beverages, and other commodities (toilet powders, tooth-pastes, tobacco, kindergarten materials, utensils used for storage of food) is considered.

Let us accept that the amount of lead permitted in food (namely, $\frac{1}{7}$ grain per lb. or per pint) is safe. What is, however, the position when this limited amount of lead is taken in daily with different foods ?

I. *Selenium.*

In view of (a) the cases of selenium poisoning in stock in the United States of America due to the presence of selenium in vegetation, (b) the fact that wheat grown on seleniferous soils is toxic, and (c) the fact that soils similar to those containing selenium in America occur in South Africa, an investigation into the possibility of selenium poisoning in the Union of South Africa would seem to be warranted. Arrangements are being made for the analysis of certain types of South African soils for the presence of selenium.

J. *Zinc.*

Cases of poisoning by zinc contained in cheese, ice-cream and toilet powders and in food prepared in vessels coated with an alloy containing zinc are described in the literature. A large amount of zinc has also been detected in a sample of canned lobster.

It is inadvisable to use vessels coated on the inner surface with alloys containing zinc for the preparation and storage of food.

Arsenic, lead, cadmium, and antimony may occur as impurities in zinc.

III. Bread Poisoning.

The term "bread poisoning" as used in South Africa signifies poisoning caused by the ingestion of bread prepared from wheat contaminated with portions of poisonous species of Senecio (*S. ilicifolius*). The symptoms are mainly those of gastro-intestinal irritation associated with degenerative and cirrhotic changes in the liver.

IV. Poisoning due to Toxic Substances normally present in Food and Drink.

A. *Coffee and Tea.*

From the available information obtained, chiefly from experiments conducted upon human beings, it would appear that excessive drinking of tea and coffee may result in harmful effects on the central nervous system, the heart, and digestion.

B. *Apricot, Plum, Cherry, and Peach Kernels and Almonds.*

Apricot, plum, cherry, and peach kernels, especially those which have a bitter taste, may contain dangerous amounts of hydrocyanic acid.

C. *Lathyrism.*

Different species of Lathyrus (Leguminosae), commonly called chickling vetch or Indian pea, are extensively used as articles of diet in India. Many cases of poisoning in human beings and animals by species of Lathyrus have been described.

The author was informed that Indians in South Africa, especially those resident in Natal, also use Lathyrus seed as a food, and it is for this reason that reference to Lathyrism is made here.

The symptoms are mainly those of paralysis.

D. *Lupinosis.*

The seeds of various species of Lupinus (lupines) form part of the diet of man in some parts of the world, and in earlier times when the seed was not properly prepared (cooked, outer skin removed and then placed in running water for a time) cases of poisoning followed its ingestion.

E. *Mushrooms.*

As any textbook on toxicology deals with mushroom poisoning it is unnecessary to discuss it here.

F. *Potatoes.*

"Greened," frosted or germinated potatoes may contain dangerous amounts of the poisonous alkaloid, solanin, and should therefore be discarded.

G. *Rhubarb and Beetroot Leaves.*

Rhubarb and beetroot leaves have been the cause of poisoning in human beings and animals owing to the presence of toxic amounts of acid oxalates.

H. *Fresh Fish, Oysters and Mussels.*

In Germany, France and Italy, isolated cases of poisoning and also mass poisoning have occurred through eating spawn (roe) of the barbel (*Barbus fluviatilis*), with symptoms of acute gastro-intestinal irritation and paralysis. The spawn is most poisonous during spawning-time and in some countries its sale is prohibited at this time. In Japan sea-urchin spawn has caused mass poisoning.

Also river lamprey (Petromyzon species) may cause very severe symptoms of gastro-intestinal irritation if they are not rubbed with salt to remove their poisonous skin-secretions. Mussels and oysters may absorb and store poisons from the water. These poisons have curare- and atropine-like actions.

I. *Margarine.*

Leschke quotes cases of margarine poisoning with symptoms of gastro-intestinal irritation and bradycardy. The poisonous principles were found to be chaulmoogra acid and hydnocarpus acid.

V. Preservatives and Dyes.

A. *Benzoic* and B. *Boracic Acid.*

Our food regulations permit the use of benzoic acid (or benzoates) and boracic acid (or borates) as food preservatives. Both these substances are poisons, and the public should be warned not to partake too freely of foods preserved with these acids or their salts.

C. *Formalin.*

It is evident from the literature that some milk vendors are still using formalin as a preservative in milk to such an extent that legal action is instituted against them. Formalin is a severe irritant and its use as a food preservative is apparently prohibited in South Africa.

D. *Nitrites.*

Nitrites are used in the pickling and preservation of meat, and cases of poisoning may occur. Cases of poisoning in a family, who had used salt mixed with nitrite, are described in the literature.

E. *Nutmeg.*

Nutmeg has caused poisoning in cases of criminal abortion. It is stated in the literature that one nut may cause poisoning in human beings. The active constituent is stated to be myristicin.

F. *Persulphates.*

In New South Wales four samples of yeast foods submitted were found to contain up to 3 per cent. of persulphates which were used as "bread improvers." Flour containing these persulphates cause severe outbreaks of baker's dermatitis in employees handling the flour, consequently the use of persulphates as a constituent of yeast foods has been abandoned.

G. *Salicylic Acid* and *Salicylates.*

These are used as preservatives of food and drink. Their use as such is, however, apparently not permitted in South Africa. Salicylic acid is a more marked gastro-intestinal irritant than sodium salicylate. Animals receiving small amounts of salicylic acid show degenerative changes in the gastric mucosa and liver.

H. *Aniline Dyes.*

Baer (*Jour. Amer. Med. Assoc.,* Vol. 103, 1934, p. 10) stresses the point that aniline dyes in foodstuffs can produce both a dermatitis and symptoms of gastro-intestinal irritation. Our regulations permit the use of all coal-tar or aniline dyes, except picric acid, Victoria yellow (dinitrocresol), Manchester yellow, aurantia, and aurine.

VI. The Effect of the Sun's Rays on Fruit and Vegetables.

The direct action of the sun's rays, especially during hot days, is prone to casue the development of toxic substances in fruit and vegetables, especially in water-melons and cucumbers. Damaged fruit and vegetables are more likely to develop toxic properties than undamaged fruit. It is certainly an undesirable and dangerous practice, especially on our markets, to expose fruit and vegetables to the direct action of the sun.

VII. The Toxicity of the Ordinary Smooth-skinned Marrow (Species of Cucumis).

Marrows having a bitter taste should not be eaten as they are very poisonous.

VIII. Fungus-infected Foodstuffs.

Cases of poisoning in human beings with maize infected with *Ustilago maidis* are described in the literature. All foodstuffs infected with fungi should be considered unfit for human consumption.

IX. Milk and Meat of Poisoned Animals.

(a) *Milk.*

As the udder is a very active organ of excretion, the milk of animals treated with drugs, or of animals suffering from poisoning, should not be used. It is possible for human beings and the young of the affected animals to be fatally poisoned by the milk of cows suffering from arsenical poisoning, although the affected animals may not be fatally poisoned.

(b) *Meat.*

It has been proved experimentally, with a number of poisons at least, that the meat of animals which have died from poison taken *per os* may safely be eaten. It is, however, essential that all the internal organs be *carefully* removed and discarded. (N.B.—*All* the internal organs should be removed from the carcass without allowing any of the contents of the gastro-intestinal tract to come into contact with the meat.)

It is, however, known that there are poisons to which the animal is very resistant and the human being very susceptible, and it is in view of this fact that it is advisable to condemn the carcasses of all poisoned animals.

X. Honey.

Poisoning with honey prepared from the nectar of the flowers of poisonous plants has been known since the earliest ages. Some years ago, suspected cases of honey poisoning occurred in Waterberg, Transvaal. The following are some of the plants, which have been responsible for honey poisoning : *Datura stramonium, Datura tatula, Nerium oleander*, and *Melianthus comosus*. The symptoms described are those of gastro-intestinal irritation and epileptiform convulsions. It is, however, clear that the symptoms will be determined by the specific plant concerned.

XI. Water and Beverages.

Poisoning with water free from toxic impurities could occur when excessive quantities are taken.

The presence of large quantities of salts (sodium chloride and sulphate, magnesium chloride and sulphate, calcium chloride, etc.) in our drinking water may be the cause of poisoning and disturbances in the calcium-phosphorous metabolism.

Furthermore, our water supplies may in certain circumstances contain arsenic (copper piping), lead, copper, fluorine, and zinc; and our beverages acrolein, arsenic, lead, fluorine, and saponins, to such an extent as to constitute a danger to health.

XII. Discussion.

I have, no doubt, painted you a very dismal picture. From what I have said, it would appear that it is very dangerous to live and that it would be better not to be born at all into a world so full of hazards to human life.

I hope I have not given you the impression that I am exaggerating the existing state of affairs. I can assure you that is not the case, and you can convince yourselves of it by perusing the voluminous literature on substances which are likely to cause and have caused food poisoning.

We cannot get away from the fact that our so-called highly developed state of civilisation has brought with it many hazards to human and animal life, not the least of which are those concerning our food and water. Not only do some of our foods contain poisons in their natural state, but in addition we introduce dangerous substances into them by our methods of preparation and preservation.

It must be clear to everybody, and of course particularly to members of the medical profession, that something is radically wrong with the state of health of human beings. We have chemist shops at almost every street corner doing "a roaring trade", in addition to the physician's dispensary; our hospitals cannot accommodate all the patients applying for treatment, and just recently a Johannesburg daily paper informed us that about two hundred thousand out-patients are being treated annually in that hospital alone. What is more, most human beings with minor illnesses do not consult physicians at all and many of them not until they have visited a number of chemist shops for advice and used all the possible remedies recommended by friends and relatives. The fact remains that perhaps more than half the people, who "do not feel well" (as it is popularly expressed) never visit a physician and that the percentage of sick people is much higher than our records show.

Denison (*Brit. Med. Jour.* No. 16, 1935, pp. 974—975), in a discussion on the possibilities of aluminium poisoning, rightly raises the question as to what "the cause could be of the thousands of chronic dyspeptics that fill every consulting room in this country" (England). The same question could also be put to members of the medical profession in South Africa.

We fully realise that the question of food poisoning is a most difficult problem and in many cases an unsettled one. We must, however, admit that the introduction of substances strange to the system and the introduc-

tion of super-normal quantities of substances normally present in our bodies and even essential for the maintenance of health, are very likely to set up reactions in our systems. In many cases it has been established that these reactions are harmful; in others it is still a matter for debate.

The information we have at our disposal certainly constitutes a serious warning to us to exercise the utmost care in the treatment, preparation, and preservation of our food, water, and beverages. I am thinking particularly of arsenic, lead, copper, aluminium, antimony, and preservatives in our food; and arsenic, fluorine, lead, zinc, and copper in our water and beverages.

Laws have been enacted as to the quantities of these substances permissible in our food and water. But are we sufficiently protected under the existing laws? What do we know about chronic poisoning in the human being by all the harmful substances contained in some of our foods, water supplies, and beverages? It is true that a large amount of experimental evidence on animals has been collected, mostly on white mice, guinea pigs, rats and rabbits. Apart from the fact that it is questionable whether the results of these experiments are in every case applicable to the human being, the tests were conducted over periods of a few weeks or months only. If the possibilities of chronic poisoning by any particular substance are to be investigated in a reliable manner, the experiments should be continued over periods lasting a few years at least. And if we wish to apply to the human being the results of experiments conducted upon animals, I would suggest that dogs be employed instead of white mice, rats, guinea pigs and rabbits. I am convinced that by using dogs in such experiments we would be more justified in applying the result of our investigations to the human being than if we use other classes of animals, except of course in those cases where the relationship between the toxicology of any given substance in the human being and any species of animal has been definitely established.

In the application of results obtained in experiments upon animals to human beings, we are and always will be faced with the problem of differences in susceptibility, symptomatology, and pathology between man and animal. In addition to this we have to consider differences in susceptibility to poisons in human beings themselves.

A point of the utmost importance is the summation of the effects of the different harmful substances upon our system. No information is available on this aspect of poisoning with the above-mentioned substances which may be present in our food, water and beverages. It is of such vast importance that it should be brought to the notice of the public health authorities and is certainly worthy of a thorough investigation.

Not only is it possible that the same poison, for example lead, may be taken in repeatedly, even on the same day, with our food, water and

beverages; but also many of the substances mentioned before have synergistic effects on the system. We also know that in many cases of synergism the effects of the substances concerned are not added but multiplied.

It is abundantly clear from the literature that many a case of chronic poisoning with arsenic, lead, antimony, aluminium, etc., has not been recognised for long periods and would not have been diagnosed had it not been for some clue which was obtained accidentally. Many cases of chronic poisoning remain entirely unrecognised.

This should serve as a warning to those concerned to consider the possibility of some kind of poisoning or other in cases where it is difficult to make a definite diagnosis, or to come to a definite decision as to the aetiology of a disease, especially if it is of a chronic nature. The situation is further complicated by the fact that the symptoms of chronic poisoning may simulate those of almost any disease, including diseases of bone, and are in many cases very indefinite. In many cases of chronic poisoning the patients concerned are often unable to describe their own symptoms —they simply "don't feel well." In such cases it would be advisable to submit blood-smears, faeces, and urine for examination and analysis, and roentgenography may be of value. In cases of suspected chronic arsenical poisoning, analysis of the pubic hair is of value. Urine specimens are certainly of great value in the detection of cases of acute and chronic poisoning. In acute cases the specimen should be collected as soon as possible after symptoms of poisoning have appeared and fair quantities (about a pint or two) should be submitted.

XIII. Summary and Conclusions.

A. It is abundantly clear that food poisoning caused by substances other than those produced by bacteria is of enormous importance to public health.

B. The efforts on the part of the Department of Public Health to protect the public against the harmful effects of poisons which may be ingested with our food, water and beverages are fully appreciated. It is, however, felt that in many cases our knowledge of the danger of minute quantities of poisons in our food, water and beverages, especially with regard to their synergistic effects, is incomplete and that it is essential to public health that reliable information be obtained. It is considered that in many cases the experiments conducted upon animals in order to ascertain the effects of minute quantities of poisons upon human beings are unsatisfactory and their results unreliable.

C. It would appear that owing to the extensive use of aluminium cooking utensils the possibility of aluminium poisoning urgently needs

thorough investigation. From the available information it would appear that heat-resistant glass vessels could be safely used in the preparation and storage of our food and drink.

D. We are very frequently exposed to the effects of arsenic and lead. Arsenic is very often contained in our fruit, vegetables, paints, tobacco, kindergarten materials (toys, crayons, water-colours, etc.), and carpets, and possibly also in beer. Lead may be present in water, wine, cider, sardines, tobacco, tooth-paste, toilet powders, fruit, vegetables, kindergarten materials, copper utensils, and the glazing of earthenware pots. Excessive amounts of copper may also be found in our water, fruit and vegetables.

As insecticides containing arsenic and lead are very extensively used on fruit and vegetables, the advisability of reducing the present limits of these poisons in our foods should be considered.

The possibility of some of our foods and drinks being contaminated with a number of poisons should serve as a warning to us not to eat too much of the same food or to drink too much of preserved fruit juices, but to vary our diet as much as possible.

The danger of becoming poisoned with fruit sprayed with liquids containing arsenic, lead, copper and (or) fluorine is greatest when unwashed and unpeeled fruit is cooked and eaten, as we then usually eat more of it and, if present, the poison is more concentrated and rendered more absorbable than when present on fresh fruit. It is essential that all sprayed fruit and vegetables and all fruit and vegetables bought from fruit-hawkers or on markets should be thoroughly washed or peeled, and the stem-ends (and calyx-ends in apples and pears) removed, before they are eaten.

It would seem advisable to exercise more supervision over fruit-hawkers and the fruit which is marketed, and that specimens of fruit, and perhaps also of those vegetables whose above-ground portions are eaten, be taken and analysed for the presence of arsenic, lead, copper and fluorine.

E. The use of fluosilicates as insecticides on fruit and vegetables constitutes a danger to health and should be very carefully investigated in all its aspects before it is permitted.

F. It has been established that the water in pipes containing lead and copper may in certain circumstances contain dangerous quantities of lead, copper and arsenic. It is advisable always to allow taps to run for a while before drinking the water.

G. Excessive amounts of zinc may in certain circumstances be present in drinking-water, cheese, and canned lobster. Some brands of toilet powders contain zinc stearate and have been the cause of poisoning in babies.

H. The use of boracic acid and borates, and of benzoic acid and benzoates, as preservatives is permitted in some of our foods and drink. In some countries the use of boracic acid and borates is prohibited, as it is considered dangerous to health. Some authors hold that the use of benzoic acid and benzoates should also be prohibited on account of their dangerous properties.

It is by no means an easy matter to decide just what amounts of these poisons, when ingested over prolonged periods, are dangerous to health. It is obvious that the limit should be a very safe one, as some persons may have a special liking for certain substances, for example fruit juices, and consume very large quantities of such juices preserved with benzoic acid.

I. Enamel vessels of which the enamel contains antimony should not be used in the preparation and storage of acid foods and drinks.

J. Fungus-infected foodstuffs should be considered harmful to health.

K. The problem of bread-poisoning through wheat contaminated with poisonous weeds is referred to.

L. The milk of animals suffering from poisoning should not be used for human consumption. In some cases the meat of such animals could be eaten provided the entire contents of the thoracic and abdominal cavities are removed.

M. As the symptoms of ptomaine poisoning resemble those of acute poisoning with arsenic, lead, antimony, etc., the possibility of the latter poisons being concerned should be considered in cases of suspected ptomaine poisoning.

Anthrax: Death in Blesbuck (*Damaliscus albifrons*) following the use of Goat Anthrax Vaccine

By W. O. NEITZ, Onderstepoort.

Introduction.

Outbreaks of anthrax have been observed from time to time in game animals all over the world. In South Africa this disease has been recorded in indigenous antelopes such as the springbuck and hartebeest. Little is known, however, about the degree of susceptibility of these wild animals. It is very well known that goats are more susceptible than sheep and that vaccines which are perfectly safe for sheep frequently produce death in goats.

Orservations at Onderstepoort.

Through the kindness of the Provincial Administration of the Orange Free State, Onderstepoort obtained several blesbuck from the Summerville Game Reserve for the purpose of establishing their susceptibility to infectious diseases of the domestic animals. As these buck had to be kept for a long period, it was considered advisable to immunize them against anthrax in order to obviate the risk of accidental infection. Bearing in mind the known susceptibility of goats the blesbuck were inoculated with a weak goat vaccine. This vaccine was avirulent for rabbits and only slightly virulent for guinea pigs, and had been prepared about a year previously. It had never caused mortality in goats. The results were as follows :—

Seven blesbuck were each injected subcutaneously with 1 cc. of anthrax spore vaccine (goat), Batch 85.

Three of the seven animals died suddenly. The first died five days, the second six days, and the third eleven days after inoculation. B. anthracis could be demonstrated microscopically in blood smears from each of the animals, and cultures were of the attenuated goat vaccine strain. The other four animals remained well.

Conclusions.

(a) It seemed from a test on a limited number of animals that blesbuck are more susceptible to a weak anthrax vaccine than are goats.

(b) The use of even a very attenuated goat anthrax vaccine was not safe for blesbuck. This fact is to be borne in mind should it at any time be necessary to immunize animals in zoological gardens, because other animals show a similar susceptibility.

Literature.

Dobberstein, J. (1936. Über Sektionbefunde bei den in zoologischen Gärten gehaltenen Tieren. *B. T. W.*, June, 1936. pp. 389—392.

Henning, M. W. (1932). *Animal Diseases in South Africa.* Vol. 1. Central News Agency, Ltd., South Africa.

Thomas, A. D., and Neitz, W. O. (1933). The importance of diseases in wild animals. *S.A. Jour. of Sci.*, Vol. XXX. pp. 419—425.

Complete Torsion of the Uterus in a Ewe.

By H. H. CURSON, Onderstepoort.

Since the above condition is fully described in *Fleming's Veterinary Obstetrics* by Craig, J. F. (1930), there is no need to give details other than those directly associated with the case in question.

Merino ewe 44715, served at Ermelo on 15/2/36 and weighing (on 10/7/36) 71 lb., was killed at Onderstepoort on 10/7/36 for anatomical observation of the foetus, which at the time was 146 days old.

On opening the abdominal cavity of the ewe, one was confronted with the striking spectacle of a uterus twisted on its long axis and involving both the cervix and cranial portion of the vagina. Still more striking was the brown-green colour of the gravid uterus.

Externally the serosa of the uterus was intact, but the mesovarium and mesosalpinx were in shreds and intensely congested. There were three well-marked spiral twists at the seat of torsion constituting one *complete* and one half turns of the cervix. The lesion resembled that featured in Fig. 71 (p. 236) of Craig's work, which describes the torsion as *incomplete*. It is stated, however, in the text (p. 237) that spiral ridges

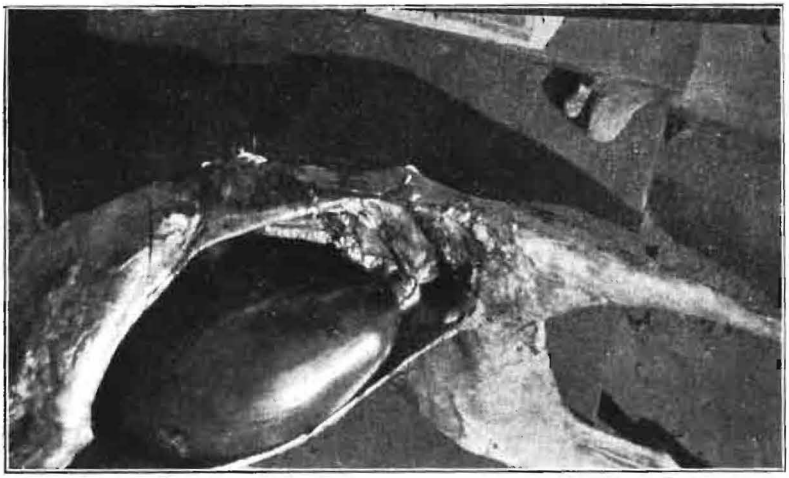


Fig. 11. Complete torsion of the uterus in a ewe (44715), 145 days pregnant.

" may sometimes be mistaken for separate twists." In ewe 44715 the torsion was directed to the left, in spite of the fact that the right horn was the pregnant one.

On section, the uterine wall was not only markedly congested, but showed a green appearance with, however, no unpleasant smell. The foetal membranes were not ruptured, but the fluids were deeply blood-stained.

The foetus, a male, had been dead some days, possibly a week at least.

Mr. F. D. Horwell, my assistant, reports that just prior to slaughter the ewe kept lying down.

This case is described on account of its rarity, being the first I have yet encountered.

The Toxicity of "Laurel" Paraffin for Sheep.

By DOUW G. STEYN, Onderstepoort.

While conducting investigations into losses in stock in the Vryheid district, I was informed by a farmer that his neighbour, a progressive sheep farmer, had told him that epidemics of bluetongue could be prevented by injecting sheep subcutaneously with 10 cc. of "Laurel" paraffin. My reply was that I doubted the efficacy of such an injection as a preventative for bluetongue and that extensive abscess formation would most probably result.

In order to ascertain what the effects of subcutaneous injections of "Laurel" paraffin would be, the following experiment was conducted :—

Sheep 42775 (32 Kg.)—10 cc. of "Laurel" paraffin was injected subcutaneously in the left groin at 12 noon, 18/6/35.

19/6/35—8 a.m.—site of injection red, warm, painful and oedematous. Animal lame in the injected leg.

20/6/35—symptoms of inflammation at site of injection more pronounced; lameness pronounced and animal not feeding.

21/6/35–23/6/35—ditto.

24/6/35—Hard swelling (12 x 5 cm.) at site of injection. The swelling appears less painful and degree of lameness is not so marked. Animal losing condition.

Up to 10/7/35 the animal's condition remained practically unchanged. Softening of the hard swelling at the site of injection now set in. It was opened up on the 24/7/36 and a large quantity of yellow cheesy pus removed. The wound was healed on the 3/8/35 after treatment with dusting powders containing zinc oxide and tannic acid.

Sheep 43612 (35 Kg.)—15 cc. of "Laurel" paraffin injected subcutaneously in the left groin at 12 noon, 18/6/35.

In this animal the symptoms and course of the affection were the same as those described above. For about a week the animal moved about on three legs and was very apathetic. The abscess at the site of injection ruptured on the 30/6/35 and discharged a large quantity thick yellow pus. The wound was healed on 15/7/35.

The toxic doses of different brands of paraffin administered *per os* to sheep have been determined previously (Steyn, 1931). It was found that 128 cc. of "Laurel" paraffin induced severe symptoms of poisoning.

The toxicity of "paraffins" is probably, partly at least, due to the presence of olefines (unsaturated aliphatic hydrocarbons).

Conclusions.

" Laurel " paraffin injected subcutaneously into sheep in doses of 10 cc. causes the development of abscesses at the site of injection as well as loss of appetite, pronounced apathy and loss in condition. It is therefore clear that paraffin should not be injected subcutaneously except in cases where the formation of sterile abscesses is required.

Reference.

Steyn, D. G. (1931). The toxic doses of some commonly used farm remedies. *Jl. S.A.V.M.A.* **2**: 135—137.

BOOK REVIEW.

The publication, only two years after the appearance of the first, of a second edition of Udall's *Practice of Veterinary Medicine* * is a sufficient indication that the book has fulfilled the purpose for which it was produced. In material and arrangement, the new edition does not differ much from the previous one. The chapter on acetonemia has been transferred to " disorders of metabolism", and a section on pleuritis has been introduced.

There are included, in a space of 273 pages, the diseases of the various systems, the specific infections, conditions due to parasites, protozoan, virus, and metazoan infections, and poisoning. In consequence, the treatment of some sections has of necessity been scanty; but discrimination has been shewn in the selection of most of the more important diseases for detailed description. For example, the importance of chronic mastitis has been recognised by devoting no less than 10 pages to a clear, instructive review of this disease, with numerous references to literature; unfortunately the latter do not include the recent work of European investigators on the question of aetiology.

A welcome brevity and conciseness is apparent when the author deals with " treatment "; the mention of numerous proprietary and obscure remedies is avoided.

It is, however, unfortunate that in a work of this nature the chapter on " Protozoan Infections " doe not reach the standard set by the remainder of the book. There are a regrettable lack of up-to-date references, a bad presentation of a number of the diseases, an obvious want of acquaintance with modern therapuetic methods and drugs, and a number of inaccuracies and omissions. As examples may be mentioned the descrip-

* *The Practice of Veterinary Medicine*, by D. H. Udall. Second edition, 1936. Pp. 273, figs. 81. Published by the author, Icatha, New York. Price $ 5, post-free.

tion of piroplasmosis in horses as South African horse-sickness, the mention of *T. brucei*, but not *T. congolense* as an important trypanosomiasis, the reference only to small piroplasms and not to Koch's bodies in the description of East Coast Fever, and the almost complete absence of references to the modern work of French and British investigators on the African continent.

This is essentially a book for practical purposes, for quick reference, and for a concise account of the various diseases of the herbivorous animals and of swine.

B. S. P.

THE ASSOCIATION.

MINUTES OF COUNCIL MEETING HELD AT POLLEY'S HOTEL, PRETORIA, ON 18/6/36.

Present : S. T. Amos (Chair), H. H. Curson, A. C. Kirkpatrick, P. J. du Toit, C. Jackson, A. D. Thomas, H. O. Monnig, S. van Rensburg, R. du Toit, C. J. van Heerden.

Apologies for absence : The President read a letter from Mr. F. J. Carless apologising for his non-attendance owing to indisposition.

1. (a) Minutes of Council meeting held on 31/3/36 were taken as read and confirmed as these had appeared in the Journal.

(b) Minutes of special Council meeting held at Onderstepoort on 12/5/36 for the purpose of electing standing committees for 1936-37 were read.

Dr. Curson drew attention to the fact that the personnel of the Parliamentary Committee had been omitted. This omission was corrected and the minutes confirmed.

2. **Matters arising from these Minutes.**

(a) *Scales of charges for veterinarians.*

The Secretary reported that letters to the N.V.M.A. in England and the Irish Free State enquiring for guidance in this matter had been written but no replies received to date.

(b) *S. & T. rates for G.V.Os.*

Mr. van Heerden proposed that time be set at the Spring General Meeting for the purpose of discussing this matter. Dr. du Toit suggested that Mr. van Heerden arrange for the circularisation of all G.V.Os to the

effect that a meeting for the purpose of discussing S. & T. Rates will be held at Onderstepoort at the time of the Spring General Meeting in order that they may come prepared with the necessary data. Agreed.

(c) *Captain Clapham : Deputation to Minister for Defence.*

The Secretary read a letter from the Minister's office and from the Adjutant General indicating that the request for a deputation to interview the Minister would be laid before him on his return from overseas.

The personnel of the deputation appointed on 31/12/35 was altered, Mr. van Heerden being substituted for Dr. de Kock who would be away at the time of the return of the Minister.

(d) *Members in arrears.*

The Secretary indicated that registered letters had been written to two members but no replies had been received. Resolved to deprive these members of membership status at Spring General Meeting.

(e) *Expert Witness Fees.*

The Secretary read letters written to the R.C.V.S. and the Maatschappij voor Diergeneeskunde in Holland enquiring what the position was regarding payment of expert witness fees in those countries. No replies had as yet been received.

(f) *S.P.C.A. Veterinary Panel in Cape Town.*

Dr. du Toit stated that the Veterinary Board was dealing with this matter and suggested no further action being taken on the part of the Association. Agreed.

(g) *Adoption of Courtesy Title : Result of Referendum.*

The Secretary indicated the result of the referendum, the votes for which had been counted during the day, viz., 162 papers had been sent out and 70 received. 37 members had voted in favour of the adoption and 33 against. Letters protesting against the holding of the referendum without adequate opportunity of discussing this matter at a general meeting were read viz., from Dr. de Kock, Dr. Alexander, Mr. L. Daly, and Mr. Jackson.

Dr. du Toit submitted the following proposal which was agreed to : " In view of the obvious division of opinion revealed by the referendum in the ranks of our members on the question of the adoption of the courtesy title of doctor, and in view of the strong protests lodged by some members and the fact that thus far there has been no adequate opportunity of discussing this important subject, Council resolves that no decision be taken at present but that this subject be placed on the agenda of the next general meeting."

In seconding the motion of Dr. du Toit, Mr. van Heerden pointed out the constitutional difficulties involved. The Chairman stated that he supported the motion and pointed out that it had been so worded that Council only postponed acceptance until the Spring General Meeting.

(h) *Appointment of Veterinarian—Germiston Municipality.*

The Secretary read out the correspondence up to date in connection with this matter.

Dr. Curson proposed that the following draw up a memorandum in support of the M.O.H. of Germiston's arguments for such an appointment : Dr. E. M. Robinson, Dr. B. S. Parkin, Mr. S. van Rensburg. Agreed. Dr. Thomas wished to know whether Council would take cognizance of the salary of the appointee.

The Chairman suggested that the memorandum should contain suggestions regarding suitable remuneration and also permanence of position. Dr. Curson stated for the information of members that Dr. Kind had been appointed by the S.A.R., Johannesburg, as veterinarian in charge of the administration's animals on a retainer.

3. **Veterinary Exhibit (S.A.V.M.A.) at Johannesburg Africana Room.**

Dr. Curson stated that Mr. Gubbins had requested that the Veterinary Profession support his Africana collection at Johannesburg.

After some discussion it was agreed that the veterinary exhibit at Onderstepoort was better displayed at this centre and it was resolved to leave the material at Onderstepoort.

4. **Sale of Akiron.**

The Secretary read a letter from Bayer Pharma requesting the names of the chemists responsible for the supply of Akiron to the lay public. Agreed to supply names of chemists involved.

5. **Motion by Mr. Runciman.**

The Secretary stated that letters of enquiry *re* the position of wind infirmities in race horses in various countries overseas had been written to several organizations. No replies had been received as yet.

6. **Commission of Enquiry into Veterinary Services.**

Dr. du Toit stated that the time was not opportune to go into this question on account of the shortage of staff and suggested that the matter be left in abeyance. Agreed.

7. **Library.**

Dr. du Toit stated that the matter had been discussed at a meeting of the hostel committee and that no difficulty was anticipated in housing the library. It was agreed to conform with the Hon. Librarian's proposal *re* the loan of the library to the Students.

8. **Expenditure—Editorial Committee.**

Dr. Thomas stated that no provision was made for a definite grant to the Editorial Committee. By general agreement it was accepted that the expenditure on the Journal should amount to about £150 per annum, but that it was extremely difficult to adhere strictly to this figure.

After some discussion it was agreed to leave the matter in the hands of the Editorial Committee, in consultation with the Finance Committee.

Dr. Thomas requested that Council indicate the policy to be adopted in future in connection with the Journal. A lengthy discussion ensued in which the value of the Journal as the official publication of the Association was viewed from all angles.

Dr. Monnig suggested that more reviews of articles of current interest be published.

Mr. van Rensburg proposed the inclusion of a personal column wherein could be included transfers of officials, etc.

Dr. Curson pointed out the necessity from the historical point of view of having the minutes of meetings published, in reply to a suggestion that minutes be excluded from the Journal.

It was decided that minutes continue to be published but in abbreviated form.

9. **Date of Spring General Meeting.**

Dr. Curson nominated the following sub-committee to go into this question and also the question of papers and the social side of the meeting : Mr. van Heerden, Dr. Thomas, and the Secretary. Agreed.

10. **Appointment of Hon. Secretary-Treasurer.**

The Secretary stated that in view of his impending departure overseas for 15 months it would be necessary for Council to appoint a successor which it was empowered to do under Sect. 9 (f) of the Constitution. Mr. van Rensburg was appointed.

11. **General.**

(i) *Reciprocity with other countries* :

Dr. du Toit stated that this matter was being dealt with by the Veterinary Faculty which had passed the following resolution : In the case of a candidate who has a degree in veterinary science of a University or Institute recognised by the University of Pretoria, the Senate may lay down the period necessary for such a candidate to serve at the University and the examinations to be written and passed.

Dr. du Toit stated further that this resolution had been accepted by the University of Pretoria and that the Rector had expressed the desire that it be submitted to the Council S.A.V.M.A. for approval. Furthermore, Dr. du Toit stated that reciprocity with the Royal College of Veterinary Surgeons was likely to be an accomplished fact in the near future.

Dr. Thomas proposed that a letter be written to the Rector signifying the appreciation of Council regarding his action in submitting this resolution. Agreed.

Dr. Monnig proposed that a letter be written to the Dean of the Faculty of Veterinary Science signifying Committee's agreement to the steps taken by the Faculty, on the understanding that in the case of each graduate from an overseas institution an examination be held which will include the following subjects: bacterial, protozoal and virus diseases, parasitology and toxicology with special reference to South African conditions. Agreed.

(ii) *Resignations* from Messrs. Hearn and Maybin were read by the Secretary. Agreed to have these submitted to the Spring General Meeting.

(iii) *Griffiths Memorial.*—The Secretary read a letter received from the Director of Veterinary Services enclosing correspondence from the University of North Wales in which was stated the desire to add a wing to the Veterinary Department of the University to commemorate its association with Dr. Griffiths Evans, whose death at the age of 100 years took place last year.

Agreed to donate £5 5s. from the Association as representative of the Veterinary Profession in South Africa.

(iv) The Secretary read a letter received from Mr. Harber *re* certain complaints. Dr. du Toit stated that the Veterinary Board had recently dealt with the matter but that no action had been forthcoming from Mr. Harber with the result that the Board concluded that the point would not be pressed. He suggested that the letter be referred to the Veterinary Board. Agreed.

(v) The Secretary read a letter from the Public Service Commission to the Chairman of the Advisory Council, Public Servants' Association, in which a proposal was submitted to the latter body for consideration regarding uniform salary scales for civil servants. The scales submitted commenced at £200 with a maximum of £600 and a barrier at £450, but it was stated that veterinary officers would not be included at present.

It was agreed to watch developments closely.

6. Dr. Curson stated that the R.C.V.S. had recently appointed a committee to go into the question of the registration of canine nurses and suggested that a committee be appointed to take this matter up as it affected South Africa.

The following committee was appointed: Mr. van Heerden, Dr. Quinlan, Mr. Amos and the Secretary.

The meeting closed at 11.15 p.m.

Natal Branch—Annual General Meeting.

The President, Mr. Diesel, welcomed the members and asked the meeting to stand for a few moments in order to pay respect to the memory of the late Mr. W. J. B. Green.

The minutes of the last meeting were taken as read and were confirmed and thereafter Mr. Diesel reviewed the happenings of the past year and showed that increasing prosperity had resulted in an increased demand for veterinary services on the part of the public. He stated also that the Government had given additional protection to the private practitioner by somewhat restricting the activities of the government veterinary officers as far as non-scheduled diseases were concerned.

It was decided that members of the Natal Branch would cease automatically to be members of the branch on leaving that province.

During the morning Dr. Steyn read a paper on " Plant Poisoning of Animals ", and Dr. de Kock discussed copper poisoning and its bearing on treatment of verminosis in sheep by the use copper compounds. After lunch Mr. Dykins read a paper on " The Duties of a Municipal Veterinary Officer " and showed the necessity of administrative training for such a position. Dr. de Kock discussed the question of abattoir control and dairy hygiene and pointed out that private practitioners might be appointed as part time officers under the National Tuberculosis Scheme. After a demonstration of instruments and appliances by Mr. Amos, Mr. Footner, and Mr. Dykins the meeting closed.

Office bearers elected for the year were :

President : A. M. Diesel.

Vice-President : W. A. Dykins.

Secretary : S. T. Jackson.

Committee : R. Paine, V. Cooper, C. M. Sharpe, and A. L. Blomefield.

Mr. Amos was re-appointed representative on the Natal Anti-tuberculosis Association.

NOTES AND NEWS.

The Editorial Committee wishes to refer appreciatively to the energetic services rendered to the Journal by Mr. M. H. V. Brown, B.V.Sc., up till the time of his resignation from the Division and his departure, in March last, for Burma, where he has taken up the post of Pathologist and Bacteriologist in the Veterinary Department. For several years Mr. Brown was an indefatigable worker in connection with the administration of the Association's affairs, and his willing assistance and advice are missed by his fellow-members.

Dr. E. M. Robinson is another retiring member of the Editorial Committee, on which, especially in the spheres of reviewing and abstracting, he rendered willing service for a period of five years. Dr. J. H. Mason and Mr. M. Sterne have accepted appointment in the place of these two members.

* * *

Dr. P. R. Viljoen and Dr. G. de Kock have left to attend the British Commonwealth Scientific Conference in London in September.

* * *

Mr. Rene du Toit has relinquished the office of Hon. Secretary-Treasurer, which for a year he had discharged with great success, in order to leave for the U.S.A., having been appointed to a Commonwealth Fellowship. He will spend 15 months studying problems of economic entomology.

* * *

Mr. J. D. W. A. Coles returned to Onderstepoort from America in November last, after studying problems of cytology under Dr. E. V. Cowdry at Washington University, St. Louis.

* * *

Two other members who have recently returned from study overseas are Mr. W. O. Neitz, who interested himself in problems of tropical medicine at Hamburg, and Dr. I. P. Marais, who obtained his doctorate at Leipzig, his thesis being concerned with the reproductive cycle of Merino ewes.

* * *

The staff of "Section A" at Onderstepoort has been augmented by the appointment of Mr. Hans Theiler (4/10/35), and by the transfer to the research staff of Mr. J. G. v. d. Wath (2/1/36) from Allerton and of Dr. K. Schultz (31/3/36) on the conclusion of the successful medical treatment he underwent in England.

* * *

Recently appointed District Veterinary Officers are (January): Messrs. N. H. Boardman, C. J. Erasmus, A. F. Tarr, G. S. v. d. Merwe, and J. H. B. Viljoen; and (June): Messrs. J. M. Fourie, N. C. Lambrechts, and W. G. van Aswegen.

* * *

The following transfers of G.V.O.'s have occurred in recent months: From Allerton Laboratory: Mr. N. Barrie to Middelburg (C.P.), *vice* Mr. W. D. Malherbe, transferred to Wellington; Mr. L. Stonier to Kimberley; Mr. R. B. Osrin to Lydenburg; Mr. A. R. Thiel to Port Elizabeth, *vice* Mr. E. T. Clemow, on long leave; Mr. J. J. v. d. Westhuizen to Worcester; Mr. N. H. Boardman to Eshowe; Mr. J. H. B. Viljoen to Dundee. From Rustenburg: Mr. J. H. R. Cloete to Ermelo, *vice* Mr. R. Clark, transferred to Onderstepoort. From Kimberley: Mr. H. P. Steyn to Armoedsvlakte. From Malmesbury: Mr. N. T. v. d. Linde to Calvinia.

OBITUARY.

JOHN DOWNIE BORTHWICK.

By the death of JOHN DOWNIE BORTHWICK at the Arcadia Nursing Home, Pretoria, on the 18th June, 1936, the veterinary profession loses its oldest member. John Borthwick was born at Kirkliston, Scotland, on the 31st October, 1867, and qualified as M.R.C.V.S. at the New Veterinary College, Edinburgh (now Liverpool Veterinary School) in 1888. He came out to the Cape Colony early in February, 1889, and was the first Assistant to the famous Duncan Hutcheon, Chief Veterinary Officer and later Director of Agriculture of the Cape Colony. In 1891 Dr. Alexander Edington was appointed Colonial Bacteriologist at Grahamstown and, in order to assist him in his study of stock diseases, Borthwick was seconded for the purpose during the period 1891–93. He later served as Assistant Veterinary Surgeon (now Government Veterinary Officer) in different parts of the Cape Colony.

When Hutcheon became Director of Agriculture, Borthwick succeeded him (as from 1st July, 1906) as Chief Veterinary Officer; and after the establishment of Union, he became the Assistant Principal Veterinary Officer, with seniority from 1/1/12 and with headquarters at Pretoria. On Mr. Gray's retirement as Principal Veterinary Officer on the 10th May, 1921, he took over the office and himself retired on the 31st March, 1927, on pension.

Borthwick then entered the service of the Imperial Cold Storage Co. and in the course of his duties came into contact with the officials of the Transvaal Cold Storage Co. and Rhodesian Export and Cold Storage Co., affiliated companies of the Imperial Cold Storage Co.

Borthwick through his early training always took a keener interest in animal husbandry than in the purely veterinary aspect of the profession. Not only was he particularly keenly interested in breeding problems, especially of mules, but also in the meat trade. Since 1927, when he was Veterinary Adviser to the Imperial Cold Storage, he visited their ranches regularly, especially the Nuanetsi, and has interested himself in the transport of slaughter stock by rail.

To his wife, daughter and two sons we extend our heartfelt sympathy in the grievous loss they have sustained. H. H. C.

WILLIAM JOHN BURGER GREEN (1901—1936).

Our colleague and friend "TIL" GREEN passed away very suddenly and unexpectedly on the 1st of June last.

He was born in Krugersdorp on the 27th of May, 1901, and received his primary education there, and his high school training at the Boys' High School, Paarl, where he showed great promise both at rugby and

athletics. After matriculating in 1919 he came to the Transvaal University College, Pretoria, to enrol for the B.V.Sc. course. He graduated as one of the first group of South African trained veterinarians in 1924. At College, Til played for the 1st Rugby team for 4 years in succession and during that time represented Pretoria and the Transvaal on numerous occasions, playing usually at centre three quarter, but often as left wing.

In 1925 he was appointed Veterinary Research Officer, at Onderstepoort. There he applied himself to bacteriology and more particularly to the study of anaerobes. He, with Dr. Scheuber, was instrumental in perfecting the formolised blackquarter vaccine now generally used in this country.

In November, 1928, he was transferred to Allerton Laboratory, Pietermaritzburg, as Officer in Charge. In 1930 he was recalled to Onderstepoort, but after a few months was seconded to the field service as "Veterinary Research Officer for work on tuberculosis" at Durban, where for three years he was in charge of the tuberculosis campaign conducted by the Veterinary Division in co-operation with the Municipal authorities.

In June, 1933, he once more went to Allerton as Officer in Charge, and in August, 1934, he came to Onderstepoort to continue his researches on tuberculosis, and to lecture on hygiene and animal management in the Faculty of Veterinary Science.

In 1930 he married Miss Little, of Pietermaritzburg; his widow is left with two young children, Peter and Barbara.

Til Green was by nature reserved, but was a conscientious and painstaking worker and a loyal friend. To the profession and to those whose privilege it was to know him well his untimely death has come as a severe shock and a great loss. To his widow and children we extend our sincere sympathy. J. H. R. B.

EDITORIAL NOTE.

This number of the Journal is respectfully dedicated to the memory of SIR ARNOLD THEILER (1867–1936).

We are fully conscious of its inadequacy as a memorial to Theiler in every respect save that of the spirit in which the contributors have undertaken their tasks. The short time which has elapsed since Theiler's death has made it impossible to fill this publication with reports of original researches into the problems in which he was especially interested, but several of the contributions are felt to be appropriate. We have also gladly used the opportunity to publish herein an article from another pioneer of protozoal diseases in this continent, Professor Kleine having just concluded a visit to Onderstepoort. The authors of the biographical article, "The Life and Work of Sir Arnold Theiler" record their thanks to all those who so willingly lent their assistance: Dr. A. D. Thomas, Mr. M. Sterne, B.V.Sc., Dr. A. J. Orenstein, C.M.G., Mr. A. Stuart, Mr. Th. Meyer, Drs. R. A. Alexander, J. Quin, and J. H. Mason. Because in several obituaries in other journals the more personal aspects of Theiler's life have already been dealt with, because the compilers and those who assisted them are especially competent to comment upon the significance of researches in which, as co-workers, successors or pupils, they have often participated, and lastly because Theiler's life was, after all, essentially his work, it is to his scientific achievements that most attention has been directed.

When a giant puts off his mantle it has to descend on many, since any single successor would find it an overwhelming burden. The carrying on of Theilers' researches in South Africa has had to be divided among many of the present workers at Onderstepoort, who, having to present a united front against the difficulty and the magnitude of the task they are facing, have been drawn into closer co-operation and sympathy since Theiler's passing. It is among these that we have found our contributors. Although they have one and all regarded their tasks as a privilege, we nevertheless wish to thank them for their response to the Editor's appeal for support in the preparation of this Memorial Number.

SIR ARNOLD THEILER, K.C.M.G. (1867–1936).

The Life and Work of Sir Arnold Theiler.

By P. J. DU TOIT and CECIL JACKSON.

During the last years of his life, the Founder of that Institute often referred to " the spirit of Onderstepoort." By this expression he not only paid tribute, with obvious satisfaction, to the quality of the work carried on by his disciples and successors, but—one feels—was conscious of the results of his own influence upon them. For on analysis this " spirit of Onderstepoort " is found to be neither more nor less than the reflection of Theiler's own spirit in a devoted band of followers : it still exists and will exist, notwithstanding his passing. It is a convincing demonstration of Theiler's immortality; it is Theiler himself, triumphing over age, infirmity, and even over death. It is still more than this : it is that ideal of service, that conscientiousness of endeavour, that pride in a task, that confidence of success in the face of difficulties, of which Theiler was as true an example as the world will ever know.

In another sphere one feels that Theiler might have changed the course of history. For never could the term " genius " be more fittingly applied than to him; and the scope of genius knows few limitations, save those dependent on the accident of circumstance and environment.

It is impossible in a small space to do justice to the achievements of a man like Sir Arnold Theiler. His scientific publications (see Appendix) would fill many volumes, and an adequate survey of their contents would cover many hundreds of pages. Nor can a satisfactory picture be presented here of a life every day of which was lived to the full. We can only express the hope that a biographer worthy of the task will one day arise. Whatever his other qualifications for the undertaking might be, he would have firstly to be a scientist, and secondly he would have to tread once more the paths that Theiler trod. He would have to seek his atmosphere in a knowledge of the Swiss lakes and mountains and of the Highveld in the early nineties; of the tin shanties at Daspoort which were Theiler's first laboratory and of the great Institute at Onderstepoort into which those crude hovels grew; of life in the veterinary and medical clinics of Europe and of the hardships of investigating the vulture-pecked carcasses of animals stricken by tropical plagues; of the simple life Theiler led at Onderstepoort and of the many far countries into which he travelled; of the bitterness of disappointment and of the joy of achievement. He would have to understand the spirit whereby a man, when stricken by a fatal complaint, knows but one anxiety : Will it kill me before I can finish the work on which I am engaged ?

Theiler's Early Days.

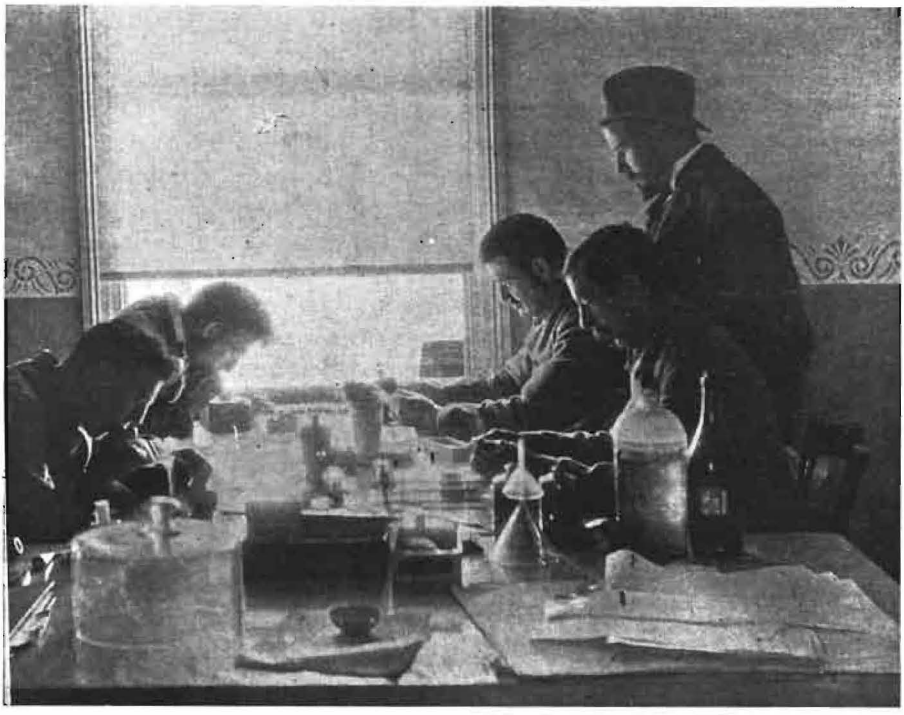
Arnold Theiler was born on the 26th March, 1867, in the little town of Frick in the Swiss Canton of Aargau, where his father was a teacher of biology. Father and son undertook many an excursion together into the surrounding country and in this way the young Theiler acquired a love for natural history and a keen power of observation which he retained throughout life. His father planned for him a classical career—Theiler often showed evidence of his early classical training—but the attraction of biological science proved too strong; and so young Theiler left the gymnasium and finally entered the veterinary college in Zürich. Here he obtained his veterinary diploma at the age of 22.

Veterinary science had attracted Theiler because it seemed to embody every phase of natural science. This wide conception of his subject formed the keynote of his whole career. He always regarded a knowledge of zoology, botany, chemistry, physics, and even of mathematics, in addition to the more strictly professional subjects, as absolutely essential for the solution of the problems of veterinary science. But Theiler would never have been content to become a practising veterinary surgeon in Europe. And so it is not to be wondered at that soon after qualifying he began to look around for a wider field in which to apply his energies. Quite by accident his attention was directed to South Africa and boldly he decided to seek his fortune there.

Theiler arrived in South Africa in 1891 and proceeded straight to the Transvaal. Only a few months later he had the bitter experience of losing his left hand. What this accident at the beginning of his career, and the knowledge that he would have to go through life with this serious handicap, meant to a sensitive nature like Theiler's, nobody will ever know. A less courageous man would have said farewell to his hopes and aspirations and would have felt that he was doomed to go through life in some minor capacity. But not so Theiler. It almost seems as if this misfortune strengthened his character and made him more determined than ever to succeed in his profession. It was surprising to see how completely he overcame his disability and although he never referred to the accident, he did not hesitate to point out that he had only one hand if there was a necessity to do so.

The first two years in South Africa must have been very hard for Theiler. He had not succeeded in finding a suitable post; he knew very little of the language of the country and the prospects in private practice did not seem very promising. But Theiler was not the man to remain idle. He used his time to study conditions in and diseases of the country. Wherever he encountered a dead animal he carried out an autopsy, thus acquiring the skill and the knowledge which served him so well in later years.

And then came his first opportunity. In April, 1893, a case of small-pox was diagnosed in Johannesburg. The disease spread rapidly and during the next few months some 1,750 cases occurred with more than 80 deaths. A Small-pox Committee was formed and one of the first difficulties which the committee encountered was the lack of reliable vaccine. A small quantity of imported lymph was available, but this gave very poor results. At a meeting of the committee held in Johannesburg on 21st July, 1895, the district surgeon, Dr. Schulz, introduced Theiler, who had been asked to attend the meeting and who was reputed to have had some experience in the production of lymph. " Dr. Schulz said that Mr. Theiler



SMALL-POX EPIDEMIC, 1893.

Theiler supervising the preparation of lymph in a room in Market Street, Johannesburg.

had shown him his qualifications, and they were satisfactory. Both were from Switzerland. The one was that of a veterinary surgeon, and the other gave him the title of lieutenant in the Swiss Artillery. Mr. Theiler, he said, had great experience in the growing of lymph." Theiler was then engaged for a month at a salary of £50. A month later he was supplying the Small-pox Committee with a sufficient stock of lymph for all immediate requirements. From his lymph farm in Market Street the Small-pox Committee were obtaining no less than 2,500 tubes and what was more important, the quality was proving satisfactory. Of 60 vaccinations made

experimentally with this lymph it was reported that no less than 58 were successful. The outbreak was brought under control and by the end of the year it was over.*

Theiler's name was now familiar to the authorities. After the conclusion of the small-pox epidemic he was appointed consulting veterinary surgeon to the Rand Health Board, one of his first duties being the drafting of legislation to deal with glanders. During these years his first publications began to appear. It is significant that the very first article which he sent to the "Schweizer Archiv für Tierheilkunde" deals with horsesickness, a disease which probably claimed more of his time and attention, during his 36 years' stay in South Africa, than any other single veterinary problem. He also writes about blackquarter, which was very prevalent and against which he used the first imported vaccine; about lungsickness, which was one of the most dreaded diseases at the time; about redwater, the cause of which had only just been discovered and in regard to the transmission of which Theiler expresses a doubt whether ticks really play a rôle in South Africa. He also relates some of his experiences in the pactice which he was trying to develop in Johannesburg, but about the success of which he does not appear to be too sanguine. In 1894 he writes as follows : The lot of a veterinarian in the Transvaal is anything but enviable. Every farmer is his own doctor and veterinary surgeon and a great deal of trust is required before a farmer will allow a foreigner to do anything for him.

However, Theiler's trials as a private practitioner were soon to end. Early in 1896 the news of a devastating cattle disease approaching from the north had been received in Pretoria and Theiler was summoned by President Kruger and sent to Rhodesia to investigate. The story of Theiler's heroic struggle with this disease, of his successes and disappointments, is told by Curson in this Journal. If the small-pox epidemic of 1893 had served to bring Theiler to the notice of the authorities, the disastrous rinderpest outbreak of 1896-97 firmly established his reputation as a man of courage and wisdom and as an investigator of the highest order.

From this time onward Theiler served the government in the Transvaal until his retiral in 1927. Up to the outbreak of the Anglo-Boer war he continued to study South African conditions and to publish the results of his observations in overseas journals, mostly in Switzerland. Glanders and "osteomalacia" in horses form the subject of one paper. But this attention during these years was occupied chiefly by rinderpest, lungsickness and horsesickness.

*We are indebted to Mr. R. V. Kennedy, Librarian of the Public Library, Johannesburg, for the information contained in this paragraph, which he kindly extracted from the minutes of the Small-pox Committee and "The Star" of 1893.

THEILER WITH HIS STAFF AT THE OLD DASPOORT LABORATORY.
There was no professional assistant at this time (about 1905).

Theiler had so impressed the authorities that a small laboratory was actually built and equipped for him at Daspoort, near Pretoria, where, as State Veterinarian to the Transvaal Republic, he ardently pursued his researches.

And then (October, 1899) the war broke out. Theiler, who held the rank of lieutenant in the Swiss army, enlisted with the Boer forces as an

DR. ARNOLD THEILER AS GOVERNMENT VETERINARY BACTERIOLOGIST IN 1908.

officer in the State artillery. He served the country of his adoption faithfully, but after the occupation of the greater part of the Transvaal by the British, Theiler realised that there was little left for him to do in the field and so he returned to Pretoria.

Theiler's reputation was now such that the British authorities were only too pleased to avail themselves of his services, and he was appointed Veterinary Bacteriologist to the government. In this capacity he served first under the "Milner regime" and later under the "Responsible Government" of General Botha. His laboratory at Daspoort soon became too small and so, in 1908 a large, well-equipped institute was erected at Onderstepoort at a cost of £80,000. Here Theiler worked until 1927, and indeed, after a break of some years, until April 1936, three months before his death.

As stated before, no attempt will be made here to review fully all Theiler's publications. All that will be done is to indicate the groups of subjects on which he worked and to make brief comments on each of these groups.

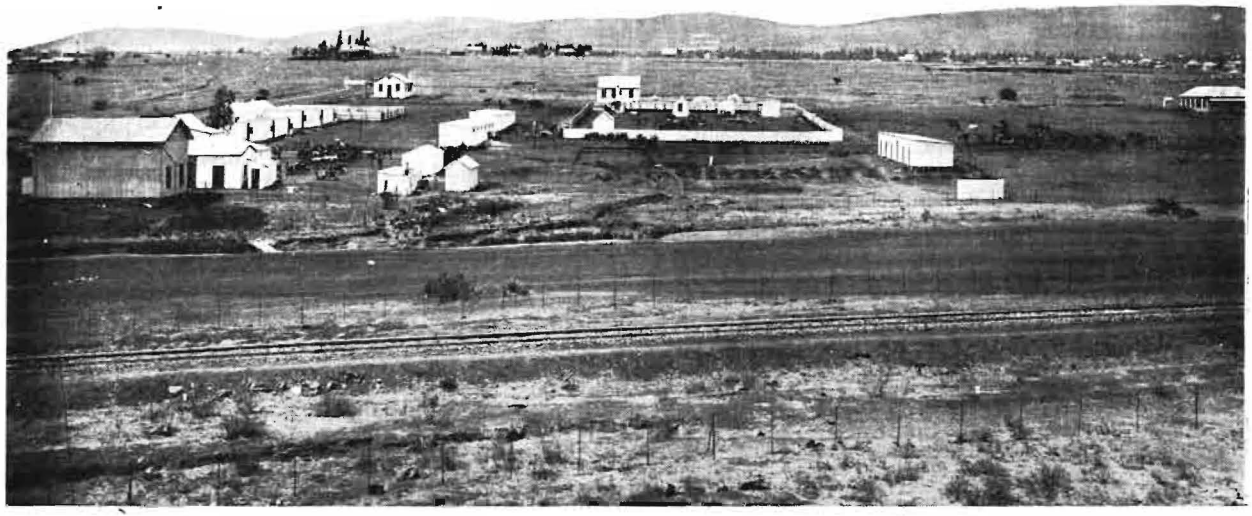
Theiler as a Protozoologist.

When Theiler commenced his work in South Africa, protozoology, at least veterinary protozoology, was in its infancy. The first piroplasms had only just been discovered in Roumania and the United States and their transmission by means of ticks was then being worked out by Smith and Kilborne in America. Trypanosomes had been discovered in India as the cause of surra, but nothing was known about the occurrence of this type of organism in other parts of the world, and the cause of nagana in animals and of sleeping sickness in man was still obscure. Nothing was known about the rôle of tsetse flies as transmitters of these parasites. Similarly, our knowledge of coccidia or of spirochaetes was very rudimentary.

In South Africa Theiler faced a position of almost complete ignorance in regard to this group of diseases. But it did not take him many years before he had unravelled all the main threads of this involved problem.

Amongst the *Piroplasma* (*Babesia*) diseases, redwater of cattle and biliary fever of horses were investigated by Theiler in his early days and their aetiology cleared up. The latter disease formed the subject of the thesis which he submitted to the University of Berne in 1901 for his doctor's degree.

No sooner had these two members of this group been elucidated when a new disease made its appearance in the North and threatened South Africa. At first there was some doubt whether this disease was merely a particularly virulent form of redwater or a separate entity. Koch, who at first regarded the two conditions as identical, later realized that he was dealing with a separate disease and called it East Coast fever. Theiler proved conclusively that this was so and first described the parasite (in 1904) under the name *Piroplasma parvum*. A few years later a new genus was created for this parasite which is now know as *Theileria parva*.



1. THEILER'S FIRST LABORATORY AT DASPOORT.

The large enclosure is where the Rinderpest serum cattle were kept. Behind the left corner of this is the *post-mortem* room. Left foreground: Main Laboratory. Left background (with trees: Theiler's house at Daspoort. In front of this, the small-pox vaccine laboratory.

In 1906 Theiler added a further very valuable contribution to this problem by distinguishing from the virulent parasite (*Theileria parva*) a harmless member of the group and describing it under the name *Piroplasma mutans*. Many years later (1928) Theiler himself (with Graf) showed that these two parasites had essentially the same mode of development and belonged to the same genus, thus abandoning a theory which he had held for a long time.

Theiler also carried out a vast amount of fundamental work on the transmission of these piroplasm diseases and established the vectors in many cases. He added a wealth of information to our knowledge of the biology of the ticks; many of the measures which are adopted to this day for the eradication of tick-borne diseases are based on the facts established by him.

In 1908 Theiler discovered the parasite causing "gallsickness" of cattle, and called it *Anaplasma marginale*. Prior to this discovery the aetiology of this disease had been obscure and many factors had been blamed for it. He also established the mode of transmission through ticks. Two years later he made the further important discovery that a variety of this parasite, *Anaplasma centrale*, caused a mild form of gallsickness and could be used to immunize cattle against the fatal disease. This method of immunization is now used in many countries. Theiler's conception of *Anaplasma* as a protozoan parasite has been subjected to heated criticism; many divergent views on the nature of this organism have been put forward. But after all these years of controversy it may be said that the weight of evidence is decidedly on the side of Theiler's original view, and that more and more investigators all over the world are agreeing with his opinion.

For the sake of convenience the Spirochaetae may also be mentioned here and it may be pointed out that Theiler was the first to discover the ubiquitous *Spirochaeta theileri* in the blood of cattle and other animals. He also demonstrated the transmission of these parasites through ticks.

In the field of trypanosomiasis Theiler also did pioneering work. In 1901 he gave a good description of Nagana in the various animals, and in 1902 he discovered the non-pathogenic trypanosome of cattle, *Trypanosoma theileri*, which has since been found practically all over the world.

Theiler's work on Virus Diseases.

Reference has already been made to horsesickness and rinderpest. A separate article in this Journal deals adequately with Theiler's share in the great fight against rinderpest. His publications form a valuable contribution to our knowledge of the epizootology, pathology and treatment of this disease. One point of interest in connexion with his work may be mentioned here: in looking for a method of preventive treatment

THREE STAGES IN THE EVOLUTION OF THE GREAT INSTITUTE FOUNDED BY THEILER.

2. ONDERSTEPOORT IN 1908 : A SINGLE BUILDING SURROUNDED BY THE BARE VELD.

Theiler had made a list of all the different organs and fluids he intended testing out. A number of unsuccessful experiments had been carried out and *bile* was the next item on his list, when the announcement was received that Koch had discovered the preventive properties of bile !

Horsesickness claimed a large proportion of Theiler's time and energy. He found it a tough problem : he buried his teeth in it and would not let go. He studied the disease from every possible angle and certainly succeeded in clearing up many of its phases, but there were others which he pursued as long as he lived. Theiler certainly knew the symptomatology and pathology of horsesickness as nobody else did. He also made a very careful study of the epizootology and the immunity problem and carried out innumerable experiments with the object of finding a satisfactory method of immunization. His labours in this connexion were not without their reward. He discovered a serum-virus method of immunization which, in the case of mules, gave very good results. (It has been said that if Theiler had done nothing else but given South Africa this method of treatment, his labours would have been worth while.) But in the case of horses the method was not so successful, although it undoubtedly saved the lives of thousands of animals. During the last few years of his life Theiler followed with great interest and satisfaction the progress that was being made in this field with the neurotropic mouse-brain vaccine; and it was a cause of considerable gratification to him that this progress had been possible by a discovery made by his son, Dr. Max Theiler (then of Harvard University, now of the Rockefeller Foundation, New York), when working on another disease (yellow fever of man).

There were two questions in connexion with horsesickness which Theiler tried very hard to answer. The one was : What insect transmits horsesickness ?; the other : Is there a virus reservoir apart from the horse ? To neither question did he find a final answer, and it is significant that to-day, in spite of extensive work, especially on the first-named problem, we are no nearer a solution.

Theiler's keen power of observation and deduction is demonstrated nowhere more clearly than in his horsesickness work. The intensive researches of recent years have proved him to have been right in all his major conclusions.

Very valuable contributions were also made by Theiler to the study of bluetongue in sheep. The disease had previously been described by Hutcheon, and Spreull had found a method a immunization by means of serum and virus. But Theiler was the first to prove the filterable nature of the virus and he discovered a very simple and effective method of vaccination which has been the salvation of many a sheep farmer. The work leading up to this discovery revealed an interesting feature of bluetongue virus : Theiler found that by simply subinoculating the virus from

sheep to sheep a gradual attenuation resulted—contrary to the behaviour of most other viruses. After about 10 or 12 generations it no longer caused mortality, and after about 40 generations it was sufficiently attenuated to be used as a vaccine with safety. Of this vaccine some 40 million doses have been used since its first introduction in 1907.

Other virus diseases which also claimed Theiler's attention are pleuro-pneumonia of cattle, "snotsiekte" of cattle, infectious anaemia of horses, ecthyma ("vuilbek") of sheep, and heartwater of ruminants. In regard to the last-named it should be mentioned that although the credit for having discovered a rickettsia as the cause of this disease undoubtedly goes to Cowdry, Theiler actually predicted this discovery on the grounds that heartwater bore a very close resemblance to Rocky Mountain spotted fever, another *Rickettsia* disease.

THREE STAGES IN THE EVOLUTION OF THE GREAT INSTITUTION FOUNDED BY THEILER.

3. ONDERSTEPOORT TO-DAY, SHOWING A FEW OF THE MANY ADDITIONS AND IMPROVEMENTS THAT HAVE BEEN MADE.

THEILER AS A BACTERIOLOGIST.

Although Theiler was an excellent bacteriologist he was never attracted to the bacterial diseases to the same extent as he was to the protozoal or virus diseases. In his earliest publications he records many

valuable observations on blackquarter, tuberculosis, glanders, anthrax, etc. Later he described an infectious foot disease in sheep, and also referred to the occurrence of bacillary necrosis in South Africa. Contagious abortion is another disease which interested him.

Theiler as a Toxicologist.

Theiler often referred jokingly to botany as his first love. He was indeed a very keen botanist and at various times collected plants extensively. His knowledge of pasture grasses was excellent. No wonder that he took a keen interest in those plants that caused poisoning in stock and his study of this interesting subject was amply rewarded.

In regard to several very important stock diseases he was able to prove one or more species of plants as the cause of the disease. He studied in great detail the relation between species of *Senecio* and " dunsiekte " of horses; between *Tribulus* and " geeldikkop " of sheep; between species of *Crotalaria* and " jaagsiekte " of horses; and between *Vangueria* and " gousiekte " of sheep. Apart from straightforward feeding experiments with these plants, Theiler was particularly interested in the pathological changes which their poisons produced in the animal body. In these studies he revealed himself as a very able pathologist—a phase of his work which is dealt with separately in a later section of this article.

But there were many other poisonous plants which Theiler investigated from time to time : The " tulps " (*Homeria* and *Moraea*), " gifblaar " (*Dichapetalum*), " slangkop " (*Urginea*), *Geigeria* as the cause of " vermeersiekte " and many other plants were studied by him.

He also co-operated with officers of the Botanical Division in searching for a solution to other problems which at the time were thought to depend on pasture conditions (*e.g.* the lamsiekte problem).

Theiler as a Helminthologist.

Theiler's early training in zoology rendered him eminently suitable to study helminthological problems. With his usual enthusiasm and thoroughness he devoted a whole year of study leave in Switzerland almost entirely to this subject.

The object of his earliest investigations was to determine the safe dose of arsenic, " Cooper's dip " and copper sulphate for sheep. These drugs were used fairly extensively for the treatment of wireworm and other worm infections, and so Theiler found it necessary to ascertain the exact proportion and quantity which would give the best results. He then applied this knowledge specifically to the treatment of wireworm (*Haemonchus contortus*) infection in sheep and thus laid a solid foundation for the method of treatment which was soon afterwards worked out

in detail by Veglia and Green. The Government Wireworm Remedy, which even to-day is frequently referred to as "Theiler's Remedy" became so popular that no less than approximately 264 million doses have been issued since 1917. A special building for the manufacture of this remedy had to be built some years ago.

But Theiler did not confine his attention to the treatment of worm infections: he studied the life history of the sheep parasites in considerable detail and added very valuable observations to our knowledge. He showed further his capabilities as a helminthologist when he published a very full account of the life history of the wireworm of the ostrich (*Trichostrongylus douglassii*).

THEILER AT WORK IN HIS LARORATORY SOON AFTER THE MOVE TO ONDERSTEPOORT.

The life cycle of the fowl nematode *Filaria gallinarum* was also worked out by Theiler. He showed that the parasite was transmitted by a termite (*Hodotermes pretoriensis*) on which the fowls feed. The termites become infested by ingesting the worm eggs contained in the droppings of the fowls, and these in turn become infected by eating the termites containing the worm larvae.

Theiler also studied the nodular worm infestion (*Oesophagostomum columbianum*) of sheep and devoted special attention to the pathological lesions caused by this destructive parasite.

Theiler's work on Deficiency Diseases.

Theiler's incursion into the field of deficiency diseases was brought about by his study of the cause of lamsiekte. This problem intrigued him greatly and he devoted much time and thought to its solution. Every avenue was explored in the hope of finding a way by which the heavy losses caused by this disease could be averted.

Lamsiekte had baffled many earlier investigators. Hutcheon, who was the first to describe and study this disease in a systematic manner, came to the conclusion that it was caused by a phosphorous deficiency. This conception seemed to offer a satisfactory explanation for some of the facts relating to the disease, but certainly not for all. Theiler was able

Sir Arnold Theiler Talking to Farmers after making a Post-mortem on an Animal in a Lamsiekte-stricken District (Vryburg, C.P.).

to prove conclusively that lamsiekte could not be regarded as a phosphorous deficiency. He proved further that it was not an infectious disease, nor a vitamin deficiency, nor connected directly with the soil. (Over 100 tons of soil were transported from one part of the country to another, to prove this latter point.) Together with Burtt Davy and other botanists, he examined in great detail the possibility of lamsiekte being caused by a plant poison : over 60 different plants were tested, some in great quantities, but it was found impossible to produce the disease in this way. Other ingenious theories were propounded to explain all the epizootological factors, but none seemed to offer a complete solution.

In 1917 Theiler, at the age of 50, weary of administrative troubles, decided to retire from the Government service. He left for Capetown to complete his scientific reports and his successor, Mr. R. E. Montgomery, took over control of Onderstepoort. At that time lamsiekte was particularly bad, and Montgomery advised the Government to persuade Theiler to undertake the special task of lamsiekte research. And so, early in 1918, Theiler took up his post of Director of Lamsiekte Research at the government farm Armoedsvlakte, near Vryburg in the Cape Province. With adequate facilities, he set about his task with determination and tested all the clues that had been found during the preceding years. One of these clues proved to be of particular interest, namely the habit of bone-chewing which is so prevalent in all areas where lamsiekte occurs. Experiments were carried out with bones collected on the veld, which were fed to cattle, and lo! the first artificial cases of lamsiekte were produced.

THE RESEARCH TEAM. THEILER, GREEN AND DU TOIT ENGAGED ON A LAMSIEKTE EXPERIMENT.

At no time did Theiler show more vividly his wonderful gift for grasping a problem in its entirety and seeing in a flash its complete solution, than when he had produced his first cases of lamsiekte. All the difficulties encountered in years of research seemed to vanish in a moment. A clear picture of the sequence of events in the development of this complicated disease appeared before Theiler's mind. He was able to explain the rôle of the soil (with its phosphorous deficiency), of the pasture (with the same deficiency), of bone-chewing, and of bonemeal-feeding (to correct that deficiency). He found the explanation for the paralysis (in the toxin contained in rotten bones and other carcase debris). He also

saw in a flash how the disease could be prevented, namely by clearing the farm of all debris which might contain the lamsiekte organisms and their toxin, and by feeding bonemeal to supply the deficient phosphorous and thus satisfy the craving for the rotten bones.

The country rejoiced over the solution of the lamsiekte problem and Parliament voted a fairly substantial sum of money to show its appreciation of Theiler's great service to South Africa.

But the solution of the lamsiekte problem was only the beginning of a long series of researches on the much wider problem of phosphorous deficiency in South Africa. In the lamsiekte experiments those animals which received bone-meal or other phosphorous components showed such remarkable improvement in comparison with the control animals receiving no phosphorous, that the advantages of phosphorous feeding immediately became apparent. A new field in the science of nutrition had been opened up by Theiler and his co-workers. It may be said that this work brought into being a new era for stock farmers in South Africa and many other countries.

The elucidation of dietetic errors and their rectification, important as it was, did not prove enough for Theiler. As a pathologist he had already noted the important changes in the skeleton associated with these conditions. His observations already clearly showed that the various animal species did not react in the same way to the same deficiencies, and furthermore that the generally accepted views in human pathology did not apply in every aspect to animals. When therefore the time came for his retirement in 1927 there had accumulated a lot of pathological material from these experimentsal cases. The study of this material (and subsequently accumulated material) occupied most of his time till his death. Reference to this work will be found in a later section.

Theiler as a Pathologist.

Theiler was as much at home in the post-mortem room and at the microscope as anywhere. Many of his pathological studies are connected with the lesions resulting from vegetable poisonings, of which diseases he investigated at length no fewer than four which in certain areas of country constituted major problems of stock-breeding. These were the dunsiekte-seneciosis, gousiekte, geeldikkop, and equine jagsiekte problems, which will be dealt with below. In addition he studied the pathology of acute liver atrophy and of the various types of nodules occurring in the lungs of horses, and made a unique contribution to the knowledge of bone pathology, as well as studying a number of smaller problems. Many of these contributions may be regarded as monumental in respect of the exhaustiveness with which they were carried out and the soundness of observations and conclusions drawn. The dignity of others is in no way marred by the erroneous deductions which he sometimes made from his observations.

Theiler's study of dunsiekte (1918) is one of the most unsatisfactory of his works in respect of the conclusions he reached. But one cannot help feeling that the reason for this is to ascribed to his over-conscientious evaluation of the observations made. Had he neglected the detailed histopathological examination, had he failed to take cognizance of the distaste which his experimental animals evinced for the senecio plants which were suspected as the cause, had he been (which he was not for a moment) willing to gloss over the significance of the difference between the liver cirrhosis characteristic of dunsiekte and the parenchymatous hepatitis which resulted from his feeding experiments with Senecio, he might well

A MEETING OF THE TRANSVAAL BIOLOGICAL SOCIETY IN 1908 AT ONDERSTEPOORT.
Theiler (seated on left) was the founder of the Society and was its President.

The Society was in 1916 amalgamated with the S.A. Ornithological Society to form the present S.A. Biological Society, of which Theiler remained the Hon. President until his death.

Seated (left to right) : Sir Arnold Theiler, Miss Leendertz, Mr. C. J. Swierstra.
Standing (left to right) : Mr. E. C. Chub, Dr. C. H. Andrews, Dr. John Hewitt.

have arrived at what is now generally believed to be the truth, *viz.*, that dunsiekte is nothing but chronic seneciosis. As a result of his observations he actually discarded the earlier conclusions of both Robertson (1906) and Verney (1911) to this effect. And it was not until thirteen years later that in actual published work (Steyn & de Kock, 1931) the justification of this attitude was queried, and until 1934 that Steyn expresses his definite conviction that dunsiekte is seneciosis. We now know that the refusal of stabled experimental horses to eat the plant is no sound criterion of the behaviour of horses towards the plant under certain conditions of pasturage; and also that the amounts fed by Theiler must be considered as very excessive and as fully accounting for the difference in degree of acuteness between the lesions he produced and those of dunsiekte: by daily feeding of about one-twentieth of the quantity of senecio used by Theiler, Steyn has since produced lesions identical with those of dunsiekte.

Theiler was the first to show that the symptom complex in sheep known as geeldikkop could be produced experimentally by the feeding of *Tribulus terrestris*. However, in the light of later results, we now know his conclusion "that *Tribulus terrestris* is the exclusive cause of geeldikkop" to have been a hasty one. After establishing in 1916 that the disease was not transmissible from animal to animal, he had to conduct repeated feeding experiments before the plant could be definitely incriminated. Many years before, Dixon (1894) had on account of negative feeding experiments discarded the then prevalent theory of the farmers that *Tribulus* was the cause. Theiler gave a good account of the symptoms and lesions of geeldikkop. He did not suspect that more than one principle derived from the plant was responsible for the train of symptoms; whereas now we know that both an icterogenic factor and phylloerythrin (derived from the chlorophyll) have their respective shares in the causation of the symptom complex, *i.e.*, being responsible for the yellow pigmentation resulting from damaged liver function and for the photosensitization respectively. Further, he was not in a position to realise that the latter, although responsible for the severest of the lesions, is actually to be regarded as a secondary factor following interference with the normal liver function, whereby phylloerythrin, normally confined within the "enterohepatic circulation" is "regurgitated" from the damaged liver into the hepatic blood and thence into the general circulation, thus causing sensitisation of superficial parts unprotected from the sun. Subsequent work has also shown that several other plants besides the dubbeltjedoorn can produce the same symptom complex, so that Theiler's identification of geeldikkop with *Tribulosis ovium* represented only a partial truth. In this connection it is somewhat surprising that although Theiler was well aware of Dixon's observations of outbreaks in midwinter, when frosts had destroyed all the *Tribulus*, he dismisses the difficulty without further comment and does not allow it to restrain the dogmatism of his conclusion

regarding the aetiology. This was nevertheless a fine piece of work on a problem whose experimental investigation was, and still is, beset with intense difficulties.

Jaagsiekte of horses was another disease in which an infectious cause had first to be excluded by transmission and contact experiments, more especially since, unlike most vegetable poisonings, it was characterised by what may be termed an incubation period, by fever, and by a peculiar symptomatology dependent on the lesions being more or less exclusively pulmonary in location. Following up the positive results of feeding to horses a sample taken from hay which was suspected to have produced jaagsiekte in the animals of several farmers who had used it, a botanical inspection (in conjunction with Dr. I. B. Pole-Evans) of the farm whence the hay had been reaped led to the recognition of the plant *Crotalaria dura,* first among the stubble and thereafter in the hay itself. The more extensive feeding experiments which were then undertaken, unlike what occurred in several of the other investigations, gave straightforward results and were not attended by difficulties : all animals fed a sufficient quantity of the plant developed typical jaagsiekte. All that remained was to give a full description of the symptomatology, pathological anatonmy and histopathology. The active principle concerned remains unknown to the present day.

In his comparative study of acute liver atrophy ("staggers") and parenchymatous hepatitis (experimental seneciosis) of horses (1918) it is obvious that Theiler was sorely beset with a double set of difficulties. In the first place the problem of the aetiology of staggers was bewildering in its complexity. He noticed at Onderstepoort and elsewhere a peculiar disease, somewhat terrifying in its violence, in horses which had undergone the immunisation against horsesickness. Much as he felt that in some way the disease was the result of the serum (or virus) employed, he found no escape from the difficulty that the disease did also appear, however less frequently, in animals which had not been treated with serum. He reported on 34 cases of staggers; of these 28 had received horsesickness serum and/or virus, 3 had been submitted to a dipping experiment, and the remaining 3 (not at Onderstepoort) had no significant history, but had not been immunised. Secondly, he kept the problems of seneciosis and dunsiekte in watertight compartments, mainly because, as has been explained, the liver lesions in these conditions did not correspond. Although this is one of the few studies in which he fails to reach definite conclusions, perhaps nowhere else has Theiler displayed more vividly his striking powers of observation and ingenious reasoning and his scientific caution. And although 18 years have elapsed since then, our definite knowledge of the aetiology of staggers has made no advance. Nevertheless most of us to-day believe that his belittling of the part played by the horsesickness factor and on the other hand his suspicion that a plant toxin was primarily concerned, were erroneous. Staggers is no longer

observed after horsesickness immunisation, the neurotropic virus method now being in use, and it seems probable, from unpublished experience outside South Africa, that not only horsesickness immunisation, but also serum antigenic against other infectious agents can produce the condition of equine staggers.

The disease gousiekte of sheep was investigated by Theiler conjointly with du Toit and Mitchell, their report being published in 1923. Investigation of this problem had been commenced by Walker in 1907. He undertook no botanical survey of the farms on which cases had occurred and, although he deals with the differential diagnosis of the disease from a number of other vegetable poisonings, accords the plant *Vangueria pygmaea*—now known to be the cause—no mention : indeed, he was not familiar with it. The following year Walker, after conducting negative feeding experiments with plants (among which *Vangueria* was not included) nevertheless reached the conclusion that the disease was due to some toxin under whose influence " the functions of the heart undergo certain physiological changes, *viz.*, insufficiency of the heart

SIR ARNOLD THEILER ON HIS DAILY ROUND OF INSPECTION. WITH HIM IS DR. H. GRAF, WITH WHOM HE WAS ASSOCIATED IN THE WELL-KNOWN "*Theileria mutans* OR *Gonderia mutans*" PROBLEM.

muscle, which induces circulatory disturbances." This was later to be proved quite accurate, and it is therefore surprising that no detailed examination of the myocardium, either macroscopically or microscopically, was at that time undertaken with a view to disclosing the organic basis of this cardiac insufficiency. Theiler and his co-workers were later to demonstrate the pathognomonic chronic myocarditis, on which to-day

routine diagnosis may be based in positive cases. Theiler heard of the gousiektebossie seven years later from a certain Mr. Strydom on whose farm a severe outbreak of the disease had occurred. In 1915-16 he commenced feeding experiments at Onderstepoort with *Vangueria* sent from a farm on which the disease was so rampant that 59% of 1,760 sheep had succumbed after grazing there for less than 24 hours. The results of this experiment were uniformly negative! The outcome of a similar experiment carried out with double the number of experimental animals the following year was similar. Undeterred by these results, these workers continued their feeding experiments in the season 1917-18, but with only inconclusive results. It was not until the season 1919-20 that the first convincing results were obtained by feeding *Vangueria*. It is almost incredible that, *with an initial list of 98 possible suspects,* a plant which season after season and also in the hands of an earlier worker had given entirely negative results should ultimately have been incriminated. And the problem did not end with this success, for it remained to show how the inconsistency of the toxicity of *Vangueria* was dependent on the individual susceptibility of the animals, on the locality in which it had grown, and possibly on climatic and meteorological influences.

One of Theiler's most extensive publications (pp. 154) and one which —perhaps because the intelligent perusal of it is a task of no small magnitude—is possibly the least well known is his study of "Nodes and Nodules in the Lungs of South African Equines." It contains a most exhaustive and minute account of the comparative appearance of the glanders nodule, the parasitic nodule, and other nodules, and a close discussion of the features on which, at autopsy, differential diagnosis is to be made. Some 570 nodules are described in detail, with comments on every one of them. This work required great patience as well as a complete mastery of pathological anatomy and histology. The campaign against glanders has long since resulted in the virtual disappearance from South Africa of this previously important disease: the control measures could not have been undertaken with any easy conscience in the absence of the accurate information made available by this work.

Theiler's work on the pathology of bone diseases occupied most of his time after his retiral in 1927. The histopathological aspect of this study, which took him two years to complete, is contained in a 4to monograph of 150 pages entitled "*Untersuchungen über den Bau normales und durch calcium- und phosphorarme Nahrung veränderter Rinderknochen.*" Most of this work was accomplished in Lucerne, his colleagues at Onderstepoort co-operating with him by forwarding to him the material which formed the basis of his investigations. He was grateful for "the help that assisted me to what I hope will be of some use to my country."

It is typical of his thoroughness that he first undertook a detailed study of the normal development of bone in cattle. Then only did he feel

confident to examine and interpret the changes found in diseased bone. His work was hailed throughout the scientific world as most authoritative and complete. Yet he appears to have been not altogether satisfied with it himself, for he writes : " I have been very long with the preparation and publication of my article, and now it has appeared I am somewhat disappointed. I feel I could have made a better job of it."

This work, besides being an important contribution to our knowledge of normal bone structure and development, enabled him to follow the pathogenesis of certain dietetic deficiencies, and by correlating this with the aetiology, to arrive at a clear conception of this hitherto somewhat misunderstood group of diseases. In the first place, it was not at that time generally appreciated that more than one causal factor, *e.g.*, lack of phosphorous or of Vitamin D or fluorine poisoning, could give rise to the same pathological lesion; and, secondly, it was not generally accepted that one set of aetiological factors could be responsible for pathologically different lesions in animals of different species.

Unlike in other diseases, then, it became apparent that the aetiology could not be taken as the basis of nomenclature. The only satisfactory means of distinction was thus on histopathological grounds. Accordingly Theiler came to recognise three histologically distinct changes in bone :—

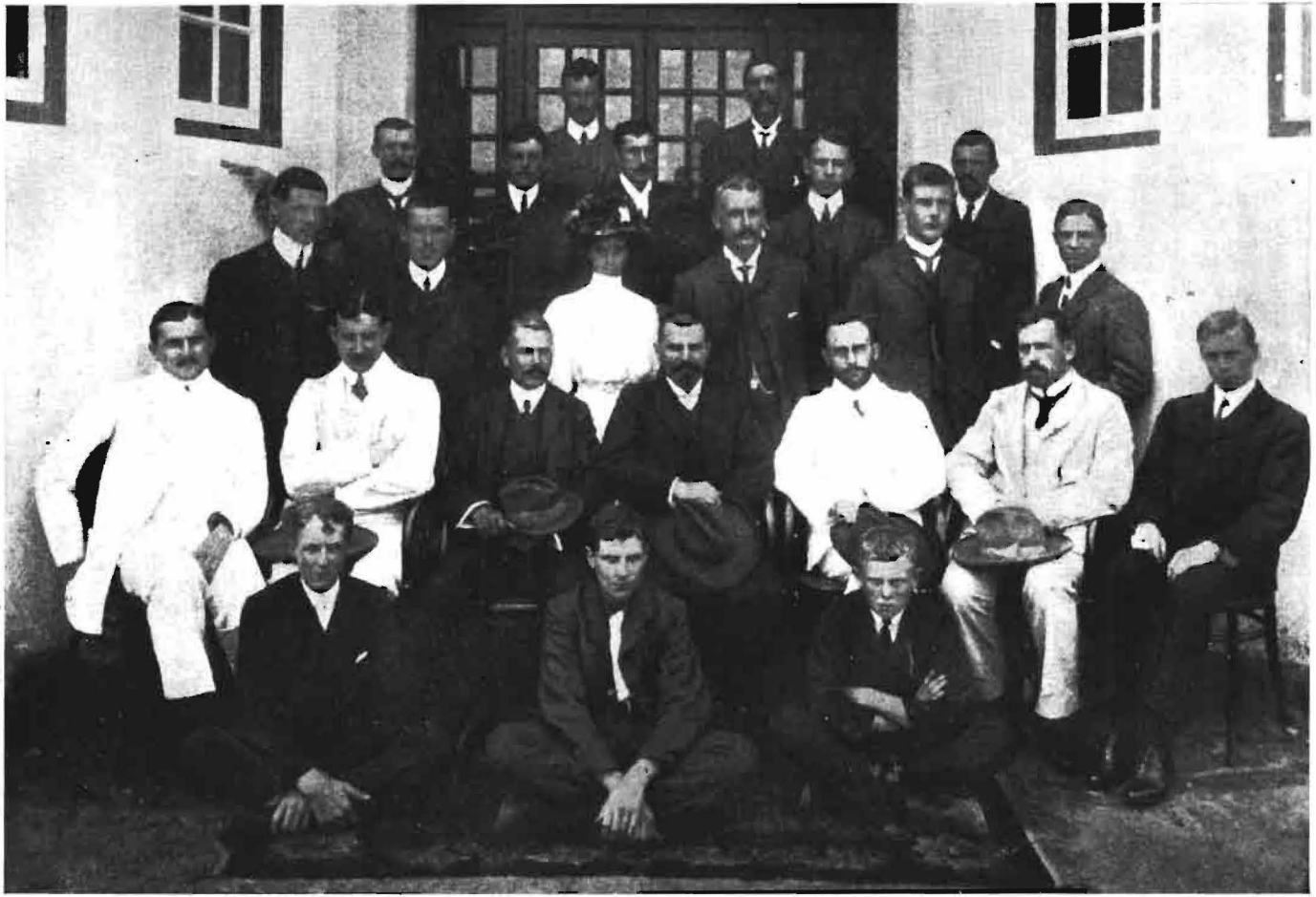
(1) *Osteoporosis* or advanced bone atrophy : a wasting away of bony tissue attendant on nearly every form of malnutrition, including those which are the causes of the next two conditions.

(2) *Osteomalacia* (including rickets) : a condition in which a superabundance of bony tissue is formed, but fails, however, to calcify and therefore remains soft. This may be caused by calcium deficiency or by Vitamin D deficiency.

(3) *Osteodystrophia fibrosa* or osteofibrosis : a substitution of bone by fibrous tissue whose cause is in some animals associated with calcium deficiency.

All these three conditions essentially involve a softening or increased brittleness of the bones, while the latter two involve also enlargement and swelling. It is easy to see, therefore, how they can be and have been confused clinically, as indicated by the multiplicity of more popular terms which are used to describe them. Nor was the general confusion improved by attempts to interpret skeletal changes in animals in terms of similar pathological conditions known in man, *e.g.* rarefying ostitis, halisteresis ostium, etc.

In spite of all that has been written about bone and its diseases, Theiler began at the beginning, content—as indeed he always had been—to accept nothing without first-hand investigation. Conscious of his failing energies at this stage of his studies of bone, Theiler wrote : " I am so anxious that Onderstepoort should contribute to the solution of the



THE STAFF AT THE OPENING OF THE INSTITUTE AT ONDERSTEPOORT IN 1908.

dystrophia in horses and take the lead again "—a hope that was and is still being fulfilled. But however many aspects of this complex study may still remain to be elucidated, it is evident that Theiler effectively broke the back of the problem and brought clarity where previously chaos had reigned.

Theiler as a Teacher.

The early struggle which Theiler himself experienced in becoming acquainted with the veterinary conditions peculiar to South Africa made him very conscious of the inadequacy of oversea training for the task of coping with them. Referring to his impressions of a colleague visiting Onderstepoort from Europe, he writes : " I realised once again how much the oversea veterinarian is out of touch with our problems, and although they may have a thorough grip of veterinary science as applicable to their own country, it sometimes seems to me almost hopeless when I realise how little they know of our own conditions. There is no doubt about it that we have our own veterinary science, and in this respect South Africa is undoubtedly unique."

The Government agreed with Theiler's view and following a favourable report by a state commission, he was in 1918 entrusted with the establishment of veterinary education at Onderstepoort. At that time he was still at Armoedsvlakte engaged on his lamsiekte problems. But without wasting any time he gathered round him in the evenings those of his colleagues who were assisting him in this work and together they drew up for the five-year course the syllabuses which still form the basis of the teaching to-day.

The constitution of the Faculty of Veterinary Science was probably something entirely novel in the history of university institutions. Theiler's idea was to make use of the existing staff of the Onderstepoort Veterinary Research Institute for teaching purposes. By dividing the work between a comparatively large number of people, nobody would be overburdened with lectures and all would still have time for research. Further, it would be possible to have a specialist for each subject. Onderstepoort thus became a dual institution : it formed a part of the Department of Agriculture with a staff composed of full-time state officials appointed as research officers. At the same time selected men from that staff received appointments from the Minister of Education and became professors or lecturers in the University.

It was Theiler's firm belief that Onderstepoort was eminently suitable as the seat of veterinary education, for it was his ideal that the students should share in the scientific activities and outlook of active research workers. This view is upheld in a letter which reaches us while this is being written, in which an educationalist in another sphere says : " Unless my pupils are both competent and industrious, I don't much care what

happens to them. If they are both, I can hardly do better than share my difficulties and interests with them."

How successful this policy proved is shown by the fact that when, in 1926, the first of a series of conferences on veterinary medicine to be held in the Dominions was announced, *The Times* commented on its taking place in South Africa, " where the special training of veterinary officers is carried out on lines that may well serve as a model for the whole Empire." Theiler rightly took this as a high tribute to his personal efforts.

The Faculty of Veterinary Science, now attached to the University of Pretoria, enrolled its first students sixteen years ago, the teaching being in the hands of Theiler (as Dean and Professor of Tropical Diseases) and of selected members of his staff.

THE " OLD MAN " WITH HIS STUDENTS AT A CLINIC IN 1926, THE LAST YEAR IN WHICH HE TAUGHT AT ONDERSTEPOORT.

The education of his students became a hobby very dear to his heart. He seemed to feel personally responsible for every one of the little band that each year would follow him on his clinical rounds, both during the period of their studies and after they had qualified. He would brook no injustice to them and was a jealous guardian of their rights and their prospects. Austere of character as he often appeared to be, he was soft-hearted towards his students, although demanding a high standard from them and very proud when they came up to his expectations . On one occasion he writes : " Last week we had a Faculty meeting with particular reference to the third year students who had failed in certain subjects . . . We had a lively discussion and the ' big guns ' were in favour of failing the students, which action would probably have been the best thing, but as I have such a natural aversion to failing anybody who shows good will, I was eventually able to get my own point of view through and to allow them to go on with their fourth year course on the understanding that they would take their exam. again in the middle of the year. I hope for my sake there will not be another failure." His hopes were not dis-

appointed. The students responded to the trust he placed in them, so that six months later he is able to record, with obvious satisfaction, that they "sat again, and this time were successful. There was no stretching of points, they knew their business and I have no doubt they have been working well to get this nightmare over. They have now a clean sheet for the future." On another occasion he writes: "I am very pleased with the fifth year students. They all had cases of East Coast fever which they were able to diagnose, and I felt really the reward of constantly drilling into them the essential facts about East Coast fever."

Theiler fought many a battle on behalf of his students. Some of these the young men were aware of and appreciated; of others they probably remain in ignorance up to the present day. In veterinary education Theiler was on one occasion confronted by a problem peculiar to this country. Regarding an application by the Transkeian Native Council for two natives to be trained in veterinary science for work in their own territory, he writes characteristically: "The resolution is interesting from the point of view of the present trend of ideas, and South Africa will have to face the problem sooner or later, since by law all races are equal, and I do not see how the native can be rightfully prevented from qualifying. If he should go overseas, there would be no difficulty in obtaining his diploma, and it would not seem just to prevent his practising on his return to the Union. Anyway, it is a problem for the politicians to solve." This was ten years ago, and of course the politicians are still solving it.

In class Theiler often used his ready wit to revive flagging attentions and to afford relief from the tedium of serious concentration. The device still to-day in use by the Onderstepoort Hostel as a badge was inspired by his well-known saying: "No good veterinarian should ever be parted from his bible, his corkscrew, and his plexímeter." On one occasion Theiler asked his students how they were getting on in pathology and one of them told him frankly that he had been lecturing far above their heads. Sir Arnold retorted, "Then there is still hope of your becoming pathologists." A lady student once excused herself for not having her percussion hammer with her at a clinical examination by explaining that she had nowhere to carry the instrument. Sir Arnold was very ready with a suggested solution of her problem, which if it might have lacked modesty was none the less efficient.

An intimate impression of Theiler as a teacher is given by one of his former students, who writes for us as follows:—

> Twelve years ago, eight of us waited for a first lecture from Sir Arnold. We were apprehensive, for our predecessors had told us much about the "Old Man" and had minimized little in the telling. We had seen students who formerly had been college drones turn into industrious workers. Thus, waiting in the tiled and rather austere post-mortem room, we felt depressed and a little worried.

Sir Arnold came in and looked at us quizzically and rather owlishly over the top of his spectacles. " Gentlemen," he said, " we will begin." The lecture seemed over in a flash and in that hour I think the " Old Man " captured the imagination of every one of us. This, we felt, is a man who has done and thought and speaks from a ripe knowledge. But, although we never had to revise this first impression, we realised soon enough that he was too big to be measured after one or two lectures.

That one hour each day meant much to us students. I do not remember one period that was tedious, for Sir Arnold had his fingers on the pulse of the class and he knew even before we did when we had had enough and when the interest of the class could best be stimulated by an anecdote that gave point and memorability to the subject. Somehow he could make part of his experience ours, so that in later years, when confronted by a problem, we did not feel altogether raw and callow, but found unrealized resources on which to draw. Only later did we realize how much knowledge we had unconsciously assimilated during many days of patient teaching. We knew as students that we were privileged to listen to a great teacher, but we had not then the measure of experience that was to enable us to appreciate the debt. Sometimes we wondered who could replace him in time to come, for I think all who knew him realized that such teaching ability is not given to everyone and that such men are not replaceable at will.

To his students, Sir Arnold was considerate and kindly; and they, in their turn, were very fond of him, apart from the respect his personality and fame commanded. His infectious laughter and pawky wit will be remembered as long as the students he taught still live; and I am not sure, but possibly the stories will be passed on to another generation.

He knew better than any that example is better than precept and although almost his first words to us were, " Gentlemen, there is no such excuse as ' I had no time ': you must make time," yet his attitude was tempered by an understanding of each student's capabilities. He never drove, he led : he did not lecture, he taught.

Theiler's Other Activities : His Travels and His Later Years.

The foregoing pages should convince those who did not know Theiler personally that he led a very busy life. His researches had to be accomplished in hours snatched from the heavy demands of administrative and routine duties, which often caused him much worry and not seldom disheartened and depressed him, although never for very long.

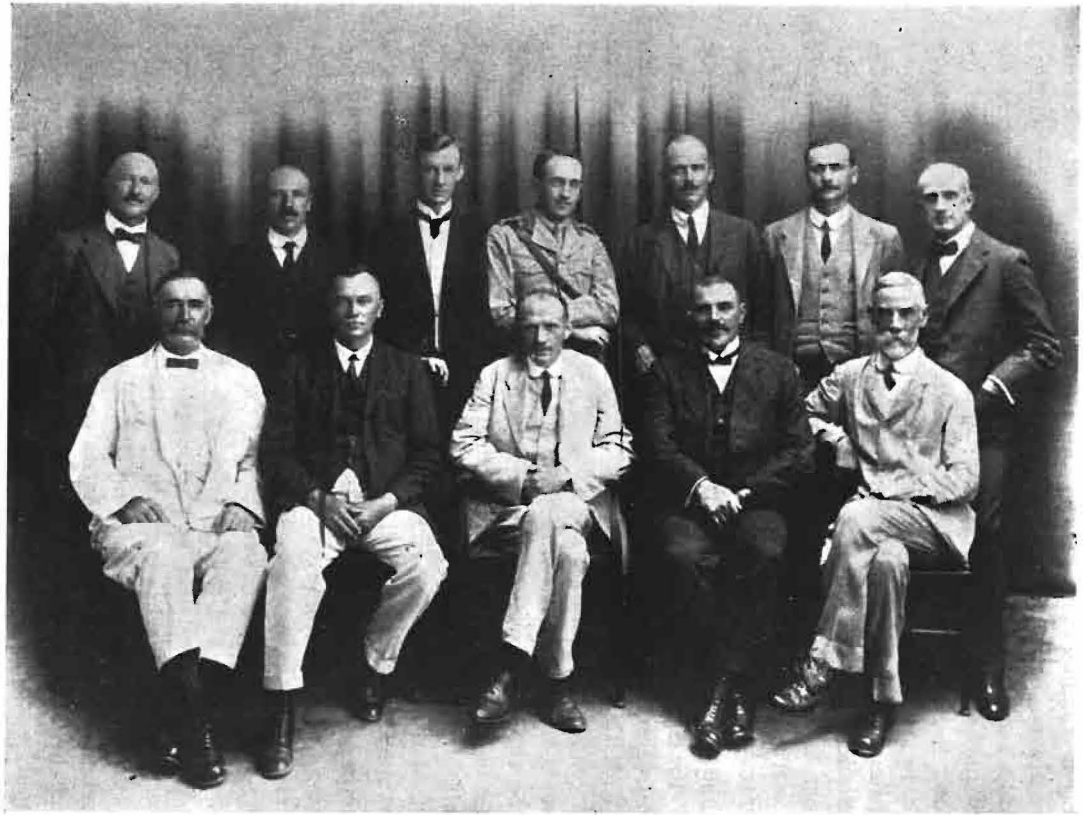
Almost daily he would find himself on the defensive against threatened encroachments of financial considerations or matters of departmental

policy on the activities of Onderstepoort or the welfare of his staff. Thus he writes : " In South Africa, unfortunately, politics in science have at times played a considerable rôle, and at times have been made use of for certain purposes." And again : " It is a sad state of affairs if economy has to begin on trivial expenditure like that (referring to the difficulties of obtaining funds to publish the results of the researches at Onderstepoort, owing to financial stringency) but scientific reports and scientific people have always been fair game for Treasury and Audit." Regarding a threatened curtailment of the privileges of his staff, he expresses his intention of putting in " a very strong protest, demanding the right for Onderstepoort to be outside general arrangements by reason of the nature of its work, by its tradition, by its standing in the scientific world, and the outstanding success that it has made in the Department and in South Africa. I would also go strongly on the lines that Onderstepoort has the right to have its own way and that the psychology of scientific workers should not have to give way to the general machine-like way of working of the Treasury, the Auditor-General, and the Department."

Referring to a proposal that an Imperial Committee should be established to co-ordinate the work of various institutes, Theiler puts forward an interesting point of view when he writes : " Personally, I do not agree with the point of view that there should be co-ordination of work to prevent overlapping. I am more of the idea that the more duplication there is of the same work, the better it will be. If the results happen to be the same, well and good : then it can be accepted that the statements and conclusions are correct. If they happen to differ, then further enquiries can be made to see why they do differ; and above all, some competition is necessary, even in the scientific world. Where there is no competition, there is to my mind very little progress."

Theiler personally supervised the never-ending job of preparing the horse-sickness and bluetongue vaccines. At times there would be insufficient to meet unexpectedly heavy demands from the farmers; at others, a safe margin would be aimed at only to find that there would be insufficient storage accommodation at the Laboratory for the huge quantities of sera. In some seasons the incidence of the dreaded equine staggers, in some obscure way connected with the immunisation, but yet not exclusively resulting from it, would be so alarming that the issue of the vaccine would have to be stopped. In other seasons no reports of staggers would come in : the mortality would be concealed by the farmers lest the issue of the vaccine should be stopped; for they wanted above all to save their animals from horse-sickness.

It should also be remembered that Theiler did not spend all these years uninterruptedly in his laboratory. He was called upon to travel about the country a great deal, to address farmers' meetings, give lectures, attend conferences, serve on commissions, and perform a hundred other duties.



INFLUENZA EPIDEMIC COMMISSION, 1918.

Seated (left to right) : Mr. C. R. Grobler (ex Administrator, O.F.S.), the late Mr. Nicholson (ex Mayor of Durban), Mr. Paul Cluver (Chairman), the late Sir Arnold Theiler, the late Dr. Samuel Evans.

Standing (left to right) : The late Mr. Hilton (Asst. Secretary), Mr. M. G. Nicholson (Town Clerk, Pretoria), Mr. A. Stuart (Secretary), Col A. J. Orenstein, C.M.G., Mr. Alpheus Williams, Commandant Hamman, the late Dr. Hugh Smith.

Like the War at the close of which it visited this country, the influenza epidemic of eighteen years ago is to-day seldom remembered. Through this terrible scourge, which took toll of some 140,000 lives and prostrated about 2½ million individuals with illness, South Africa experienced privations and terror such as in the War her civilian population had largely escaped. For the second time Theiler's services were requisitioned to combat a danger to the human population. The Government appointed an Influenza Epidemic Commission which consisted of seven laymen, two medical men (Col. A. J. Orenstein and Dr. Hugh Smith) and Sir Arnold Theiler, under the chairmanship of Mr. Paul Cluver and with Mr. A. Stuart as secretary. The Commission, whose appointment was gazetted on the 3rd December, 1918, lost no time in getting to work, actually commencing its sittings two days thereafter. The energy with which the Commission worked, visiting all the important towns in the Union, can be judged from the fact that in two months' time its report was ready for presentation to the Governor-General (Lord Buxton).

Theiler played a dominating rôle in the deliberations of the Commission. His penetrating judgment and characteristic directness were much in evidence in the examination of the two hundred witnesses who were heard. Although, fortunately, the necessity was not to arise of applying its recommendations to a similar emergency, the report of the Commission was to have a considerable influence on the organisation of public health in South Africa. Theiler's influence in the drafting of the report is, to those who knew him, obvious from a perusal. The report, in effect, indicted as inadequate the elementary conception of the strength and organisation of the Public Health Department with which, up till that time, the country had been content. It made far-reaching recommendations regarding a variety of services; from telephones and education to medical research. The lack of co-operation between two Institutes with such kindred aims as the South African Institute for Medical Research and the Onderstepoort Veterinary Research Laboratory was (politely) condemned.

Instead of pursuing a chimerical panacea for the evil which the country had suffered, the Commission rightly stressed the need of recognising the fundamental realities of the problem. The "magic wand" which no one more than Theiler was always expected to have ready to wave over the ailments of man or his animals was dismissed as a phantasy : the remedy lay in research, education, organisation, and hygiene.

The report hastened the enactment of the Public Health Act of 1919 and had much influence on the provisions whereby the country to-day enjoys the protection of a Department which, compared with its state at the time of the epidemic, is relatively well-staffed, and live and up-to-date.

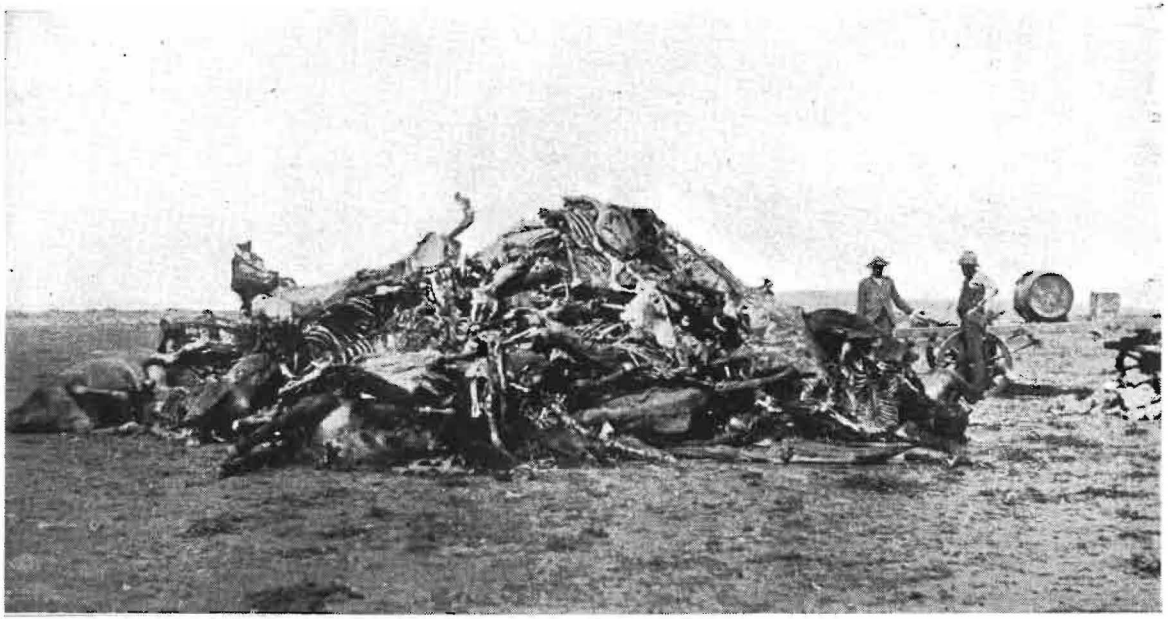
Theiler also recognised the necessity of keeping in touch with oversea scientists and their work. He attended all the international veteri-

RESIGNATION! A PATHETIC SCENE IN THE RINDERPEST EPIDEMIC OF 1896–7.

nary conferences held in this century. In 1905 he took an active part in the Eighth Conference in Budapest, and in 1909 in the Ninth at The Hague. He was not present at the opening of the ill-fated Tenth Congress in London on the 1st August, 1914; but at the very successful Eleventh Congress held in London in 1930 he was one of the vice-presidents, and the same honour was bestowed on him at the Twelfth Congress in New York in 1934. At all these congresses he created a deep impression with his forceful personality, his deep knowledge of his subject and his remarkable ability as a linguist. For, although always most at home in his native Swiss dialect, he was fluent in at least five European languages and had a working knowledge of several others. It must not be thought, however, that Theiler was an English stylist; yet, characteristically enough, he often used a wrong expression with unmistakable clarity of meaning and with ten times the force that an Englishman might have used the right one. And to his writings, however deficient in syntax, the orderliness of his thought lends a dignity and a clarity that many a better stylist fails to achieve.

Apart from attending these conferences, Theiler spent a year overseas in 1912-13 and again in 1920-21. On both occasions he devoted practically all his time to the study of some particular subject and generally to bring his knowledge up to date. The latter trip was a particularly busy one and he felt the strain of it. Thus he writes from Berne in 1920 : " I attend the courses regularly and take in as much as will go in. I am, however, no longer so young to stand all this great effort without it leaving some mark on me.' ' But little more than a week later his spirits improve : " I am still enjoying my stay and am decidedly taking in quite a lot. Since all may day is fully occupied I have not yet had any time to think anything else except my work." Theiler always "thought his work," not "of his work" as most of us do ! This attitude was one of the secrets of his success.

Christmas, 1921, brought some welcome relaxation from this strenuous time to Theiler and the colleagues who were with him. From Engelberg he writes in one of his happiest and most kindly moods : " The crowd of ten are enjoying themselves properly, indoor and outdoor, and may decidedly be called a merry lot. So far the snow has been ample and there was good occasion for skiing, toboganing and skating. There was plenty of tumbling and summersaulting and some of the young people were more often on their heads than on their feet, or hidden in the deep snow. Gradually, however, things are improving and progress has been remarkable in all lines of sport. Some talk already of becoming *experts.* Can't get away from that word ! Anyhow we hope to stay here some time and then return fresh in mind and bruised in body to our work. This [subject] of course is at present taboo ! " But the holiday had been too good for the party and early in the New Year Theiler has to confess :



RINDERPEST, 1896.—COLLECTING CARCASSES FOR DESTRUCTION.

" Our lectures have commenced again, but I regret to say we still feel the bad effect of our holidays in our bones and are very reluctant on a morning to rise. I hope, however, that we shall get over this weakness."

Theiler again went overseas in 1923, when he attended an international Dairy Congress in America and travelled through the States. On this occasion he completed a tour round the world, visiting many scientific institutions in the Far East.

His later travels fell in the period after his retiral in 1927, in which year he went to Europe and studied at Basle; and shortly after this the Australian Government asked him to visit that country and advise them on nutritional and other stock problems. How young at heart he was, and how full of energy and confidence at the age of sixty, is shown by his writing from Basle : " I am attending the p.m. diagnoses, the conferences and the demonstrations and I see that I am learning daily"; and still more by his description of the interview which preceded his Australian oppointment : " To the question whether I would place my services at the disposal of the Colonial Office I replied in the affirmative. Asked whether I was prepared to go again into the Colonies, I assented by stating that I was prepared to go anywhere and to undertake any research so long as I could see that my services would be useful."

Theiler much enjoyed his stay in Australia, writing from Melbourne : " People here are very enthusiastic . . . I have been able to raise interest everywhere. My time has been well spent and I have made myself well acquainted with all the problems. I received the hospitality of a prince, at times almost embarrassing, and I have learned to like the Australians. I have seen the finest sheep in Australia and I have gone out of my way to understand wool and the problems associated with it. An interesting subject with great possibilities of research in various directions."

After this he settled down for a number of years in Lucerne. Here he had large apartments which allowed him to continue his osteological researches without leaving his home; for the climate of Switzerland was bothering him and he was longing for his sunny haunts in South Africa : " I returned . . . with a bad cold and out of sorts. When I am not too well then I am getting homesick, *viz.*, for South Africa. In only begin to realise now that that warm country has a very warm spot in my heart ! " Again he writes : " It is our . . . hope to come back one day and it is even my wish to die in the country in which I have worked for so long and for which I have given the best of my life." In Lucerne he broke the back of the very difficult problems he encountered in bone pathology : " The histology of bone is such a difficult thing that I understand why so few people ever tackle it . . . I think, however, I have mastered it, and now I find it even fascinating." His home in Lucerne became the Mecca of his former pupils and associates from South Africa. These " brought a bit of African sunshine into our dreary October weather."

But Lucerne did not altogether satisfy his requirements and ambitions, and during this period he spent several winters in Florence and Rome, where he developed his great love of painting and architecture. The latter seemed to much bound up in his mind with the study of the structure of bone, to describe certain features of which he was often wont to employ architectural terms. He also visited Spain and Tunis and Algiers.

Some of his descriptions of these journeys make interesting reading :

" We had an excellent time in North Africa. We were pleasantly surprised to see that this country is so well developed and we had to change our opinion about the capability of the French as colonisers. I am sure North Africa could give tips to South Africa in road-building, in hotel construction and in agriculture. Of course we were there in spring, when everything was nice and green. What struck us was the enormous extent of ground under cultivation and in regions that have a low rainfall and otherwise look bare and dry. It is a winter-rain country and that accounts probably for the successful cultivation of wheat and barley. Both in Tunis and Algiers much wine is grown, which to taste I had plenty of opportunities. I saw near Alger the most modern installation for the production of wine. The country looks in many parts much like South Africa. The wheat-fields and vineyards remind one of the Western Province and when you enter the so-called desert you fancy to be somewhere in the Karroo. Even table mountains and many kopjes are seen in many places. Cattle, however, are very inferior. It being the end of winter, they were naturally very poor. The sheep also are of a low breed. It was only in Tunis that I saw fat-tailed sheep; they bear wool. They are absent in Algiers . . . where a kind of wool sheep is kept. The wool is of a very coarse quality. It is mostly locally consumed for the manufacture of carpets of which the Arabs use a lot and have developed an industry. Horses, too, are generally a poor lot. I saw nowhere the fiery Arab ! They resemble much our South African ponies. I was struck by the relative smallness of these animals and I could not help thinking that phosphorous deficiency is probably also at the root of it, assisted like in South Africa by a generally dry climate. I could, however, nowhere see any cattle chewing bones. There were no bones to be seen either. Arabs kill their animals when *in extremis* and consume them. North Africa has no rain during the summer. The rains had just stopped when we were there. The shepherds roam about with their herds for grazing. This and the fact that the ground is cut up into small-holdings makes it difficult to develop an animal industry on modern ideas. However, the Arabs do not seem to require much; their wants seem to be easily satisfied. They seem to have adapted themselves, like their animals, to minimum requirements. The fact is that, as at one time used to be the case in the Transvaal, there is very little milk to be had and no fresh butter. The beef was tough and scarce. The mutton was somewhat better and more plentiful. It seems to be the meat of the Arabs. We were fed with much *poulet au ris,* sometimes

twice a day, but they were no spring chickens. We enjoyed only the lamb and on the coast the sole, but of the latter I had so much that I was in fear I might grow scales. You know what are the difficulties in Northern Africa with *l'elévage du bétail*. Like with us at one time, there are many diseases, many of which wait for investigation. Cattle suffer much from piroplasmoses, and foot-and-mouth disease seems to be endemic, as well as pox in sheep. Horses are said to be free of pests. There is said to be no glanders. The veterinarian seems to be appreciated by the Arabs mainly on account of his surgical skill and the success in the prevention of sheep pox by vaccination. There is a veterinary organisation to assist the farmer against disease and to advise him on the nutrition and breeding of animals . . . Where diseases are overcome and a constant supply of

THE HOUSE AT ONDERSTEPOORT IN WHICH THEILER LIVED FOR 16 YEARS.

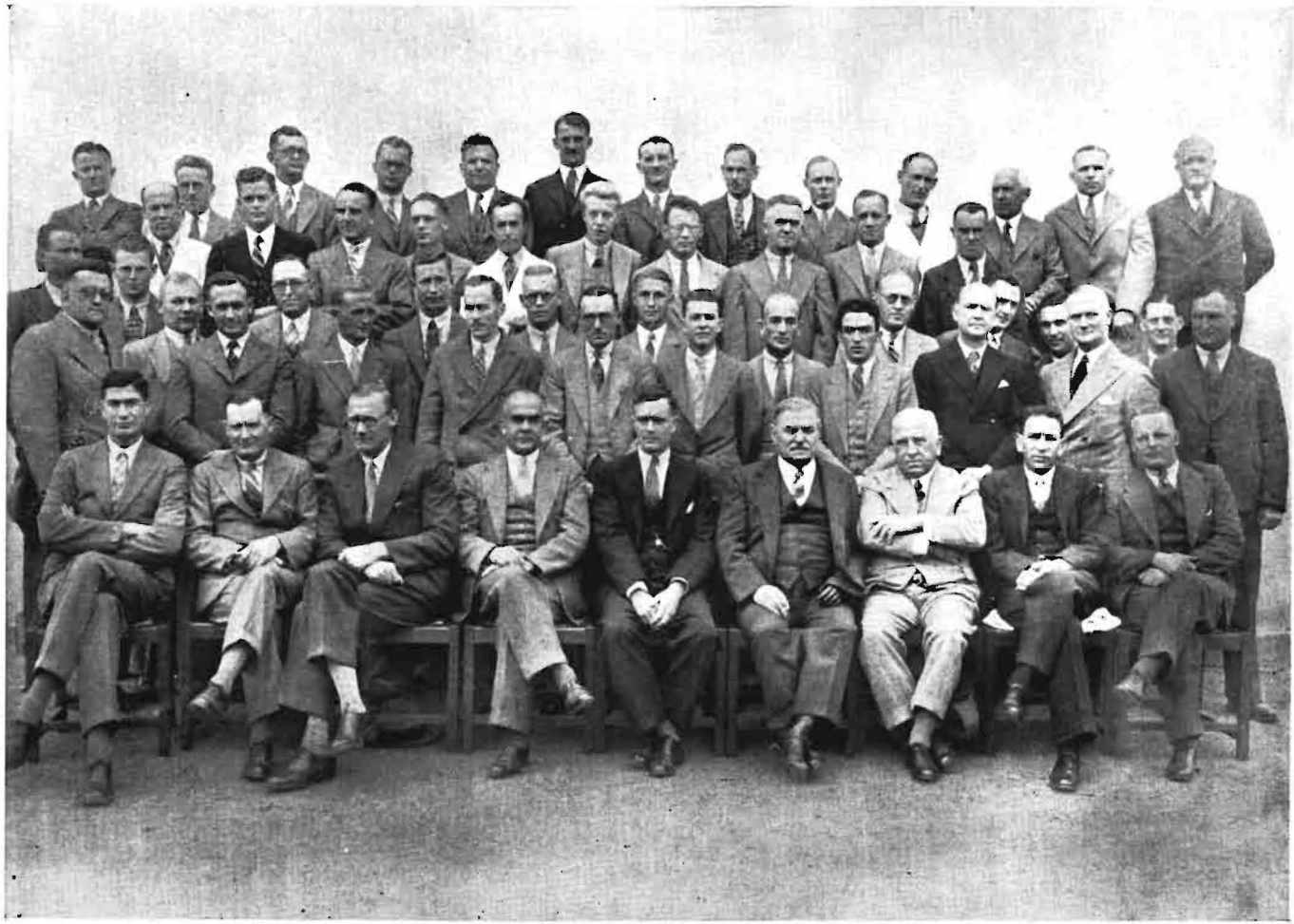
food is assured, European cattle are doing well. I saw in Morocco pastures of Kikuyo and Rhodes grass, originating from South Africa, doing very well indeed and the farmer who keeps Swiss Brown and Friesland cattle speaks highly of it. The difficulty with the European cattle lies in the necessity of their premunition against four piroplasmoses : *B. berbera, P. bigemimum, Th. dispar* and *A. marginale*. With the exception of the anaplasmosis, satisfactory methods were evolved. *Th. dispar* is premunised by a strain that has been transmitted through a number of generations and has become a fixed virus. The blood is not taken from an immune animal, but from one that has an acute attack produced with blood from a previous acute attack and the virus is kept going all through the year by subinoculations. They had no method against anaplasmosis that was

reliable and this disease did a great amount of damage. It is now hoped that with *A. centrale* also this difficulty will be overcome. In the Institute at Alger I saw two cases of *Th. dispar* produced by subinoculations. What struck me was a marked reaction of the lymphatic vessels leading away from the place of injection to the nearest lymph gland; which always swells first, the others following later. Donatien tells me that the same observation is made after tick-infestation. I do not remember having ever seen a similar occurrence in our East Coast fever. It would be worth while to follow it up . . . *Th. dispar* is transmitted by the *Hyalomma mauritanicum,* a stable or kraal tick, and that accounts for the peculiar epizootology of this disease, which appears at an almost definite period of the year, about June, when the adults emerge from their nymphal shells; the larvae and numphae having engorged the previous year on immune cattle and remaining dormant all through the winter . . . In Morocco Velu showed me a most peculiar condition in the teeth of animals and also in men living in a region where rock phosphates are exploited. It is known under the name of ' Darmouse.' It is an affection of the enamel, which becomes eroded, so that the teeth become blunt and discoloured; small pits and holes are formed; finally the dentine is exposed. It decays and the tooth falls to pieces. Sometimes all the teeth are attacked, often, however, only a few. Incisors and molars, permanent and milk teeth are subject to ' darmouse ' while an animal lives in the region. When previous to dentition it is removed outside the region, the teeth that are formed remain normal after its return. Velu has produced the condition in sheep by supplying them drinking water in which pieces of rock phosphate were placed. In donkeys I saw associated with ' darmouse ' a swelling of the mandible and in one case of the maxilla. This case looked like one of osteofibrosis . . . Velu does not think that fluorine is the cause as might be expected. He failed to produce it with fluorine. Whilst in Morocco I learned that much use is made of our wireworm formula . . . In looking into sheep parasites of Morocco I learned that Oesophagostomum is absent. I was struck by this fact; because in Australia I missed *O. columbianum* also in the region of winter rain, whilst it was plentiful in New South Wales and Queensland, regions of summer rain. We have never given in South Africa any attention to the climatic distribution of this parasite. It would be worth while to direct attention to sheep that are bred . . . in our winter rain regions. *O. columbianum* has been seen in Morocco in sheep imported from South America; it seems not to have spread . . . Whilst I was in Casa Blanca a meeting was held by the *Société de Médicine et Hygiène,* formed by veterinarians and medical men, who seem to harmonise there excellently. C. of Paris had been asked to read a paper on B.C.G. and since I happened to be there as well I was gently pressed to give a *causerie sur l'aphosphorose du bétail,* which I did somewhat hesitatingly as I had practically no time to prepare it. However, it went off quite to the satisfaction of my friends . . . Sergent in Alger

is a very enterprising man. I believe his outlook on veterinary problems has been much influenced by our doings in South Africa. Three years ago he took over a large piece of uncultivated, neglected, swampy ground in Oulid Mendil, not far from the town, to grow his own foodstuffs and to produce his own milk for the laboratory. He wanted all sorts of advice from me about the planting of South African forage plants and grasses. I helped as much as I could remember."

Thus Theiler as a correspondent, his letters full of the fruit of his varied interests and acute observational powers, giving the essential facts regarding the scenery, climate, social, scientific, and professional conditions of the countries he visits, ready always to advertise the South African work and to carry back with him for the benefit of his old South African colleagues any knowledge that would be useful to them in the problems which he had uncovered and which they were still facing.

His trip to Spain " was very interesting, but rather short. We were 24 days away, practically always on the road, *viz* in an autocar, and were making anything from 250 to 380 kilometers per day, a total run of about 5,200 kilometers. We had a day off in Barcelona and Seville and two days in Madrid. We saw plenty of country : south as far as Gibraltar, Algeçiras and Cadiz, and then across Spain, touching Seville, Cordoba, Madrid and Burgos to S. Sebastian on the gulf of Biscay; then via Bordeaux and Dijon back to Switzerland. We left Switzerland in snow and we had bad weather as far as Barcelona. It then cleared up and with the exception of one bad day in Granada we had splendid sunshine until we crossed again to France, where it rained, and we entered with snow into Switzerland, crossing the Jura Mountains. In the south of Spain we had spring, here we are again back in a wintry landscape, the snow on the mountains around the lake coming far down. However, it is no longer cold, the days have considerably increased in length and shortly the cherry trees will be flowering. On an auto trip one sees plenty of country and is able to form a good picture of its configuration; one comes, however, but little in contact with the people, except in the hotels, and naturally one sees not much of their doings, always rushing past them. I have seen but little of things that interest me most : the breeding of cattle, sheep, and horses, although I saw plenty of goats, asses and mules, and lazy Spaniards on the back of the latter two. I did not come in touch with any colleagues of our profession, although I saw the signboard 'Veterinario' in many villages and usually associated with a farrier shop, donkey shoes being fixed on the wall or the door and donkeys and mules standing usually near by waiting to be shod. It appears to me that the Spanish veterinarians are at the same time farriers or at least run a farrier shop. The shops were a poor show. I had no occasion in Madrid to visit the Veterinary College. We were there on Good Friday and the day before, and there was vacation. The famous Prado was open for half a day and we profited to see that famous picture gallery. Of course we did not miss



SIT ARNOLD THEILER (SEATED FOURTH FROM RIGHT) FOR THE THE LAST TIME AMONG HIS PROFESSIONAL COLLEAGUES IN SOUTH AFRICA AT THE 29TH GENERAL MEETING OF THE SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION (ONDERSTEPOORT, 1935).

to see the famous monument of Moslem art and the many Gothic cathedrals of Spanish style, wherever we passed and could spare the time for a visit. We saw plenty but had no time to see it properly, and therefore we are now a good bit muddled of what we saw and where we saw it. — The roads in Spain are excellent, with but few exceptions all are asphalted; in the villages they are neglected, very narrow, and dirty. The drive along the south coast is one long marine drive à *la* Cape Peninsula, the road sinking down to sea-level in some places and rising in others to considerable heights and winding along the sheer cliffs that drop into the sea. The scenery is beautiful. Going across Spain we had to traverse a high plateau and actually reached an altitude of 1,440 meters. The highland resembled much the Orange Free State plains; also other parts of Spain appeared to be a replica of South and North African sceneries : countries with low rainfall resemble one another more or less. I have not seen enough of Spain and I hope to return some other day, but shall prepare myself to know something of the language. I was amazed to see how little French or English is understood even at some first-class hotels."

During this period in Lucerne, Sir Arnold's heart started to trouble him. In 1932 he wrote : " I have not sent the programme (of proposed work) before, because I felt for a while that I would not live so long to see its conclusion and to do my portion of the job. In August my heart began all of a sudden to strike; with the first attack I knew what the diagnosis would be ! [coronary disease]. X, in Basle, whom I consulted, agreed. Things looked for a while very unpleasantly; they have, however, improved a little . . . I begin to feel again that I may yet have a prolonged lease of life. I want to clean up the question of osteofibrosis in horses and so to satisfy my last ambition in life."

From then onwards he realised that in his researches he was fighting against time : " Although my heart is bothering me very much indeed, it must last until this work is finished." At the same time he continued to be intensely interested in South African events, writing : " South Africa has recently supplied the world with some surprises. There is to be a coalition government and race hatred is to be sunk . May that be possible ! I hope the change . . . will bring together the moderate and cultured men of both parties; and may . . . Onderstepoort have all possible advantages from this change . . . I see in *The Star* that foot-and-mouth disease has jumped to Germiston . . . the first jump rinderpest made was into the neighbourhood of Germiston. We stamped it out there by slaughtering, but subsequently it jumped again to other places." No one more pleased than Theiler when his forebodings regarding the serious effects of foot-and-mouth disease in the Union were belied and the danger was averted. Already before the disease had entered this country he had expressed his apprehension that it would spread across our borders, and he felt after his experience with rinderpest, that this much more highly

infectious disease would almost inevitably sweep right through the Union. When the danger was averted, he was among the first to congratulate those concerned : " I never expected this, and something must have come over the farmer of South Africa since the days of rinderpest which is very much in his favour."

In 1933 Theiler decided to transfer his abode to London, where he had better facilities for his work and more opportunity to discuss his problems with his colleagues and friends, especially his former assistant Dr. H. H. Green.

A year later he went to New York to attend the International Veterinary Congress. From there he went across the States, visiting old friends and then sailed from Vancouver to New Zealand and Australia. Thence he continued his voyage to South Africa, where he landed for the last time at the end of 1934.

The whole of 1935 and the first portion of 1936 Theiler spent at Onderstepoort. Perhaps this was the happiest year of his life. Freed from all administrative worries and tiresome routine he could devote his whole time to his work, his family, and his friends. He accomplished much during this time, but he planned even more for the future.

And then in April, 1936, he set out on his last journey. His main object was to attend the Second International Micro-biological Congress in London in July, and there to meet his son who was coming from New York also to attend the congress. Doctors had warned Theiler not to attempt anything too strenuous, but to lead as quiet a life as possible. But a quiet life to Theiler meant at least 8 or 10 hours' work a day and many days of travel. He first went to Germany and then to Utrecht in Holland, where at the tri-centenary celebrations of the University he, along with his distinguished countrymen from South Africa, General Smuts and General Hertzog, received honorary degrees. Then he went to Norway and from there to England, where he arrived a few days before the opening of the Microbiological Congress and where he met his son, Dr. Max Theiler, and his grandson, Arnold Theiler. A few days later he had a severe heart attack and on the 24th July, on the eve of the opening of the congress, he had another sudden attack and died.

Arnold Theiler was not without honour in his own country. His outstanding ability and great achievements were recognised by everyone from the highest to the lowest in the land. In 1914 he received the K.C.M.G. from the King. Universities and learned societies vied with each other in bestowing on him honorary degrees and other distinctions. He received no less than seven honorary doctorates. Of other great distinctions may be mentioned his election to the French Academy of Sciences, the award of the Laveran Gold Medal, of the Budapest Gold Medal, and the Gold

Medal of the Royal Agricultural Society of England. He was an honorary or corresponding member of some twenty scientific societies.

Theiler died at the height of his mental powers and in the midst of a vast scientific undertaking. He is survived by his widow, who was his inseparable companion in his adversity and in his triumphs; who accompanied him on all his travels and contributed more to the success of his scientific work than most people know; who in the early days learned to make his culture media and sterilize his instruments; who played with equal success and quiet efficiency the parts of wife, mother to his children, friend, technical assistant, and secretary. Theiler lived long enough not only to contemplate his own successful career, but to enjoy the outstanding successes of his four children each in his or her own sphere of work.

Arnold Theiler's name will endure as long as his creation, the Veterinary Research Institute at Onderstepoort stands and as long as Veterinary Science is taught.

Nothing could have been more fitting, nothing more symbolical, than Sir Arnold's return, in the closing months of his life, to the Institute which he—and at which he was—so well loved. Doubtless conscious of the handicap of encroaching infirmity, he made Theilerian efforts to complete the researches on which he was engaged. It is futile to regret that he was not spared to fulfil this task; he would certainly have turned to further problems and there would inevitably have been a last unfinished one. But perhaps only those who were privileged to attend his last lectures will appreciate by how many years the clock of progress in bone pathology has been set back by his passing.

The last of many questions put to Sir Arnold on his departure from Onderstepoort was : "When are you coming back to us?" And he replied : "I cannot say; my programme is so uncertain." Uncertain or predestined, the answer is now plain : the "Old Man" was to return sooner than he expected.

Each building and each laboratory at Onderstepoort knows his presence. Every path, stable, and camp has been trodden by his feet. Practically every piece of work now undertaken at the Institute is a continuation of what he commenced or shows the influence of his teaching and inspiration. His writings, whether in print or in the form of the meticulously accurate notes which he was daily accustomed to make, are consulted constantly.

He is with us still.

APPENDIX

CLASSIFIED LIST OF THE WORKS OF SIR ARNOLD THEILER

Note: Many of Theiler's articles deal with more than one disease or problem. Such are relegated to general headings at the end of each of the classified sections, or to the miscellaneous list of works at the conclusion of the appendix.

Abbreviations: Titles of journals are abbreviated in accordance with common usage, except the following:—

A.J.—Agricultural Journal of the Union of South Africa.

G.V.B.—Report of the Government Veterinary Bacteriologist, Transvaal Department of Agriculture.

Rep. D.V.R. (*D.V.E.* and *D.V.S.*) *Annual Report of the Director of Veterinary Research* (*Veterinary Education and Research, Veterinary Services*), Union of South Africa. (The title of the Director underwent changes from time to time.)

T.A.J.—Transvaal Agricultural Journal.

Protozoal Diseases.

Anaplasmosis.

1909. A contribution to our knowledge of gall-sickness. *T.A.J.* **8/9** : 423.

1910. *Anaplasma marginale* (gen. and spec. nov.). The marginal points in the blood cattle suffering from a specific disease. *G.V.B.* 1908-09 : 104.

Anaplasma marginale (genus nov. et species nov.). Un nouveau protozoaire du bétail. *Bull. Soc. Path. Exot.* **3** (3) : 135.

Gall-sickness of South Africa. (Anaplasmosis of cattle.) *J. Comp. Path. & Therap.* **23** : 98.

Anaplasma marginale. A new genus and species of the protozoa. *Proc. Roy. Soc. of S.A.* **2** : 69.

A contribution to our knowledge of gall-sickness. Transvaal Farmers' Bulletin No. 111. (With J. M. Christy.)

1911. Further investigations into anaplasmosis of South African cattle. 1st *Rep. D.V.R.* : 47.

1912. The transmission of gall-sickness by ticks. *A.J.* **3** : 173.

Gall-sickness of imported cattle and the protective inoculation against this disease. *A.J.* **3** : 1.

Weitere Untersuchungen über die Anaplasmosis der Rinder und deren Schutzimpfung. *Z. f. Infektionskh.* **12** : 193.

Übertragung der Anaplasmosis mittels Zecken. *Z. f. Infektionskh.* **12** : 105.

Piroplasmoses.

Nuttallia equi (Biliary Fever of Equines).

1901. Die Malaria des Pferdes. *Inaug.-Diss.*, Bern.

1902. Equine malaria and its sequelae. *J. Comp. Path. & Therap.* **15** : 40.

1903. Biliary fever in the horse. *T.A.J.* **1** : 142.

1904. Die Piroplasmosis des Maultieres and des Esels. *Z. f. Tiermed.* **8** : 382.

1905. Notes on piroplasmosis of the horse, mule and donkey. *G.V.B.* 1903-04 : 171.

Further notes on piroplasmosis of the horse, mule and donkey. *J. Comp. Path. & Therap.* **18** : 229; *T.A.J.* **3** : 706; *G.V.B.* 1904-05 : 94 (1906).

Transmission of equine piroplasmosis by ticks in South Africa. *J. Comp. Path. & Therap.* **19** : 282; *G.V.B.* 1905-06 : 105 (1907).

1906. La piroplasmose, complication de la peste de cheval. *Rev. Gén. de Méd. Vét.* **7** : 178.

Piroplasma equi as a complication of horse-sickness. *G.V.B.* 1904-05 : 104.

1907. Inoculation against equine piroplasmosis. *G.V.B.* 1905-06 : 90.
Piroplasmosis in horses due to hyperimmunisation. *G.V.B.* 1905-06 : 171.
1908. A continuation of experiments on protective inoculation against equine piroplasmosis. *J. Comp. Path. & Therap.* **21** : 97; *G.V.B.* 1906-07 : 214.
1909. Further inoculation experiments with biliary fever in equines. *G.V.B.* 1907-08 : 13; *Vet Jl.* **65** : 302.

P. bigeminum (Redwater).

1904. The *Piroplasma bigeminum* of the immune ox. *Jl. R.A.M.C.* Dec., 1904; *G.V.B.* 1903-04 : 116 (1905).
Redwater. *T.A.J.* **3** : 476.
1905. On the *Piroplasma bigeminum* of the immune ox. *J. Comp. Path. & Therap.* **18** : 91. (With S. Stockman.)
1906. Redwater. Trans. Dep. Agric. Bull. No. 3. (With S. Stockman.)
1907. Experiments with English and South African redwater. *T.A.J.* **6** : 534; *G.V.B.* 1906-07 : 62 (1908); *Jl. Trop. Vet. Sc.* **4** :1 (1909).
1909. Quelques observations concernant la transmission du *Piroplasma bigeminum* par les tiques. *Bull. Soc. Path. Exot.* **2** : 384.
1911. The treatment of redwater in cattle with Trypan Blue. *A.J.* **2** : 562; *Vet Jl.* **68** : 64 (1912).

P. canis (Biliary fever of dogs).

1904. Beitrag zur Frage der Immunität bei der Piroplasmosis des Hundes. *Cb. Bakt.* **37** (3) : 401.
1905. Notes on the immunity of the piroplasmosis in the dog. *G.V.B.* 1903-04 : 174.

Th. mutans (*G. mutans*).

1906. *Further notes on Piroplasma mutans* (nov. sp.). *J. Comp. Path. & Therap.* **19** : 292.
1907. *Piroplasma mutans* (n. sp.) of South African cattle. *G.V.B.* 1905-06 : 33.
Further notes on *Piroplasma mutans*. A new species of Piroplasma in South African cattle. *J. Comp. Path. & Therap.* **20** : 1; *G.V.B.* 1906-07 : 45 (1908).
1909. The immunity of cattle inoculated against *Piroplasma mutans*. *G.V.B.* 1907-08 : 1.
Further investigations into sickness caused by *Piroplasma mutans*. *Vet. Jl.* **65** : 257.
1928. *Gonderia mutans* or *Theileria mutans?* 13th and 14th *Reps. D.V.R.* (1) : 69. (With H. Graf.)

Th. parva (East Coast fever).

1903. The Rhodesian tick fever. *Fortsch. d. Vet.-Hyg.* 1903-04 : 276; Meeting S.A. Assn. Adv. Sc., Johannesburg : 210-220; *T.A.J.* **1** : 193.
The Rhodesian cattle disease. *T.A.J.* **1** : 37; 321.
1904. East Coast fever. *Jl. R.A.M.C.*, Dec. 1904; *T.A.J.* **2** : 421; *G.V.B.* 1903-04 : 133 (1905).
Some observations and experiences in connection with East Coast fever. *T.A.J.* **3** :49. (With S. Stockman.)
Transmission of East Coast fever by ticks. *T.A.J.* **3** : 71. (With S. Stockman.)
Some observations in connection with tropical bovine piroplasmosis. *J. Comp. Path. & Therap.* **17** : 193.
1905. Experimentelle Übertragung der tropischen Piroplasmosis des Rindes mittels Zecken. *Fortsch. d. Vet.-Hyg.* **2** : 257.
Experiments to show how long an area which was at one time infected with East Coast fever will remain infected. *G.V.B.* 1903-04 : 157. (With S. Stockman.)
Inoculation experiments according to the method of Prof. Koch. *G.V.B.* 1903-04 : 158. (With S. Stockman.)
Dipping experiments. *G.V.B.* 1903-04 : 161. (With S. Stockman,)

Possible influence of the different seasons on the outbreak of East Coast fever. *G.V.B.* 1903-04 : 165. (With S. Stockman.)

Further experiments to note how long an area remains infected with East Coast fever. *T.A.J.* **3** : 700; *J. Comp. Path. & Therap.* **18** : 163. (With S. Stockman.)

1906. Experiments with serum against East Coast fever. *Jl. Trop. Vet. Sc.* **1**; *G.V.B.* 1905-06 : 81 (1907).

1907. Treatment of East Coast fever. *G.V.B.* 1905-06 : 11.

Further transmission experiments with East Coast fever. *T.A.J.* **6** : 413; *G.V.B.* 1906-07 : 70 (1908).

Experiments with serum against East Coast fever. *Jl. Trop. Vet. Sc.* **2** (3) :249.

1908. Weitere Versuche das Ostküstenfieber durch Zecken zu übertragen. *Z. f. Infektionskh.* **4** : 265.

1909. The influence of cold on ticks and *Piroplasma parvum*. *G.V.B.* 1907-08 : 10.

Investigations into East Coast fever. *Vet. Jl.* **65** : 260.

Diskussionsbemerkung zum Vortrage von Tartakowsky. *Verh. d. 9. Int. Kongress.*, The Hague : 224.

1910. The prevention and eradication of East Coast fever. Farmers' Bulletin No. 129. (With J. M. Christy.)

Some observations concerning the transmission of East Coast fever by ticks. 1st *Rep. D.V.R.* : 208; *Trans. Roy. Soc. S.A.* **2** : 319 (1912).

The methods adopted to combat the spread of East Coast fever. *Agricultural South Africa*, 2 : 27.

1911. Progress report on the possibility of vaccinating cattle against East Coast fever. 1st *Rep. D.V.R.* : 47.

The transmission of Amakebe by means of *Rhipicephalus appendiculatus*, the brown tick. 1st *Rep. D.V.R.* : 229; *Proc. Roy. Soc.* London, **84** : 212; *Jl. Trop. Med.* **14** : 275.

1912. Weitere Beobachtungen betreffend die Übertragung von Küstenfieber vermittels Zecken. *Z. f. Infektionskh.* **12** : 26.

The immunisation of cattle against East Coast fever. 2nd *Rep. D.V.R.* : 226.

1928. Theilériose Sud-africaine expérimentale, transmise par le sang. *Bull. Soc. Path. Exot.* **21** : 121. (With P. J. du Toit.)

1929. Transmission of East Coast fever by means of blood. 15th *Rep. D.V.S.* (1) : 15.

Miscellaneous.

1903. Die Piroplasmosen in Süd-Afrika. *Fortsch. d. Vet.-Hyg.* **1** : 133.

Les piroplasmoses dans l'Afrique Australe. *Rev. Vét.* (1903) : 625; 670.

1910. Texasfieber, Rotwasser und Gallenkrankheit der Rinder. *Z. f. Infektionskh.* **8** : 39.

1912. Das Trypanblau und Trypanrot in der Behandlung der Piroplasmosen. *Z. f. Infektionskh.* **11** : 305.

1930. Un nouveau medicament pour le traitement des piroplasmoses. *Bull. Soc. Path. Exot.* **23** : 506.

Spirochaetosis.

1904. Spirillosis of cattle. *J. Comp. Path. & Therap.* **17** : 47.

1906. Transmission and inoculability of spirillosis in cattle. *G.V.B.* 1904-05 : 123.

Trypanosomiases.

1901. Die Tsetse-Krankheit. *Schweiz. Arch. f. Tierhk.* **43** (3) : 97; (4) : 153.

1902. Sur un nouveau Trypanosome des bovidés. *Comp. Rend. Acad. Sc.* **84**.

1903. A new Trypanosome and the disease caused by it. *J. Comp. Path. & Therap.* **16** : 193.

A new Trypanosoma. *Trans. Am. Micr. Soc.* No. 4.

1904. Diseases caused by Trypanosomes. *T.A.J.* **3** : 60.

Trypanosomiasis in camels. *T.A.J.* **3** : 117; *G.V.B.* 1904-05 : 106 (1906); *Vet. Jl.* **62** : 214 (1906); *Jl. Trop. Vet. Sc.* **1** : 295 (1906).

1906. Trypanosomiasis chez le chameaux. *Rev. Gén. d. Méd. Vét.* **7** : 298.
1909. Sur l'existence de Trypanosoma demorphon ou d'une espèce voisine au Mozambique et au Zoulouland. *Bull. Soc. Path. Exot.* **2** : 39.
Sur un nouveau Trypanosome de l'Afrique du Sud. *Bull. Soc. Path. Exot.* **2** : 392.
1919. Slapsiekte in horses in Griqualand West (Dourine). Un. of S.A. Dep. Agric. Leaflet No. 54.

Miscellaneous.

1909. Transmission des Spirilles et des Piroplasmoses par differentes especes de tiques. *Bull. Soc. Path. Exot.* **2** : 384.
1923. Protozoan diseases of dairy cattle. Proc. World's Dairy Congress in U.S.A.

Virus Diseases.

Bluetongue.

1904. Bluetongue in sheep. *T.A.J.* **3** : 117; *G.V.B.* 1904-05 : 110 (1906).
1907. Das Katarrhalfieber der Schafe in Süd-Afrika. *Z. f. Tiermed.* **11** : 301.
1908. The inoculation of sheep against bluetongue and the results in practice. *G.V.B.* 1906-07 : 263.
The inoculation of sheep against bluetongue and the results in practice. *T.A.J.* **7** : 30; *Vet. Jl.* **64** : 600.
1909. The inoculation of sheep against bluetongue and the results in practice. *Vet. Jl.* **65** : 301.

Heartwater.

1903. Heartwater in cattle. *T.A.J.* **1** : 100; *G.V.B.* 1903-04 : 190 (1905).
1904. Heartwater diagnosis in cattle. *Vet. Jl.* **9** : 300; *T.A.J* **2** : 163.
1906. Immunisation against heartwater. *G.V.B.* 1904-05 : 121.

Horsesickness.

1893. Über südafrikanischen Zoonosen. Die Pferdeseuchen. *Schweiz. Arch. f. Tierhk.* **35** (4) : 145.
Über südafrikanischen Zoonosen. Die Dikkoppaardenziekte. *Schweiz. Arch. f. Tierhk.* **35** (5) : 202.
1901. Die südafrikanische Pferdesterbe. *D.T.W.* **9** (20) : 201; 221; 233; 241.
1903. Immunisation contre la peste du cheval. *Rev. Gén. d. Méd. Vét.* **3** : 481.
Investigations into the nature and cause of horse-sickness. *Cape of Good Hope Agric. Jl.* **23** : 155.
1904. Über Untersuchungen über die Pferdesterbe. (Horse-sickness). *Cb. Bakt.* 1e Abt. (Referate) **34** : 770.
Horse-sickness experiments. *J. Comp. Path. & Therap.* **17** : 139; *T.A.J.* **2** : 332; *G.V.B.* 1904-05 : 151. (1906.)
1905. Horse-sickness. (Results from former experiments and serum treatment applied to horse-sickness.) *G.V.B.* 1903-04 : 207.
1907. Transmission of horse-sickness into dogs. *G.V.B.* 1905-06 : 160.
The immunity in horse-sickness. *G.V.B.* 1905-06 : 163.
Horse-sickness. The results of inoculation in practice during 1905/06. *G.V.B.* 1905-06 : 168.
1908. Horse-sickness. The results of inoculation in practice during 1906/07. *G.V.B.* 1906-07 : 85.
The inoculation of mules with polyvalent virus and serum. *G.V.B.* 1906-07 : 192.
The immunity of horses against horse-sickness. *T.A.J.* **7** : 355.
The immunity of mules against horse-sickness. *T.A.J.* **7** : 175; *Vet. Jl.* **65** : 178.
Further notes on immunity in horse-sickness. *G.V.B.* 1906-07 : 89.
1909. The loss of virulency of horse-sickness virus in practice. *G.V.B.* 1907-08 : 50.
The inoculation of mules with polyvalent virus. *G.V.B.* 1907-08 : 24.
On the variability of a particular strain of horse-sickness virus. *G.V.B.* 1907-08 : 57.

1910. The susceptibility of the dog to African horse-sickness. *J. Comp. Path & Therap.* **23** : 315.
1911. Horse-sickness. *S.A. Mining Jl.* **9**.
1915. The problem of horse-sickness. *S.A. Jl. Sc.* **12** (3) : 65—82.
1921. African horse-sickness (Pestis equorum). Un. of S.A. Science Bull. No. 19.
1923. African horse-sickness. In *Encyclop. of Vet. Med., Surg. & Obstetrics,* edited by G. H. Wooldridge. Pp. 362—375. London : Henry Froude and Hodder & Stoughton.
1930. African horse-sickness. In A System of *Bacteriology in Relation to Medicine,* Vol. 7, pp. 362—375. H. M. Stationery Office, London.
1934. Research into horse-sickness in South Africa. *The Horse* **6** : 21.

Lungsickness.

1899. Die Lungenseuche in Südafrika. *Schweiz. Arch. f. Tierhk.* **41** : 57.
1904. Pleuropneumonia. *T.A.J.* **2** : 332.
1914. Übertragung der Lungenseuche durch geimpfte Rinder. *B.T.W.* No. 32 : 592.

Rabies.

1903. Rabies. *T.A.J.* **1** : 41.
1934. Rabies in South Africa. *Vet. Jl.* **90** (1) :

Rinderpest.

1896. De runderpest, hare geschiedenis, verschijnselen, enz. *Staatscourant,* 27/5/96.
1897. Rinderpest in Südafrika. *Schweiz. Arch. f. Tierheilk.* **39** (2) : 49.
Experimentaluntersuchungen über Rinderpest. *Schweiz. Arch. f. Tierhk.* **39** (5) : 193.
Die Rinderpestimpfung nach Geheimrat Dr. R. Koch. *Schweiz. Arch. f. Tierheilk.* **40** : 60.
Rapport inzake onderzoekingen volgens opdracht der HEd. Regeering omtrent runderpest. *Staatscourant,* 14/7/97.
1898. Blutserum immuner Tiere im Kampfe gegen die Rinderpest. *D.T.W.* **6** (24) : 205.
1902. Das Wiedererscheinen der Rinderpest und die Erfolge der Schutzimpfung in Süd-Afrika. *Monatsh. f. prak. Tierhk.* **13** : 145.
1904. Die Simultanimpfung gegen Rinderpest und ihre Gefahr. *Monatsh. f. prak. Tierhk.* **16** : 195.
1905. The danger of simultaneous immunisation with serum and virulent blood for rinderpest in cattle not immune against redwater. *G.V.B.* 1903-04 : 166.

Miscellaneous.

1901. Eine contagiöse Stomatitis des Pferdes in Südafrika. *D.T.W.* **9** (13) : 131.
1906. Die Schweinepest und Schweineseuche in Südafrika. *Fortschr. d. Vet. Hyg.* **4** (6) : 121.
1907. Observations and experiments on swine fever and swine plague. *G.V.B.* 1905-06 : 121.
1909. Fever reactions simulating horse-sickness. *G.V.B.* 1907-08 : 114.
Notes on fever in horses simulating horse-sickness. *T.A.J.* **8/9** : 581.
1910. A fever in horses simulating horse-sickness. *Vet. Jl.* **66** : 587.
1911. Rinderpest Serum und aktive Immunisierung. In Klimmer & Wolff-Eissner : *Handb. d. Serumtherapie und Serumdiagnostik,* Bd. 2. Leipzig.
1914. Pernicious anaemia. *Farmers' Weekly,* 6/5/1914.
1915. Infectious or pernicious anaemia of equines in South Africa. 3rd and 4th *Reps. D.V.R.* : 215. (With D. Kehoe.)
1918. Observations on epizootic contagious catarrh of the respiratory organs of equines and its relation to purpura haemorrhagica. 7th and 8th *Reps. D.V.R.* : 360.
1928. Ecthyma contagiosum of sheep and goats. 13th and 14th *Reps. D.V.E. & R.* (1) : 9.

Bacterial Diseases.

Blackquarter.

1894. Über Rauschbrand und anderes im Transvaal. *Schweiz. Arch. f. Tierhk.* **36** : 258.
1897. Rauschbrand. *Schweiz. Arch. f. Tierhk.* **39** : 103.

Botulism and Parabotulism (including Lamsiekte).

1912. Facts and theories about styfsiekte and lamsiekte. *A.J.* **3** : 463; **4** : 1; 2nd *Rep. D.V.R.* : 7.
1914. Historical sketch of the investigations into lamsiekte. *Rep. of Dep. of Agric.*, Un. of S.A. 1913/14 : 123.
1915. The results of recent investigations into lamsiekte. *Dep. of Agriculture,* Un. of S.A.
A contribution to the study of deficiency disease with special reference to the lamsiekte problem in South Africa. 3rd and 4th *Reps. D.V.R.* : 9. (With H. H. Green and P. R. Viljoen.)
1916. Proefnemingen inzake gallamziekte. Agric. Congress, Kimberley, Sept., 1916.
1920. The cause and prevention of lamsiekte. *Jl. Dep. Agric.* **1** : 2211.
Lamsiekte in cattle. (Lecture to Members of Parliament). Rep. of Agriculture.
1925. Das Knochenfressen der Rinder in Südafrika. *Schweiz. Arch. f. Tierhk.* **67** : 405.
1927. Parabotulisme des Equides. *Rev. Gén. d. Méd. Vét.* **36** : 424. (With E. M. Robinson.)
Der Botulismus der Haustiere. *Z. f. Infektionskh.* **31** : 165. (With E. M. Robinson.)
1927. Lamsiekte (parabotulism) in cattle in South Africa. 11th and 12th *Reps. D.V.E. & R.* (2) : 821. (With P. R. Viljoen, H. H. Green, P. J. du Toit, H. Meier and E. M. Robinson.)
1928. Botulism (parabotulism) in Equines. 13th and 14th *Reps. D.V.E. & R.* (1) : 47. (With E. M. Robinson.)

Glanders.

1903. Glanders or farcy. *T.A.J.* **1** : 34.
1910. The infectivity of blood of animals suffering from chronic glanders. *G.V.B.* 1908-09 : 65.

See also under "Pathology."

Miscellaneous.

1897. Die Tuberkulosis unter der Haustiere in Südafrika. *Schweiz. Arch. f. Tierhk.* **39** : 100.
1904. Epizootic lymphangitis. *T.A.J.* **2** : 52.
1911. On an infectious foot disease in sheep. 1st *Rep. D.V.R.* : 273; *Vet. Jl.* **67** : 659; *A.J.* **2** : 29.
Notes on the occurrence of bacillary necrosis in South Africa. *A.J.* **2** : 718.
1912. Anthrax in the ostrich. *A.J.* **4** : 370.
1918. Contagious abortion in cattle. Un. of S.A. Dep. of Agric. Leaflet 25.

Toxicology.

1918. Geeldikkop in sheep (Tribulosis ovium). 7th and 8th *Reps. D.V.R.* : 1.
Jagziekte in Horses (Crotalariosis equorum). 7th and 8th *Reps. D.V.R.* : 57.
Dunziekte in South African horses (Enzootic liver cirrhosis). 7th and 8th *Reps. D.V.R.* : 105.
1921. Pflanzen und Vegetation als Ursache von Tierseuchen in Südafrika. *Mitt. d. Naturforschende Gesellschaft,* Bern. (Heft 3) : 30.
1923. Gousiekte in sheep. 9th and 10th *Reps. D.V.E. & R.* : 7. (With P. J. du Toit D. T. Mitchell.)

1924. Recent investigations on plant toxins and deficiency diseases of stock in South Africa. *Kenya Medical Jl.* **1** (1) : 2.
1927. Die Diplodiosis der Rinder und Schafe in Südafrika. *D.T.W.* **35** (25).
See also under " Pathology " for Seneciosis.

Helminthology.

1903. Internal parasites. *T.A.J.* **1** : 236.
1912. Wire worms in sheep and their treatment. *A.J.* **4** : 572.
1913. The dosing of sheep with Cooper's dip and bluestone for wire worms. *Vet. Jl.* **69** : 252.
Ophthalmia in cattle. *Farmers' Weekly,* 31/12/13 : 1484.
1915. Investigations into the life history of the wire worm in ostriches. 3rd and 4th *Reps. D.V.R.* : 291. (With W. Robertson.)
1918. A new nematode in fowls, having a termite as an intermediary host. (*Filaria gallinarum* nova spec.) 5th and 6th *Reps. D.V.R.* : 695.
1921. The nodular worm and the lesions caused by it. *Jl. Dep. Agric.* **2** : 44.
See also under " Miscellaneous " for investigations into the safe dosage of the ingredients of the wireworm remedy.

Mineral Deficiencies and Nutrition.

1907. Die Osteoporose des Pferdegeschlechtes. *Monatsh. f. prakt. Tierhk.* **18** : 198.
1911. Stiff-sickness or stijfziekte in cattle. *G.V.B.* 1909-10 : 84; *A.J.* **1** : 10.
1924. Phosphorus in the livestock industry. *Jl. Dep. Agric.* **8** : 460. (With H. H. Green and P. J. du Toit.)
1927. Minimum mineral requirements in cattle. *Jl. Agric. Science* **17** : 291. (With H. H. Green and P. J. du Toit.)
1931. L'Aphosphorose naturelle et expérimentelle des bovidés. *Maroc. Médical.* No. 109, 15th July.
The pathological aspect of phosphorus and calcium deficiency in cattle. *Vet. Rec.* **11** (45) : 1143. (Nov., 1931.)
1932. Aphosphorosis in ruminants. *Nut. Abst. & Rev.* **1** : 359. (With H. H. Green.)
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Theiler and the Rinderpest Epizootic of 1896-1903.

By H. H. CURSON, Onderstepoort.

Introduction.

Discussing with me, only ten months ago, the major events of his career, Sir Arnold Theiler agreed that his most difficult task had been the campaign against rinderpest, particularly during its first appearance in the Transvaal, *i.e.* 1896–98. Unfortunately this period is but little known to the South African veterinarian; for not only did Theiler publish in German and Dutch, but the literature containing his researches is only available to the few who have access to the Library at Onderstepoort. Theiler published in professional journals five articles on rinderpest (1897—twice, 1898, 1902 and 1904), while his earlier official reports appeared (1896, 1897) in High Dutch in the *Staatscourant*. A formidable task was the perusal of the *Staatscourant* from 1896—1899, an undertaking made arduous because of the absence of an index, although annually a sum of £60 had been put aside by the authorities for this service! Glimpses of Theiler's activities are also obtained from a study of the reports of inter-colonial conferences and of reports, chiefly annual, published by the Transvaal Department of Agriculture during the latter years of the epizootic. All these are in English. No proper idea, however, can be gained of the colossal nature of Theiler's task, unless the *Staatscourant* of 1896 and 1897 be studied, for it is here that we learn (through the many proclamations) of the organisation of the courageous yet forlorn campaign he instituted against rinderpest.

Undeterred by his knowledge of the ineffecuality of Law 3 of 1870, which sought to control lung-sickness by legislation, aware that rinderpest was highly communicable and hitherto resistant to all treatment, whether curative or prophylactic, conscious of the conservatism of the farmers who believed that the disease was an act of Providence, and in spite of the handicaps of a scanty police force, no professional staff, difficulty of postal communications and absence of fencing, Theiler conducted for 20 months a campaign to which no parallel exists. The very fact that he was prepared with his scanty resources to undertake the struggle shows the nature of the man. Not only had he to draft regulations, to amend some and repeal others—a whole-time task in itself—but he undertook research, attended committee meetings and conferences, answered correspondence, issued reports, advised and supervised such as he was never again called upon to do.

We learn in his first rinderpest paper (1897) that eight days (*i.e.* 14th March) after the receipt of the telegram from the High Commissioner at Cape Town to the British Agent at Pretoria, Theiler proceeded by coach from Pretoria to Bulawayo to study the disease (not then definitely diagnosed) *in loco*. He travelled *via* Pietersburg and Fort Tuli and arrived on 20th March at his destination, where he met Mr. C. E. Gray, M.R.C.V.S., then acting as veterinarian for the British South Africa Chartered Company ([1]). Just at this time the natives of Matabeleland, long dissatisfied with their lot under European government, broke into open rebellion, the immediate cause being the compulsory destruction of their herds by the Administration in order to prevent extension of the disease. Theiler naturally left by coach as speedily as possible, travelling *via* Tati, Palapye and Mafeking to Pretoria. On 3rd April he met at Palapye Otto Henning, a veterinarian of the Cape service seconded to the Bechuanaland Protectorate on account of the scourge, which Henning had also satisfied himself to be rinderpest. As can be understood, Theiler on his journey south passed hundreds of dead oxen, the wagons being left derelict along the road. He eventually reached Pretoria on 9th April " und hatte eine Besprechung mit Präsidenten Kruger und dem ' Uitvoerenden Raad ' wobei ich meine Vorschläge einreichte . . ."

The campaign from the Transvaal point of view has now to be described.

Narrative.

In consequence of a telegram dispatched on 6th March, 1896, from the High Commissioner (Sir Hercules Robinson) at Capetown to His Majesty's Agent at Pretoria (Sir Jacobus de Wet), instructing that the Government of the South African Republic be notified that rinderpest or some similar disease had broken out near Bulawayo, the Proclamation of 11/3/1896 was published (*Buitengewone Staatscourant* ([2]), 11/3/96). It prohibited (a) the introduction of all game and domesticated animals from Mashonaland, Matabeleland and Khama's country, (b) transport to and from those territories and ordered (c) the withdrawal of all stock along the threatened border to a distance of three miles south of the Limpopo river and (d) that all stock suspected of suffering from communicable disease were to be dealt with in terms of article 34 of the Pound Law (Law 2 of 1882). Then followed a day of prayer not only on account of the menace of rinderpest, but also owing to the ravages of drought and locusts. By Proclamation of 24/3/96 (*S.* 25/3/96), the 5th April was set aside for the purpose.

([1]) This point is stressed, for on 1st Jan., 1896, Gray had endeavoured to obtain employment in his profession with the Chartered Company, but all that he was offered was the post of telegraph operator at Macloutsie ! This post Gray accepted, but as is evident from the text only for 2 months.

([2]) Hereafter *Staatscourant* is indicated by the letter *S.* *S*.* = *Buitengewone Staatscourant.* G.N. = Government Notice.

So far the disease had been outside the Transvaal, but on 1st April (*S.* 1/4/96), since information had been received from Marico that rinderpest had appeared in Linokani's Location ([3]), the Proclamation of 1/4/96 extended the prohibition relating to transport to the districts of Zeerust (Marico) and Lichtenburg. Obviously measures directed against transport to and from affected areas were now insufficient, so on 14/4/96 a Proclamation was promulgated (*S.* 15/4/96) (a) forbidding even inter-farm movement unless the owner possessed a permit furnished by the Magistrate, Justice of the Peace or Field Cornet of his ward certifying that the stock (excluding equines) had not been in contact with diseased animals, (b) ordering notification to neighbours and isolation of suspected cases and (c) providing that anyone contravening (a) and (b) should be responsible for the damage arising from his negligence. Since it was clear that horses, mules and donkeys were not susceptible to the disease, the word " vee " excluded equines. Then arose the need for contending with the traffic in diseased flesh, a real difficulty where natives are concerned. Owing to a report from the Customs official at Hendriksdal that meat from rinderpest carcases was being introduced into the Republic, the Proclamation of 15/4/96 (a) forbade the importation not only of animal products but also of anything which might convey infection, *e.g.* fodder, and (b) decreed a fine of £7 - 10 - 0 or up to one month's imprisonment for contravention of clause (a). Confiscated material was either to be buried not less than 3 feet deep or was to be burnt. This Proclamation, along with Resolution 289 of the Executive Council, was published under G.N. 92 (*S.* 16/4/96).

On 17/4/96 there was held at Mafeking the first rinderpest conference, delegates having assembled from Cape Colony, Natal, Orange Free State, Bechuanaland Protectorate and Transvaal (*Blue book Cape of Good Hope* G 43—1897). Indeed, it may be viewed as the first Inter-colonial Veterinary Conference, for among the delegates were Messrs. Hutcheon of Cape Colony, Theiler of Transvaal and v. d. Plank of Natal, and Dr. Edington of the Colonial Bacteriological Institute at Grahamstown, who were directly concerned in veterinary affairs and who contributed most of the discussion on policy. With regard to the Transvaal, Theiler reported that " he had left Pretoria three weeks ago for Bulawayo to investigate the disease there, but on hearing of the outbreak at Zeerust he had at once returned to Pretoria. His Government had adopted strong quarantine measures, but he had no authority to stamp out the disease by the killing of infected cattle and compensating owners. A cordon along

([3]) A telegram from the State Secretary (Division A) to the High Commissioner on 1/4/96 states also Skelvynstad. According to Mr. Krogh, one of the two Under-Secretaries for the Interior and a Transvaal delegate at the Vryburg Rinderpest Conference on 31st August and 1st September, 1896, the disease entered the Transvaal before the 11th March, 1896.

Bechuanaland and the Protectorate on the Transvaal border had been established and he had recommended that infected cattle should be killed, but he had no idea of what steps the Transvaal Government intended taking. He did not think that any compensation would be awarded." This statement is sufficient to indicate Theiler's difficulties (4), for the value of his profession was still to be appreciated in his territory (5). Eventually the Conference passed the following resolutions, *viz*: (a) "That the respective Governments should be requested to agree to mutual action in . . . stamping out and compensation and to contribute a *pro rata* share of the expenses", and (b) "That the Western and Northern borders of British Bechuanaland and the Transvaal border . . . should be fenced by a double fence, and that all outbreaks of the disease south and east of that fenced boundary should be immediately stamped out." It was unfortunate that the delegates (except for the Cape Colony) were not vested with authority, for the seriousness of the situation demanded prompt and united action.

The inevitable demand for rinderpest remedies then received attention, the curative treatment recommended in G.N. 98 (*S.* 22/4/96) being water-deprivation for at least five days and three-quarters of a bottle of raw linseed oil on each alternate day. Preventive treatment consisted in daily washing out the mouth with a mixture of paraffin oil and salt, a purgative to be administered and Stockholm tar applied around the nostrils—rather a formidable task among large herds of intractable cattle.

Continued spread of the disease made it necessary to issue the Proclamation of 27/4/96 (*S.* 29/4/96) which extended the Proclamations of 11/3/96 and 1/4/96 to Bloemhof. In the same gazette the Proclamation of 28/4/96 (*S.* 29/4/96)—a direct result of the Mafeking Conference—appeared, its chief provision having regard to the stamping out policy and compensation. Other noteworthy clauses were (1) the appointment of a committee of three in every ward for the execution of duties such as notification, quarantine of affected animals, valuation of herds (from calves at 10/- to oxen and bulls at £5), slaughter, disposal of carcases, compulsory labour where necessary, placing of guards, disinfection, closure of roads, issue of permits, posting of rinderpest notices, tracing of in-contacts and prohibition of movement, etc.; (2) a magisterial district to be closed to transport if more than three wards were infected; and (3) infliction of a fine up to £500 or imprisonment for as much as 2 years for

(4) Theiler once mentioned that his greatest difficulty at the Conference was his poor knowledge of English. This obstacle, however, he soon overcame.

(5) A proposal that a Department of Agriculture and Animal Husbandry including a State Veterinarian, be created (*S.* 3/2/96) was not accepted by the First Volksraad (G.N. 173 in *Staatscourant* of 1/7/96). In the meantime, however, a "Staats-veearts" had been appointed! The term "Staatsveearts" has recently again been adopted.

any contravention. This Proclamation contains the first official reference to the Government Veterinarian, Arnold Theiler (6).

As the scourge still pursued its lightning course, G.N. 113 drew attention to the Proclamation of 9/5/96 (*S.* 9/5/96) which ordered (a) complete cessation of all movement of ruminants throughout the Republic for one month. Those *en route* were to remain where they were, unless a permit were procurable from the ward committee, (b) continuous supervision, *i.e.* by day and night, of all herds, and (c) the appointment of vigilance committees in towns for the control of abattoirs, slaughter stock, and delivery of meat.

Under G.N. 116 was published the Proclamation of 16/5/96 (*S.* 16/5/96) which tightened up the anti-rinderpest measures generally, especially with regard to the responsibilities of the ward committees, whose personnel might be increased by two or more if necessary. It was also laid down that dogs, pigs, and game were to be destroyed (and buried) where the disease had appeared, this step being imperative to prevent spread of infection. For the purchase of disinfectants, etc., the Government Veterinarian was to be consulted by the ward committee. Further, the disposal of milk from suspected cases was prohibited and provision was made for the conveyance of meat to populous centres by train or by vehicles drawn by horses or mules. Those transgressing the regulations might be fined a maximum of £25 or imprisoned for up to one month.

As the pestilence continued to sweep onwards like a raging fire, it is not surprising that the God-fearing farmer Government at Pretoria in their desperation again resorted to a day of prayer, the 7th June being set aside for that purpose by the Proclamation of 22/5/96 which was published under G.N. 138 (*S.* 22/5/96). The *Staatscourant* of the following week (27/5/96) contained a description of the history and course of rinderpest, the second (7) of Theiler's publications, dated 18/5/96 and published under Government Notice 121. The same gazette contained G.N. 140 which prohibited the export of meal and grain on account of the danger of spreading infection to adjoining territories. The penalties for contravention were laid down in the Proclamation of 19/9/96 (*S.* 19/6/96).

The next Proclamation was that of 4/6/96 (*S.* 4/6/96) which appeared under G.N. 152. This enacted that the Game Law (Law 5 of 1894) should be temporarily suspended, so far as ruminants were concerned (*e.g.* buffalo, eland, giraffe, blue wildebeest, kudu, and antelopes

(6) "Gouvernements-veearts" is mentioned in Law 8 of 1894 relating to glanders, but this was a part-time position at Johannesburg. Theiler framed the measure in question.

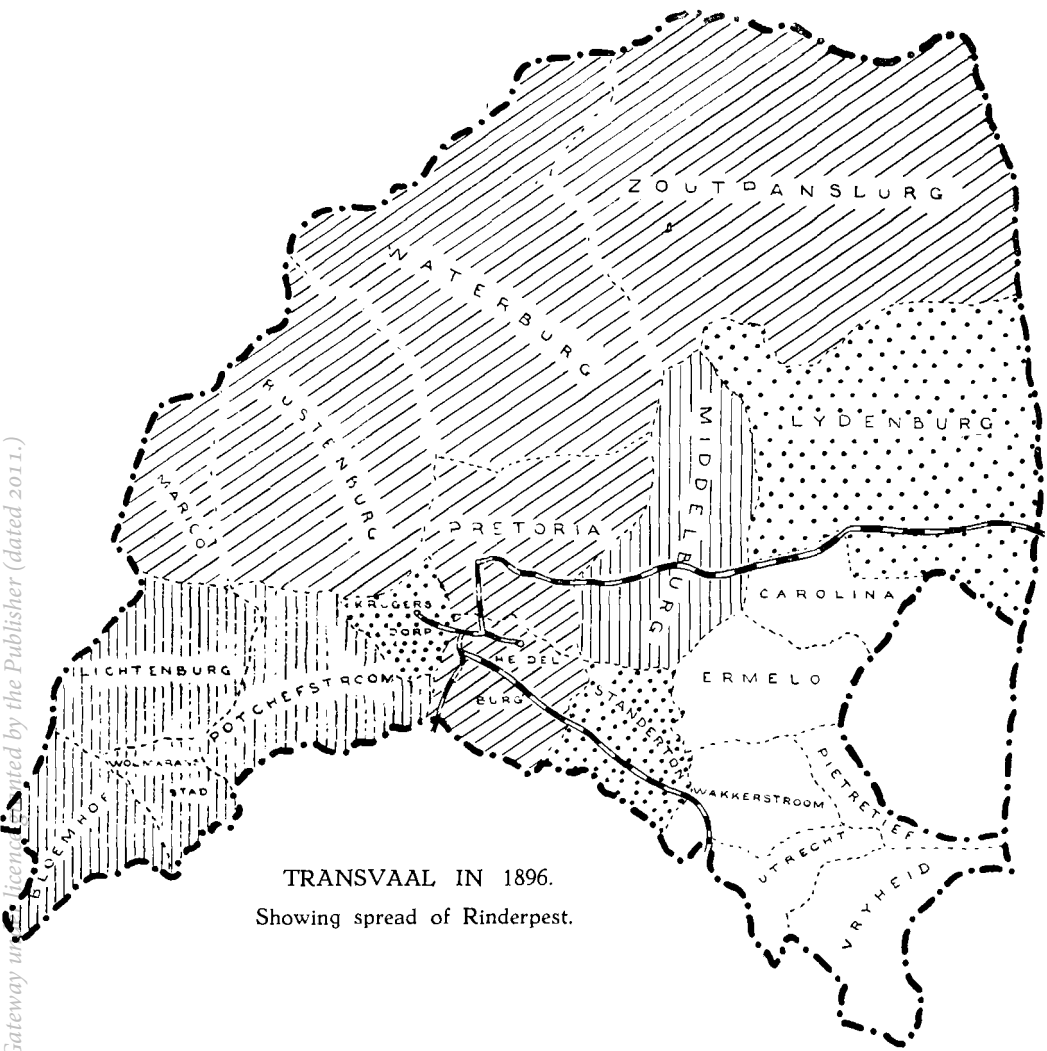
(7) The first paper "Ueber Südafrikanische Zoonosen" appeared in the *Schweiz. Archiv f. Tierheilk.* in 1893.

Rinderpest infection, early July, 1896.—G.N. 210 of 8/7/96.

" " mid-September, 1896.—G.N. 77 of 23/9/96.

" " " December, 1896.—G.N. 542 of 23/12/96.

(Disease reached Natal, July, 1897.)



TRANSVAAL IN 1896.

Showing spread of Rinderpest.

generally), since it was reported that such animals distributed the disease. Obviously where rinderpest existed game was to be disturbed as little as possible, but it was to be prevented from carrying the virus elsewhere. The same gazette contained G.N. 153 which allowed the burgers and inhabitants of Pretoria District to move, under permit, with their sheep and goats to winter grazing in the lowveld.

Then followed, six days later, the Proclamation of 8/6/96 (*S.* 10/6/96) published under G.N. 161, which may be considered as a consolidating measure, repealing some articles of former proclamations, reaffirming others, and strengthening the anti-rinderpest measures generally. An important step was the institution of cordons, the first immediately around the quarantined farm, and the second 6 miles further back, this being the " beschermings- of zekerheidslijn ". The duties of the Rinderpest Ward Committees were accordingly clarified, one instruction being the forbidding of all movement of ruminants within the second cordon for at least one month after the last case of disease. Another important regulation was that each ward committee was to report weekly to the Government Veterinarian, who would compile and distribute a rinderpest bulletin.

The above Proclamations bearing directly on rinderpest control and G.N. 121 were issued in 1896 as a pamphlet by the Government Printer, being entitled *Proclamaties betreffende de Runderpest : De Runderpest, hare geschiedenis, verschijnselen, enz.*" Only one copy has been traced, this being in the Transvaal Archives and bearing the catalogue number 36.

One might well ask at this stage to what extent the Transvaal was now infected ? Unfortunately the first of the rinderpest bulletins mentioned under the Proclamation of 8/6/96 is not available, but according to the second, published under G.N. 210 (*S.* 8/7/96), infection apparently existed in the districts of Zoutpansberg, Waterberg, Rustenburg, Marico, Pretoria, and Heidelberg—(see map).

As might be expected, rinderpest was frequently given other names, in order to evade the stringent regulations, although in a number of cases there was genuine uncertainty. Several notices in the *Staatscourant* at this time draw attention to the public auction of cattle seized under the rinderpest regulations, especially the Proclamation of 16/5/96.

In connection with the supply of meat for Johannesburg, regulations, framed by the Rinderpest Committee of Johannesburg and approved by the Government, were gazetted under G.N. 228 (*S.* 22/7/96). Slaughter stock was to be accepted at Vereeniging and Volksrust (on the Free State and Natal borders respectively) after veterinary inspection and to be consigned to Fordsburg. Slaughter was to be effected within 48 hours after arrival and a veterinarian appointed by the butchers (but under the control of the Rinderpest Committee) was to be responsible for meat inspection. A sub-committee of three, appointed by the Rinderpest Committee to supervise all arrangements concerning introduced cattle and

distribution of meat, was to report daily to the Secretary. Later regulations gazetted under G.N. 361 (*S.* 16/9/96) made provision for slaughter stock purchased within the Transvaal.

Since it was desirable in certain cases to permit the transport of goods, the Proclamation of 3/8/96 (*S.* 5/8/96) authorised this traffic under strict supervision and at the discretion of the ward committee.

G.N. 267 (*S.* 5/8/96) authorised the erection of fencing (even over private property) provided no damage was done in its subsequent removal.

In the case of farmers who had " trekked " with their herds to the lowveld for winter grazing, the Proclamation of 7/8/96 (*S.* 12/8/96) allowed them to return to their homes in the highveld under certain restrictions (*e.g.* need for permits and prevention of straying from the road, etc.). Early the same month (*S.* 2/9/96) three Proclamations were published, two dated 28/8/96, one permitting the dispatch of slaughter stock from healthy areas to towns (under strict supervision) and the other regulating the movements of travelling natives, who were regarded as a big factor in the extension of the disease. Such natives were classified according to whether they were from affected or clean farms and arrangements were to be made for permits, disinfection, roads along which they could travel, etc. The third proclamation to appear in the *Staatscourant* of 2/9/96 was that of 31/8/96 which authorised officials to enforce punishment for contraventions of the Rinderpest regulations.

Then followed at Vryburg (31st August and 1st September) the second interterritorial rinderpest conference, delegates being present from Cape Colony, Natal, Orange Free State, South African Republic, Basutoland, Bechuanaland and German South West Africa. Among the delegates were Duncan Hutcheon (Cape Colony), Herbert Watkins-Pitchford (Natal) and Arnold Theiler (South African Republic). Also representing the South African Republic were Messrs. T. J. Krogh, Under State Secretary and P. G. du Plessis, Rinderpest Commissioner (8). After much discussion, resolutions bearing on the following subjects were passed, the various Administrations, however, not being committed in any way :—

(a) That the most effective mode of stopping the spread of rinderpest was by the erection of *double* wire fences not less than 500 yards apart. The various states were urged to adopt this form of protection.

(b) That as natives were a serious menace in regard to the spread of infection, steps should be taken for their control, including disinfection.

(c) That hides, horns, and skins could be rendered safe for export by immersion in 5% carbolic acid, 1 hour for hides and horns and 15 minutes for skins.

(8) A rinderpest report was issued by the Commissioner under G.N. 420 (*S.* 21/10/96).

(d) That wool and mohair could be suitably disinfected by a proper process of scouring.

(e) That research work in connection with the disease was desirable.

From the discussion it is learned that the Transvaal Authorities were constructing a fence from "Rooigrond in the West, through Marico, Rustenburg, Waterberg, a part of Zoutpansberg and then eastwards ([9]) to meet the main railway line on the highveld in the district of Middelburg" (p. 7). A fence was also being erected from Natal, presumably to meet the main fence just described (p. 19) and along the railway line from Komatipoort to Waterval-Onder. Also that Theiler had tried several so-called "cures" but with no success, and lastly, that kudus, vlakvarks, duikers and guinea fowls had died of rinderpest, the last mentioned probably through eating rinderpest meat ([10]).

As indicated in the map, the disease was at this period extending in the South West Transvaal and G.N. 339 (*S.* 9/9/96) accordingly forbade the inter-communication of Europeans between Bloemhof and Wolmaransstad and the Orange Free State (Boshof and Hoopstad) unless on foot and subject to disinfection at the three ports of exit, Bloemhof, Christiana, and Commando Drift. The export of equines, dogs, and pigs to the Orange Free State was also forbidden until further notice.

The Proclamation of 2/10/96 (*S.* 7/10/96), referring to the threatening famine as a result of rinderpest, drought, and locusts, set aside 18/10/96 as a day of prayer. So serious was the position that the official quinquennial celebration ([11]) of Dingaan's Day at Paardekraal (16th Dec.) was cancelled by G.N. 430 (*S.* 4/11/96).

Of particular importance was the Proclamation of 3/11/96 (*S.* 4/11/96) which, owing to *continued* extension of the disease, revised the forlorn rinderpest policy hitherto pursued. Among other provisions were the following: (a) compulsory slaughter of infected herds would be discontinued except in special cases; (b) remedies might be tested in infected areas; (c) ward committees and special guards would be abolished from 15th November; (d) compulsory herding of stock by owners and burial in case of death. Failing action by owners, new ward committees (consisting of the field-cornet and two persons) were empowered to commandeer labourers at 5/- *p.d.* for Europeans and 1/6 for natives; (e) field-cornets were to submit reports regularly to the Government; (f) all horned transport was prohibited for 2 months, but the dispatch of slaughter stock from healthy areas to towns was allowed under permit;

([9]) It was admitted the disease was within this fenced zone, but it was hoped to eradicate it by slaughter.

([10]) G.N. 377 (*S.* 23/9/96) refers to springbok, steenbok, and reedbuck also succumbing to the infection. This was the 3rd rinderpest report.

([11]) £33,000 had been put apart by the Government for the festivities (G.N. 403—*S.* 21/10/96).

(g) Asiatic hawkers were forbidden to travel about the countryside; (h) no further fencing was ordered except that persons might enclose their own farms with Government material under certain conditions; (i) the Government intended carrying out research; and (j) disease of stock was to be reported immediately to the field-cornet, failing which a fine up to £25 might be imposed.

Following on the Vryburg Conference ([12]) Government Notices 458 and 459 (*S.* 11/11/96) are of interest. The former gives details of two preventive treatments against rinderpest, (a) that of the Rev. Zimmerman, who advocated the heating (for 24 hours) of salt enclosed in the hide taken from a beast suffering from the disease, and then administration of three-quarters of a cupful to each beast. While the field-cornet of Boschveld, Marico, reported favourably ([13]) Theiler at the Vryburg meeting stated, as would be expected, that it was useless; (b) that of D. J. Oosthuijsen, who vaccinated (as for lung-sickness) with a mixture of bile, heart-blood, and stomach contents. The latter refers to regulations framed by the Natal authorities concerning the importation into Natal of stock and animal products.

We next learn from Mr. F. Verney, F.R.C.V.S., now of Kokstad, who worked with his chief Watkins-Pitchford and with Theiler and published his experiences in the *Jl. Comp. Path. Ther.* Vol. XI (2), June 30th, 1898, that a rinderpest experimental camp had been established "near the Marico River, about 20 miles from the British Bechuanaland border", at the end of October ([14]). The Marico investigators worked on serum therapy which, as is well known, supplanted Dr. Koch's bile method.

([12]) Another rinderpest conference, chiefly of Cape delegates, was held at De Aar on 27/10/96 (*Minutes published by W. A. Richards, Capetown, for Cape Govt. Rlys.*)

([13]) The same "remedy" was favourably reported upon by the Landdrost of Zeerust G.N. 481—*S.* 2/12/96). Details of another "remedy", podophyllin and tobacco water, recommended by a certain du Preez, were published in the *Staatscourant* of 9/12/96.

([14]) Verney writes that "at the end of March, 1897, owing to the behaviour of the Transvaal Government, our camp was broken up and Mr. Pitchford and myself came back into Natal. It was not until the middle of July that the first outbreak occurred in this colony" (p. 97). He adds (letter 12/10/36) : "Conditions there were very trying and difficult, and except for one minute building of wood and iron the rest of the Camp was composed of tents. We worked there for about three months and it was under difficult and trying conditions that Theiler so impressed one with his untiring energy, his intense keenness, optimism, and above all his great knowledge of the problem we were trying to solve. There was no literature on rinderpest that he had not perused, and he was entirely *au fait* with the work the Russian worker (Semner) had done, and which formed the basis of the numerous experiments we carried out, and it was here the foundation work of serum and virulent blood was established."

A striking example of the constant need for amending the rinderpest regulations is provided by the Proclamations of 10/11/96 (*S.* 11/11/96), 26/11/96 (*S.* 2/12/96), 8/12/96 and 10/12/96 (*S.* 23/12/96), which sought to tighten up compulsory labour and to improve the facilities for transport. It is learned from the Proclamation of 26/11/96 that, in order to alleviate distress following rinderpest, drought, and locusts, the Government had provided equine transport (see also G.N. 561—*S.* 23/12/96), and that the value of immunised cattle was thoroughly realised.

This concludes the legislative measures up to the end of December, 1896, the cost of the campaign so far having been met out of a special grant of £300,000 in the estimates for the year 1896.

The first official mention of rinderpest in 1897 was the 5th rinderpest report published under G.N. 43 (*S.* 3/2/97). It is valuable in that it allows an estimate to be made of the mortality. It was reckoned in Ward 3, Lichtenburg, that not more than 5 per cent became *immune* (*i.e.* recovered), in the Harts River ward of Christiana approximately 20 per cent, in the Upper Schoonspruit ward of Klerksdorp about 11 per cent, and in the Crocodile River ward of Pretoria approximately 5 per cent ([15]).

Further regulations were made under the Proclamation of 16/2/97 (*S.* 17/2/97) to assist transport, *e.g.* owners of farms were to keep their cattle at least 300 yards from the public road, transport riders were also to take precautions against contact, etc. Appearing on the same day was the Proclamation dealing with an outbreak of the disease on Brakfontein farm, Pretoria, and directions were given as to the routes to be followed from Pretoria to Heidelberg and from Pretoria to Johannesburg.

Further to the Proclamation of 26/11/96 and G.N. 561 (*S.* 23/12/96), G.N. 81 (*S.* 3/3/97) gave details concerning the sale of mules and donkeys for transport purposes.

Of particular interest is the publication of the Report issued by the members of the Commission (D. J. C. Erasmus, Chairman; P. G. du Plessis, Rinderpest Commissioner; T. L. Loxton, Medical Officer of the Staats-Artillerie; A. Theiler, Government Veterinarian; Dr. J. W. Stroud; P. Kruger, Field-cornet of Zwartruggens, Rustenburg; and Dr. J. Bordet of the Pasteur Institute, Paris) which visited Dr. R. Koch at Kimberley at the end of February, 1897, in connection with his bile immunisation method. As a result of their report the Proclamation of 2/3/97 was published (*S.* 3/3/97), its purpose being to draw attention to the advantages of bile inoculation in *affected* areas. As there was a scarcity of syringes, the members of the Commission would teach suitable persons

([15]) According to *Blue-book G. 72—98, Cape of Good Hope*, in the Cape Colony proper of 1,639,435 cattle 575,864 *died* of the disease during the period 1896—8, giving a percentage of 35.125.

the technique and to these a certificate would be issued. No fee was to be charged and reports of the efficacy of the inoculation were to be sent to the authorities.

Whereas £300,000 had been voted for rinderpest services for 1896, only £223,861 12s. 3d. was expended. According to the Estimates for 1897, £150,000 was set aside for rinderpest control.

The Proclamation of 30/3/97 (*S.* 31/3/97) is important in that it refers to good reports by Theiler, Bordet, and Danysz at Waterval on the Koch bile method, so much so, that regulations are issued as to procedure, a noteworthy provision being that of payment by owners to inoculators. The fee is 1/- per head up to 50, 9d. per head up to 100, and 6d. for more than 100 head.

The first Proclamation of 20/4/97 (*S.* 21/4/97) allows the exportation of meal and grain subject to the rinderpest regulations, *viz.* that oxen might not be used for transport purposes on account of the risk of spreading infection. The second Proclamation of 20/4/97 (*S.* 21/4/97) draws attention to complaints received from farmers that some officials would not allow trekking. In order to regularise matters, the field-cornet and landdrost were to make it clear which roads were permissible for trekking, and farmers, provided of course with permits, were allowed to proceed to their winter grazing only with healthy cattle, and then as speedily as possible. As the disease had broken out in Chief Mariep's Location in Lydenburg (G.N. 192—*S.* 12/5/97) no permits could be issued for that area. In fact, G.N. 284 (*S.* 7/7/97) and G.N. 303 (*S.* 7/7/97) thereafter prohibit the introduction of cattle into Swaziland.

The next day set apart for prayer, the 13th June (Proclamation of 22/5/97—*S.* 26/5/97) was not only because of rinderpest but also because of enteric fever.

Just as happens to-day, complaints were sent by aggrieved persons to headquarters, and G.N. 254 (*S.* 9/6/97) refers to laxity in the payment of fees due to certain individuals for services rendered in the campaign against rinderpest. By the Proclamation of 24/8/97 (*S.* 1/9/97), which repealed the measures of the previous November and December regarding commandeered labour, it is evident, Theiler, Danysz, and Bordet having perfected a serum from immune cattle, that legislative control was coming to an end, the chief disadvantages being the enormous cost it entailed and the difficulty of enforcement.

Of greater professional interest and to be considered along with Theiler's description of rinderpest, published under G.N. 121 (*S.* 27/5/96), are the reports (a) of the investigations of Theiler (and Watkins-Pitchford) into serum therapy at Marico between October, 1896, and January, 1897 (G.N. 322—*S.* 14/7/97), (b) from Waterval (Pyramids) where Danysz, Bordet, and Theiler (*S.* 28/7/97) had been engaged

from 15th February to 15th June, 1897, and (c) of the International Rinderpest Congress held at Pretoria from 2nd to 13th August, 1897. In 1897 were also published papers by Theiler on "Rinderpest in Süd-Afrika" and "Experimentaluntersuchungen über Rinderpest" in the *Schweiz. Archiv f. Tierheilk.*, Vol. 39.

Another day of prayer, 3rd October, 1897, was ordered by the Proclamation of 16/9/97 (*S**. 18/9/97). As rains fell soon after, a day of thanksgiving was set aside, *viz.* 31st October, this being ordained by the proclamation of 15/10/97 (*S**. 16/10/97).

In spite of the association of rinderpest and game, it is significant that by the Proclamation of 1/11/97 (*S.* 3/11/97) rhinoceros and buffalo were protected throughout the Republic and kudu, blue wildebeest, waterbuck, and nyala in the district of Vryheid for five years.

As was indicated by the Proclamation of 24/8/97 (*S.* 1/9/97), it was now realised that the arrest of the disease by special legislation was useless. The Proclamation of 11/11/97 (*S**. 12/11/97) confirms this by repealing all rinderpest legislation except the regulation allowing the export of immune cattle to the Orange Free State ([16]). Field-cornets, however, were empowered to commandeer natives to assist the farmers to bury or burn carcases. In the place of special rinderpest regulations, Law 3 of 1870, originally promulgated to combat lungsickness, would operate, except article 12, which allowed half the fine (which might be imposed on anyone contravening the lungsickness law) to be paid to the informer.

Finally, in 1897, G.N. 537 (*S.* 1/12/97) laid down the conditions under which persons impoverished by rinderpest might receive financial assistance, the State having allocated £150,000 for this purpose.

The first proclamation of veterinary interest in 1898 was that of 4th February (*S.* 23/2/98) which forbade the importation of second-hand clothing, ox tails, and raw hides, unless properly disinfected. Since Law 3 of 1870 did not provide against the importation of cattle suffering from communicable diseases, regulations regarding the introduction of cattle from adjoining states were promulgated under the Proclamation of 7/3/98 (*S.* 9/3/98). It was laid down that a certificate of origin was essential, that inspection was to be made at the port of entry, that the railway authorities were to satisfy themselves as to the health of the animals, and that animals proceeding by road could be stopped by anyone suspecting disease, etc. In case of quarantine being necessary, the owner or importer had to pay all charges. If it had been possible to undertake supervision, such legislation would have been most useful, but there was little or no

([16]) Verney states (p. 98) that the Natal Veterinary Department carried out the bile inoculation of Koch for a month and in the meantime immune cattle "were procured from the adjoining states" in order to undertake serum treatment.

compulsion, an excellent example being the widespread distribution of lungsickness in the Republic at the time, in spite of Law 3 of 1870! The Proclamation of 23/3/98 (*S**. 24/3/98), also relating to the introduction of cattle, clarified a point regarding the certificate of origin.

With the abatement of rinderpest in 1898 (only £5,000 ([17]) was set aside this year for combating the disease) legislation was passed which protected for long periods game in several parts of the Republic, *e.g.* in Pretoria Townlands and Groenkloof (*S.* 26/1/98) and in Rustenburg, Waterberg, Marico, Belfast Town, and Wakkerstroom Town (*S.* 4/5/98). In this year the Proclamation of 26/3/98 (*S.* 6/4/98) established the Sabi Game Reserve (now the Kruger National Park).

Of particular interest was the publication of G.N. 174 (*S.* 20/4/98), to which was appended a report by Messrs. O. Schwikkard and F. Verney, M.R.C.V.S. These gentlemen had been commissioned by the Natal Government to investigate the rumour that so-called immunised cattle might succumb to further infection. Among other things it was stated that about 50 per cent of the cattle in the Republic had died of rinderpest, (b) that approximately 400,000 head had not been immunised, thus indicating that they were susceptible, (c) that the Pitchford-Theiler serum system of inoculation was more valuable than Koch's bile method, (d) that deaths after a period might follow the serum-alone inoculation (also practised by speculators) as the immunity was necessarily brief, and (e) that Theiler himself had not encountered cases where actively immunised cattle had later died of rinderpest.

In 1898 Theiler published an article "Blutserum immuner Thiere in Kampfe gegen die Rinderpest" in the *Deutsch. Tierarz. Wochensch.* No. 24 (11/6/98).

In the *Staatscourant* of 13/7/97, tenders were invited (Bestek No. 482) for "Zuurkasten en werktafels, voor het Laboratorium van den Gouvernements Veearts, nabij Daspoort" ([18]). Further information could be obtained from the notice board in the vestibule of the Government Buildings, Pretorius Street entrance. A fortnight later (*S.* 27/7/98) applications were invited for the posts of secretary and assistant secretary to the "Veearts", the salaries being £200 and £180 p.a. respectively. The usual qualifications of the period, *viz.* certificates of citizenship and religion were demanded.

In the *Staatscourant* of 17/8/98, G.N. 398 indicates that, as in 1896, a considerable body of public opinion favoured the creation of a State

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([17]) The Estimates for 1898 still include £300 for the *Paardenarts* of the *Staats Artillerie* and £500 for the *Gouvernements Veearts* (Medical Dept.), who, however, has now a secretary at £200, an assistant for preparing vaccines at £180, and three natives at £48 each. There is also the item "calves for State Veterinarian for vaccines" at £464.

([18]) The *Government Gazette* of 4/1/99 seeks tenders for the supply of 51 blinds for the Daspoort Laboratory.

Department of Agriculture and Animal Husbandry (see draft regulations in *Staatscourant* of 1/2/99).

Of particular interest is the Proclamation of 8/9/98 (*S**. 8/9/98) appointing the 18th September as a day of prayer in view of the ravages of the drought and the small-pox epidemic. The reference to small-pox is interesting because it was the preparation of the vaccine against this disease that first (in 1893) brought recognition to Theiler. It is of interest to note in the *Staatscourant* of 12th October, 1898, from G.N. 523 that Theiler had a supply of calf lymph available at his Laboratory and prepared "in gesteriliseerde glasbuisjes". Appended to the notice are instructions for use.

That rinderpest had not entirely spent itself is evident in G.N. 543 (*S*. 2/11/98), for the Justice of the Peace, Belfast, recommends the use of snake poison as a curative agent!

The final item of interest in the *Staatscourant* of the pre-Anglo-Boer War period is the Estimates for the year ending December 31, 1899. Here we learn that the *Staats-Artillerie* still has a "*paardenarts*" at £300 p.a., with the rank of Second Lieutenant, that Theiler continued to be in the Health Department, his salary being £500 p.a. and that of his secretary £200. He had two assistants to prepare vaccines and an additional staff of six "*bedienden.*" Most significant of all was the special grant of £2,500 for the control of rinderpest, a big drop from the £5,000 voted the previous year, and a tremendous improvement on the £150,000 of 1897.

Then followed the tragedy of the second Anglo-Boer War, during the early stages of which the disease was not manifest. Smith (1914) mentions (p. 206) that isolated cases probably existed in 1900 and in July of that year what was apparently rinderpest was encountered on the Zeerust road among cattle brought in from Bechuanaland. Again suspicious cases were observed on *post-mortem* examination at Pretoria in August ([19]).

Dr. Turner (1902), who had been transferred from the post of M.O.H., Cape Colony, as Sanitary Adviser to the military authorities in the Transvaal, next appeared on the scene with regard to the Transvaal. Accompanied by Theiler he diagnosed rinderpest at Thaba 'Nchu and Maseru in May, 1901. Theiler remained at Maseru to demonstrate the method of bile inoculation, no serum being available, and Turner "was directed to start a rinderpest station at Pretoria." At first everything went well, sheds, fecing and a destructor being added to Theiler's laboratory

([19]) It is hardly necessary to emphasise that prior to this date, especially in 1897, the disease raged throughout South Africa, but in 1899 and 1900 seemed to have disappeared except possibly in German South-West Africa. The last reported outbreak prior to May, 1901, was in August, 1899, on the borders of Transvaal and Bechuanaland.

of 1898 at Daspoort, but it was many months before an ample supply of serum was available.

We learn next from the report of the Auditor-General, Transvaal, for the year ending 30th June, 1902, that £861 13s. 9d. was spent for the year in question on the Daspoort rinderpest camp, the revenue from serum alone being £1,272 4s. 3d. The total rinderpest expenditure, however, was £6,066 5s. 5d.

In Theiler's first report as Government Veterinary Bacteriologist, *i.e.* covering the period 1st January, 1900, to 30th June, 1903, he gives a short history of the Daspoort Laboratory and mentions that from January to June 1,093.51 litres of rinderpest serum were produced. During the next year 740 litres of rinderpest serum, value £1,850, were issued.

The report of the Principal Veterinary Surgeon (S. Stockman) for the period May, 1903, to June, 1904, states that 14 outbreaks of rinderpest were dealt with, the last death occurring at Gopani Location, Marico, on 30th August, 1903. Stockman adds that " the manufacture of serum has now ceased, but a stock large enough to deal with initial outbreaks has been kept on hand ". Theiler reports that the stock in hand on 30th June, 1904, was 638 ccm.

It is significant, after the untiring efforts made after Koch's arrival in 1896 to improve the method of immunication, that at the first Pan African Veterinary Conference held at Bloemfontein in December, 1903, the following resolution was passed :—

" The means best suited to attain this end are the stamping out of outbreaks of rinderpest by a liberal use of serum if obtainable; failing this, *pure bile* inoculation, carried out under professional supervision is preferable to any other method."

So ended rinderpest in the Transvaal and indeed in what was to form the Union of South Africa.

Summary.

For the first time an account is given of the vigorous part taken by Theiler in the rinderpest epizootic of 1896–1903.

The description is naturally restricted to the Transvaal, where from March, 1896, until November, 1897, much reliance was placed on legislation with, extraordinary to relate, unprecedented results, having in mind the inevitable ineffectiveness of legislative control.

Thereafter inoculation first with bile and later with serum was adopted.

An idea of the rate at which rinderpest spread in the Transvaal may be gained from a glance at the map.

The struggle against rinderpest, particularly in 1896, although a failure, was Theiler's greatest achievement.

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*) In 3. *Heft* Theiler published "Klinische Beobachtungen aus Südafrika," including (a) "Die Tuberculosis unter den Haustieren in Südafrika", (b) "Rauschbrand", (c) "Eine enzootische Blasenlahmung," and (d) "Über das Wasser reiten."

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Remarks on Sleeping Sickness.*

By F. K. KLEINE, Professor at the University of Berlin.

What I shall tell you this evening is not new : you will find it already recorded in the literature of this subject. But still I believe that my personal remembrances connected with the research work on trypanosomes may offer something of interest to one or other of you.

You will perhaps remember that in about 1900 at Lake Victoria a devastating disease of unknown nature, the so-called sleeping sickness, destroyed upwards of 100,000 human beings. An English Commission, of which Dr. Aldo Castellani was a member, worked in Uganda to study the disease. At the end of 1902 he claimed to have discovered the germ of the disease in a certain streptococcus. As Castellani at this time became Professor of Pathology in Ceylon, Colonel David Bruce, from the Royal Society, was appointed leader of the commission. When they both met in Entebbe, Castellani told David Bruce of the occasional finding of trypanosomes in the cerebrospinal fluid of patients who had died from sleeping sickness. Like a flash of lightning the idea came upon David Bruce, who after his nagana investigations in Zululand had a special interest in trypanosomes : these parasites are the real cause of sleeping sickness ! He urged Castellani to examine all cerebrospinal fluid smears of the deceased once again and this time they found trypanosomes in a rather high percentage.

After that Castellani reported his findings to the Royal Society and also published in German a paper about trypanosomes as the cause of sleeping sickness. The name of David Bruce was not mentioned. In honour of Castellani, Dr. Kruse, the Professor of Hygiene in Bonn, in whose institute Castellani had formerly worked, named the newly discovered parasite *Trypanosoma castellanii.*

In his own report to the Royal Society, David Bruce tried to correct the history of the discovery. But even now several authors do not realise that it was David Bruce who was the real discoverer of the cause of sleeping sickness.

That trypanosomes are found in human beings was already known before. In West Africa, Ford, a veterinary officer, had seen a parasite in human blood which was diagnosed by Dutton as a trypanosome. When

* A lecture delivered at Onderstepoort in September, 1936.

later Dutton saw trypanosomes in human blood again, he called them *T. gambiense*. The parasites were thought to be rather harmless, not unlike *T. lewisi* in rats, *T. theileri* in cattle, or *T. kochi* in crocodiles. Their connexion with sleeping sickness was recognised only by David Bruce.

To-day it seems somewhat surprising that Castellani and his colleagues did not realise the connexion, especially since at that time a medical officer at Entebbe, Dr. Baker, had seen trypanosomes during attacks of fever in three human beings. Castellani mentioned this in his report to the Royal Society, but added that his parasites differed from those of Baker and those of earlier observers.

In the beginning of 1906, a German expedition under the leadership of Robert Koch, to whom I was seconded, arrived at Lake Victoria, as the disease began spreading to the German territory. The chief results of this expedition were the systematic and in several cases rather successful treatment of patients with an arsenical drug, Atoxyl; and, further, improved diagnosis. When we started our investigations on the Sese Islands, examining ordinary blood smears, we found trypanosomes in only about 2% of the cases. But when we changed over to the method of the so-called "big drop", trypanosomes were found in up to 90 and even higher percentages. A drop of blood from the ear of the patient was spread to the size of a shilling on a slide. After drying without fixation and without de-haemoglobinising we stained for an hour with a weak solution of Eosin-Azur II. The slide has to be carefully dipped in water and after drying it is ready for microscopical examination. The white blood corpuscles and the parasites are stained, the red blood cells have disappeared.

That method is of the greatest value for the detection not only of trypanosomes, but also of many other blood parasites. As far as I know, it is used in Germany for routine work in most institutes as well as in the Tanganyika Territory and Kenya. Recently the method was used by Mr. D. A. Lawrence in Salisbury with most satisfactory results.

Bruce established the fact of sleeping sickness being transmitted by the tsetse fly, *G. palpalis*. When he fed flies on a sick human being or a sick monkey and thereafter on a healthy monkey, he sometimes succeeded in transmitting the disease, especially if the feeding on the sick animal was interrupted. But mostly he was not successful. When David Bruce killed flies a few hours after feeding them on an animal whose blood was swarming with trypanosomes and inoculated the contents of the intestines into a clean monkey, the monkey did not become infected. In the intestines of the fly the trypanosomes loose their infectivity very quickly. If he examined the intestines of such a fly by smears the next day he did not find anything : the trypanosomes had disappeared. Therefore David Bruce and his coworkers were of opinion that the flies

transmit the trypanosomes mechanically. As one could with a lancet, so with its proboscis does the fly inoculate the disease from a sick animal to a healthy one.

R. Koch did not agree with this opinion. If it were right, how could it be that the disease only occurred in fly areas, whilst Africa is infested with so many different kinds of stinging insects? From the theoretical as well as from the practical point of view, Koch suggested quite a close connexion between flies and parasites. Examining flies caught in sleeping sickness areas, he found in the intestines large broad trypanosomes, together with very thin ones, both of which he believed to be sexual developmental forms of *T. gambiense*. His view was strongly shaken when E. A. Minchin, the well-known Professor of Protozoology at the University of London, found the same parasites in flies living on islands devoid of any kind of mammals. The American scientist Novy considered them to be normal commensal flagellates of the flies.

If Koch dissected laboratory-bred flies a day or some days after feeding on sick animals, like Bruce he found nothing. Both these workers, as well as many others, expended much energy and time on these investigations.

In spite of all these disappointments I kept to my opinion that a development *must* take place in the insect and that the fault of the former experiments lay in employing too small a number of flies. Perhaps the examination of flies had not been continued long enough; perhaps the supposed development would take weeks! David Bruce calculated, that under natural conditions, among 2,000 flies one was infective. The conditions of the experiments being similar, we might kill for the histological investigations just the very fly which may become infective later. Therefore I decided entirely to refrain from killing flies before the development of the trypanosomes was experimentally proved. For this purpose flies were bred on a large scale. Generally 3 females and 1 male were kept in one container.

The plan was to feed flies on an animal infected with trypanosomes and afterwards to feed them every day on a healthy animal until trypanosomes should be found in the blood.

At the beginning the number of flies reared from the pupæ was not sufficient for the experiments. If flies caught in the bush were used, it was possible that some of these were already infective, and therefore the development of the trypanosomes could not be proved. *To eliminate this danger I worked with T. brucei instead of with T. gambiense.* As there was no nagana in the neighbourhood of my experimental station near the coast of Lake Victoria, the flies could not be infected with *T. brucei*. From a *G. morsitans* area in the hinterland I got some animals (two sheep and one donkey) infected with *T. brucei* and on these I fed on

three consecutive days a large number of *G. palpalis*, caught in the bush. These then were fed every day on other and healthy sheep or cattle. The animals remained healthy. But one ox became infected on which I had put the flies 25 days after feeding on a sick sheep. From that time onwards all animals stung by these flies got the disease. The development of the parasites in the fly was proved.

The experiment (1909) was immediately repeated on monkeys with *T. gambiense* and flies bred in the laboratory. The result was always the same; the development of the trypanosomes in the fly takes 21 days at least. In the meantime the flies are not infective.

After having succeeded in transmitting *T. brucei* by *G. palpalis*, I could expect that, *vice versa*, also *G. morsitans*—widespread in East Africa—might transmit *T. gambiense* and sleeping sickness. Originally the disease was indigenous to the areas of *G. palpalis*, which belongs to the West African fauna. When the disease had been diagnosed at Lake Victoria about 1900, it was perhaps just on the point of invading East Africa.

At first at Lake Victoria I did not succeed in transmitting *T. gambiense* by *G. morsitans*. When I went on leave to Europe I therefore commissioned my co-worker, M. Taute, to continue these experiments at Lake Tanganyika. Here he succeeded in transmitting the trypanosomes without any difficulty. In my opinion the cause of the former failure lay in the different climatic conditions. Later comparative investigations, very carefully carried out by me and my co-worker W. Fischer, with 13 different strains of *T. gambiense*, demonstrated that *G. morsitans* transmits *T. gambiense* at least as well as does *G. palpalis*. But the developmental course in *G. morsitans* took some days more.

Sir David Bruce feared that what happens in the laboratory may not happen in nature, and he underrated the practical value of our experiments.

In the meantime from the south of German East Africa, from Nyasaland, and from Rhodesia reports about sleeping sickness in *G. morsitans* areas increased. But the germ, so it was reported, was different from the well-known *T. gambiense*. In the human blood the parasites could not be distinguished. After inoculations into rats and guinea pigs, in the new trypanosome so-called posterior nuclear forms—at that time unknown in *T. gambiense*—occurred, *i.e.* the nucleus was not situated in the middle of the parasite but near to the blepharoblast. Stephens and Fantham called the new parasite *T. rhodesiense* (1910).

Kinghorn and Yorke's report (1912), stating that in Northern Rhodesia as much as 16% of the game was infected with *T. rhodesiense* caused the greatest sensation among all people concerned. L. E. W. Bevan of Salisbury immediately emphasised the improbability of Kinghorn

and Yorke's discovery : the few human cases in Rhodesia were quite disproportionate to the high percentage of infected game. The P.M.O. of Northern Rhodesia, Dr. May, reported that the great majority of new cases of human trypanosomiasis had been found on or close to the main traffic routes and could be traced back to a known *T. gambiense* endemic area; that meant close relationship between the two infections.

That is also my opinion. During my stay in Northern Rhodesia in 1921, 1922 and 1923, and also (as a member of the League of Nations Sleeping Sickness Expedition) in 1926 and 1927, I endeavoured to make out clear clinical differences between the two diseases. I could not find any.

Mostly it is not difficult to trace the connexion of a new outbreak with an old focus. The Tabora district in the Tanganyika Territory offers a good example. Before the war there was no sleeping sickness, in spite of very many tsetse flies. When during the war hundreds of Belgian askaris with their wives, children, and boys had been camping there for a considerable period, the flies became infected and a dangerous outbreak of sleeping sickness occurred.

Furthermore, I cannot make out clear morphological differences between the two parasites. We have strains of *T. rhodesiense* with numerous posterior nuclear forms and strains in which such forms are rare. But also in *T. gambiense* we find sometimes posterior nuclear forms. In *G. mortisans* areas we meet with strains of trypanosomes scarcely distinct from strains of the common *T. gambiense*, and the most characteristic *T. rhodesiense* strain obtained by the International Commission came from the Belgian Congo and from a real *G. palpalis* area. I believe the so-called *T. rhodesiense* to be nothing else but the virulent form of *T. gambiense* in fresh outbreaks. Formerly my opinion was only shared by a few people, but now the followers increase. Particularly has Lester in West Africa emphasised that the name *T. rhodesiense* is useless and superfluous.

Sir David Bruce (1913) studying a new sleeping sickness focus in Nyasaland in a *G. morsitans* area, suggested that *T. rhodesiense* was nothing else but *T. brucei* having suddenly become pathogenic for human beings.

Our epidemiological and experimental experiences in no way conform with Bruce's suggestion. For instance, formerly between Dar-es-Salaam and Lake Tanganyika, in areas swarming with *G. morsitans*, where neither dog nor ox could remain uninfected, never a case of sleeping sickness occurred. To demonstrate the non-infectivity of *T. brucei* to man, Taute inoculated himself and then again himself, Dr. Huber, and more than 100 natives with *T. brucei*. Nobody became infected. Since that time the experiment has been repeated with variations by several people—lately

by Corson. The result was always negative. It is quite probable that hundreds or thousands of years ago *T. gambiense, rhodesiense* and *brucei,* and perhaps some other trypanosomes, originated from the same source, but to-day they differ considerably in respect of their pathogenity.

Previously cattle, sheep, and goats were believed to be insusceptible to *T. gambiense.* Under natural conditions *very* few animals infected with trypanosomes were found in the old sleeping sickness areas near Lake Victoria. When, with W. Fischer, I tried to infect a series of sheep and goats by laboratory-bred infectious flies, we only succeeded in 16.7% of subjects, whilst in the same experiment monkeys became infected to a percentage of 93. When we fed clean flies on those infected sheep, only for a limited period of time was the blood of the mammals infective. After 100 days it has lost its infectivity. Therefore I did not estimate highly the rôle of animals in spreading the disease.

Sir David Bruce got other results. If I remember right he could infect flies on a bushbuck even after two years. He recommended dealing with game as one would with mad dogs. Later on, Duke found the blood of another bushbuck, infected by *T. gambiense,* already sterile after a few months. Certainly the different results of these experiments depend on the difference of the strains. But as under natural conditions in *G. palpalis* areas we almost never meet with infected mammals, the importance of the latter in spreading the disease may be considered negligible.

In regard to the more virulent form of the human parasite, *T. rhodesiense,* the question is not yet settled. The investigations are not finished and are to be continued. But in the opinion of the English medical officers the chief source of sleeping sickness is man, also in *G. morsitans* areas.

To-day nobody believes Kinghorn and Yorke's statement regarding the percentage of infection in game. Without any doubt confusion with *T. brucei* occurred. When 14 years ago I asked Dr. Kinghorn why he had never found *T. brucei,* which is so common in game, he answered : "Because from a study of smears of a strain of *T. brucei,* kept for a long time in mice, I believed this parasite to be monomorphic and therefore thought that the dimorphic parasites in game were *T. rhodesiense.*" Indeed, as you know, strains of trypanosomes kept for many years in mice in the laboratory, lose the dimorphism and the ability to develop in flies.

I should like to add some words about combating sleeping sickness. We do it by sanitary measures and by medical treatment of the patients. We transfer the population from fly-infected areas to clean ones. Furthermore, we try to destroy the flies by cutting down trees, the shade of which they need, and by clearing the bush. However, the latter practice is advisable only if the native population is large enough to cultivate the cleared area. Otherwise bush-clearing is a waste of time and money. The Harris trap is of great value, as is also the hunting of game on which the flies feed.

For medical treatment Bayer 205, a drug of the group of Afridol dyestuffs, is the best. Of fresh cases, 100% became cured. Chronic cases are much more difficult to cure and a combined treatment with arsenical drugs (atoxyl, tryparsamide, etc.) is advisable. Bayer 205 has to be administered in all cases. It sterilises the blood of the patients for a long time and the patients no longer remain a source of fly infections.

You know that opinions differ regarding the way in which the drug acts—whether directly or indirectly. The school of Ehrlich suggests the direct destruction of the parasites. Many scientists believe that the action is an indirect one dependent on a reaction between the body and the drug, and one in which the species of animal is of prime importance. For instance the effect of Bayer 205 in human beings is excellent; not so in cattle. Antimonial drugs work very well in animals; not at all in sleeping sickness cases. You may object that the trypanosomes of human beings and animals are different and the difference of the parasites is sufficient explanation for the different effect of the drugs. But, as far as I know, in mice Bayer 205 has a good therapeutical effect on *T. brucei, gambiense, congolense,* and *equiperdum, i.e.* on a number of quite different parasites.

To settle the dispute about the direct or indirect effect of drugs, I suggest that some cattle should be infected with *T. rhodesiense.* If the cattle cannot (like human beings) be cured easily with Bayer 205 then, the susceptibility of the parasite not being in question, the influence of the species of the animal would be proved. I believe that this would be found to be the case. For I remember that Ehrlich sent me many arsenical drugs, most excellent on *T. gambiense* in mice. When I tried them on human beings they were of no use at all, to Ehrlich's great disappointment.

Robert Koch often said : *" Vergessen Sie nie dass Mäuse keine Menschen sind."*

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The Horsesickness Problem in South Africa.

By R. A. ALEXANDER, Onderstepoort.

The problem of the control of horsesickness in South Africa continues to present many of the features and difficulties that were outlined by Theiler in 1915, but the chances of success of the campaign against the disease have been enhanced considerably as a direct result of data accumulated from the research work which has progressed from that time. There remains a formidable quantity of work to be carried out to elucidate numerous essential aspects of the disease, particularly in the light of the many recent contributions to our knowledge of the biology of viruses in general, but since some progress has been made, the time is opportune to review the present position of the problem.

Naturally the final solution remains the total eradication of horsesickness from the country together with the adoption of effective measures to prevent its reintroduction from outside. However, the attainment of this goal does not appear to be in sight, chiefly owing to the lack of knowledge of two important factors in the cycle of infection, namely, the identity of the invertebrate vector or vectors and the reservoir of infection.

A considerable amount of time and energy has been expended in an effort to identify the vector, which all epizootological evidence indicates is a night-flying insect whose prevalence is associated with seasons of heavy rainfall. Up to the present this work has yielded entirely negative results (Nieschulz, Bedford, and du Toit). This is regrettable, since the lack of knowledge not only prevents the prescription, except on the broadest empirical grounds, of rational measures to minimize the risk of infection, but also serves as a barrier to what might well be a profitable avenue of approach to the determination of the virus reservoir, namely an intensive study of the natural sources of food of the vector.

Theiler appreciated the possibility of horsesickness virus existing in symbiosis with some animal other than the equine, and carried out extensive transmission experiments from a wide variety of wild animals, birds, and amphibians that were caught or shot at random in horsesickness areas. All these experiments yielded negative results; but, if the vector were known, the search for a reservoir would be narrowed down to those species which serve as the normal source of food of the transmitter and the problem might be solved, not by chance, but by systematic research. Naturally one must not lose sight of the possibility of equines alone constituting the habitat of the virus and that the recovered horse,

mule, or donkey comprises the source from which the vector obtains its infection. Against this conception two main arguments are advanced. In the first place it is generally accepted as a fact that the disease may make its appearance among susceptible horses introduced into areas from which all equines have been absent for many years. To this it is merely necessary to reply that this belief is based on observations which are unsupported by adequately controlled critical experiments and is therefore quite untenable. In the second place it is stated that transfusion experiments have shown that the blood of recovered animals is infective for only a limited period of time after recovery. (Theiler). Although this is true, it has been shown that neutralizing antibodies are not demonstrable in the serum until some weeks after infection and that they do not attain a high titre until almost six months after recovery (Alexander 1935). Consequently, blood withdrawn from a recovered horse a few weeks after the febrile reaction may be infective, while at a later stage any circulating virus would be masked by the excess of antibodies with which it is in contact; yet this virus may be capable of initiating infection in the invertebrate host if credence is given to Sabin's (1935) conception that in virus diseases the antibodies are not virucidal. Again a series of critical experiments are required to elucidate this point. In the meantime it remains necessary to admit that no definite opinion can be expressed regarding the reservoir of horsesickness virus under natural conditions.

At this stage it should be emphasized that, even should the vector and its source of infection be identified in the immediate future, it might remain a matter of doubt whether the chain of infection could be broken by eradicating the one or eliminating the other. Consequently the present practical solution of the entire problem is dependent upon the discovery of an easily available specific for the treatment of affected animals or the elaboration of a simple and safe method of preventive immunization which will be efficacious in approximately 100 per cent of cases.

Every attempt to discover or synthesize a drug or combination of drugs with the specific action either of arresting the development of the virus after entry into a susceptible host, or of inactivating that virus after multiplication has commenced, has proved unsuccessful. On the other hand, careful investigation into the problems of immunity and immunization has been attended by most encouraging results. Much of the more recent work on this aspect has been made possible by the discovery of the susceptibility of the white mouse and guinea pig after inoculation by the intracerebral route (Nieschulz, Alexander, 1933); and the method of immunization which has been introduced into general practice recently is based upon the phenomenon of attenuation of the viscerotropic virus after neutortropic fixation.

It is evident, therefore, that any campaign against horsesickness must be based upon effective systematic immunization. And in this communi-

cation a broad outline will be given of some of the additions that have been made to our knowledge of the immunology of the disease. Such aspects as the symptomatology and pathology will not be dealt with, since the original descriptions by Theiler require no elaboration.

Active Immunity.

Early recognition of the durable immunity possessed by those animals which had recovered from a naturally-contracted attack of horsesickness prompted the initial efforts to develop a method of artificial immunization. As this work progressed it was observed that on exposure to reinfection a variable percentage of immune animals might undergo a second and more rarely a third reaction either of which might or might not be fatal. Locally these secondary reactions are spoken of as "relapses", but it is now known that the term is a misnomer. Secondary reactions are the result of infection with a strain of virus immunologically distinct from that responsible for the initial attack, and the immunity against a given strain remains solid against that strain. This point is well illustrated by the series of reactions produced in a particular horse (20334) as a result of the injection of different viruses collected from a variety of sources. The horse received initially an intravenous injection of an attenuated neurotropic strain of virus (strain K) which had been collected from a fatal case of horsesickness in an immune horse in the stables at Onderstepoort. A severe reaction followed and 15 days after recovery the animal was found to be solidly immune to the homologous non-attenuated virus. After an interval of 14 days an injection of virulent blood, strain O, was given. A severe reaction, followed by ultimate recovery, ensued, indicating partial immunity since O virus can be relied upon to be fatal in 100 per cent of fully susceptible animals under laboratory conditions. After a further interval of 20 days a third injection of virulent blood was given. This strain had been isolated some time previously from a fatal case of horsesickness in the field. Again there followed a severe but non-fatal reaction. Subsequenty the horse was found to be solidly resistant to the injection of all three strains of virus.

The experience with this horse clearly illustrates an observation which has been recorded repeatedly, namely, that the immunity set up as a result of recovery from infection with one strain of virus is sufficient to protect against subsequent infection with the same strain, but can afford at most only partial protection against a different strain. Under conditions of good hygiene and of rest in the stable, this partial immunity may be sufficient to save the life of the animal, but under adverse conditions in the field the severe reactions may prove fatal in a large percentage of cases.

This variation in antigenic structure of different strains of virus has been substantiated by recent work on the *in vitro* neutralization of viruses

by type sera. Details of the technique employed have been reported elsewhere (Alexander 1935), but briefly is may be stated that groups of horses were immunized against various trains by the injection of the attenuated neurotropic virus. Serum was collected after an interval of about six months, *i.e.* at the time when the antibody content could be expected to have attained a maximum. Neutralization tests were carried out by mixing falling dilutions of the pooled sera from each group with an equal quantity of a virus emulsion known to contain in 0.025 cc. approximately 100 minimal infective doses for mice. Mice were inoculated intracerebrally with 0.05 cc. of each mixture, after it had been incubated at 37° C and fixed overnight in the ice box. In this way it was possible to determine the smallest amount of a given serum capable of neutralizing 100 minimal infecting doses of each strain of virus. The results show that whereas a dilution of serum as high as 1 : 1024 may be capable of neutralizing 100 M.I.D. of the homologous strain of virus, a concentration of 1 : 2 may not suffice to inactivate the same amount of a heterologous strain. Usually, however, there does appear to be some overlapping of antigenic structure; but for practical purposes the possible common antigen must be regarded as being insufficient to produce an adequate immunity against the heterogenous natural infection in the field. In this connection it is interesting to note that anti-serum produced against virus type O—the strain which formed the basis of Theiler's serum-virus method of immunization—has been found, by *in vitro* methods, to neutralize, albeit only to very low titre, practically every strain which has been isolated up to the present time. This observation pays striking tribute to the accuracy of the deductions drawn by Theiler from his *in vivo* experiments on horses, since O virus was incorporated in his scheme of immunization when it had been demonstrated by extensive trial that the best results were obtained in the field only when this strain was used as a basis for the method.

In this article it would be quite out of place to enter into any discussion on the merits or demerits of the *in vitro* neutralization technique as a basis for comparison of the antigenic structure of virus strains. It must suffice to say that, in spite of the admitted fact that the antibody content of the serum cannot be regarded as an accurate index of the immunity of a particular animal, the method so far has not failed to identify aberrant strains collected in the field and is the only economic method for reliable differentiation known at present.

Since this work was commenced a total of 12 virus strains have been isolated and have been fixed neurotropically in mice. The task of identifying all these strains has not been completed; but, as will be shown in an article now in preparation, at least five show wide antigenic differences that justify classification as different types. Whether these five types cover the entire antigenic range of those to be found in nature is a problem which still awaits elucidation.

Now that a clear conception of the nature of active immunity has been obtained, it is possible to proceed to a critical survey of the methods of immunization which have been investigated in the past and to hazard an opinion on the probable value of the neurotropic virus method which has come into general use.

Method of Immunization.

As pointed out by Theiler (1930), the methods of Edington and Bevan, which apparently consisted of vaccination by means of an attenuated virus, cannot be discussed owing to the lack of any published account of the technique of attenuation, the method of application, and of a statistical survey of the results obtained. There remain for consideration, therefore, the serum-virus progressive method elaborated by Theiler, the formolized spleen-virus method and the neurotropic virus method.

A. *The serum-virus method.*

Essentially the method consists of the simultaneous injection of a particular selected virus (N virus) and 400 cc. of hyperimmune serum, followed three days later by the simultaneous injection of a second selected virus (O virus) and an additional 400 cc. of hyperimmune serum. This combination has been worked out, after careful experimentation over a number of years on many hundreds of animals, as that which is attended by the least danger of mortality and which results in the development of the most satisfactory general immunity. Full details of the laborious technique of preparation of adequate hyperimmune serum are omitted since these will be found in the numerous publications by Theiler on the subject.

Horses immunized by this method undergo a reaction which varies from a mild horsesickness fever to a severe febrile condition accompanied by dikkop (supraorbital oedema). Rare cases of fatal shock as a result of the intravenous injection of the massive doses of serum have been recorded and on occasion the mortality as a direct result of immunization has reached as high a figure as 10 per cent. Moreover, many of the reactions are so severe and prolonged as to necessitate a long period of convalescence, with consequent serious economic loss to the owner.

It is exceedingly difficult to obtain reliable statistics on the results of immunization in the field by this method, but accurate figures have been obtained through the courtesy of Major D. D. Morton, Veterinary Officer to the South African Police, covering the results obtained with police remounts for the period 1927–34. During that time 2,643 horses were immunized : 62 or 2.35 per cent died of horsesickness as a result of inoculation; 85 or 3.21 per cent subsequently died of horsesickness on exposure to natural infection in the course of patrol duty; 3 or 0.11 per cent died of " staggers " some time after immunization. Thus the total

mortality was 5.67 per cent. This figure is not excessive. But it must be admitted that the results are considerably better than those obtained by farmers, since the hygiene and general management of police horses approximates the ideal. Nevertheless du Toit, after a careful survey of the horsesickness position after the record epizootic of 1922–23, concluded that in spite of a record of 17.6 per cent mortality amongst immunized horses in the field, the consensus of opinion among both veterinary authorities and the farmers was that immunization on the whole had been a success and that under no circumstances should the application of the method be discontinued.

To summarize the position as it appears to-day it is necessary to indicate that—

(a) The cost of immunization is high; a charge of £2 (subsequently reduced to £1) was made for sufficient serum and virus for each animal, and it is doubtful whether this sum entirely covered the cost of production of the hyperimmune serum.

(b) The method is cumbersome owing to the necessity for the intravenous injection of large quantities of serum at precise intervals, a procedure which should be carried out only by a qualified veterinarian.

(c) It is necessary to maintain an elaborate organization at Onderstepoort to ensure a constant supply of hyperimmune serum of high potency.

(d) The mortality as a direct result of immunization is too high and consequently it was not possible to advocate the application of the method to the more valuable types of horses.

(e) The active immunity produced is inadequate to afford protection against the multiplicity of strains encountered in the field and the cost of production of a polyvalent hyperimmune serum would be prohibitive.

(f) Finally, the incidence of "staggers" in immunized horses may on occasion attain alarming proportions. The aetiology of this condition, which is invariably fatal, is unknown; but it appears to stand in some relation to recovery from horsesickness and possibly it may be due to liver derangement caused by the large intravenous dose of serum under certain dietetic conditions.

So far no reference has been made to the immunization of mules: the serum virus method, using a single injection of virus together with 300 cc. of serum, has given very satisfactory results. This might be anticipated when the greater natural resistance of this species of animal is taken into consideration.

B. *The formolized spleen virus method.*

A considerable amount of experimental work has been carried out both in the Colony and Protectorate of Kenya and at Onderstepoort on

this method of immunization. At the outset it must be stated that, although a close study of the published reports indicates that an identical technique was used by both sets of workers quite independently, the results obtained at Onderstepoort on a fairly large scale, with adequate immunity tests in every case, have been less encouraging than those reported from Kenya. On our part every effort was made to develop this method which appears to have been so successful in the campaign against rinderpest in many parts of the world; but when applied to horsesickness the limitations are so numerous that all hope of its eventual introduction into general practice had to be abandoned. Briefly these limitations may be enumerated as follows :—

1. The antigenic potency of different batches of formolized vaccine, even when prepared from the pooled material from several spleens, varies within wide limits.

2. The lowest concentration of formaldehyde required to "attenuate" the virus to a consistently safe level is 1 part in 100 parts of a 20 per cent saline emulsion of infective spleen, but the immunity produced by the injection of this inactivated material is insufficient to protect against fully virulent virus. A concentration of formaldehyde not greater than 1 : 4000 must be used if a consistently solid immunity to unaltered virus is to be produced.

3. The immunity produced by formolized vaccine is transient, so that it is essential to complete the immunization process by the injection of fully virulent virus.

4. Ultimately it was found that the best results were obtained by giving four injections of vaccine inactivated by progressively lower concentrations of formaldehyde (0.1, 0.05, 0.033, 0.025 per cent formaldehyde) at intervals of 14–21 days prior to the injection of virulent blood. Thus the method necessitates five injections over a period of not less than two months, a procedure quite unsuitable for general application.

5. A severe and even fatal reaction may result from any one of the injections, indicating that the margin of safety is exceedingly narrow.

6. The keeping quality of the final product is not good; bacterial contamination, which readily occurs during manipulation of the infected spleens, is not controlled by the high dilutions of formaldehyde; each batch of vaccine would require testing on an adequate number of horses before issue could be contemplated.

7. The difficulties attendant upon the production of a potent vaccine against even a single strain of virus are so great that it was not possible to entertain any hope of eventually developing a polyvalent product.

8. Finally an attempt was made to combine the formolized spleen virus and the serum virus methods, but with little success, since large quantities of serum were required to control the severity of the reactions.

It is seen therefore that in our hands the production of a solid immunity by the use of tissue virus inactivated by formalin proved a distinct failure and any attempt to substitute it for the serum virus method was contraindicated.

C. *The neurotropic virus method.*

As stated previously, this method of immunization is based upon the phenomenon of attenuation of virus by serial passage through mice by the intracerebral route. Details of the technique of vaccine production together with the results obtained during the first season of extensive use in the field (1934–35) have been published recently. (Alexander, Neitz and du Toit, 1936). It is unnecessary to recapitulate the results, but it may be stated briefly that up to the present time approximately 90,000 horses and mules have been treated. The mortality as a direct result of immunization, if there has been any mortality at all, is negligible; in fact, it is the exception to be informed that injected animals have shown signs of any visible reaction whatever. Unpleasant sequelae have not been reported, except for about five cases of blindness in mules which may or may not be associated with immunization, and the onset of "madness" in two horses seven days after injection. The immunity produced is solid, as indicated by a total mortality of less than 1 per cent on exposure to natural infection and by the fact that in no single instance under laboratory conditions has the immunity of an animal been broken down by the injection of the homologous strain of virulent virus.

It is evident, therefore, that a method of immunization has been made available that holds out considerable promise for the future. A vaccine of standard potency may be prepared in large quantities with ease, and consequently the cost is low. The method of immunization, consisting as it does of a single small subcutaneous injection, is simple and easily applied. Inoculation is unattended by danger, so that the more valuable and better class of animal may be treated without misgiving. This is in marked contrast to the serum-virus method the use of which on valuable thoroughbreds was too dangerous: as a result, the chief value of many immunized animals rested in the fact that they were "salted" rather than in the possession of a record of outstanding performance, noteworthy bodily conformation, or excellence of pedigree. Finally, the immunity produced is solid and durable, so that the attention of workers may be focussed upon the development of complete polyvalent immunity. The latter is a problem which will require a great deal of time for its solution, because the isolation, neurotropic fixation, and accurate typing of a strain of virus requires, by present methods, a period of time of not less than two years. Progress is being made, although it is admitted frankly that, as yet, finality does not appear to have been attained.

Discussion.

It is now apparent that in the light of our present knowledge of the disease it is not possible to consider the formulation of a plan of campaign which will have as its object the eradication of horsesickness from the country. Since the identity of the insect vector is unknown and the reservoir of infection remains obscure, rational measures cannot be adopted to break the chain of infection at that link which comprises the infective invertebrate host. Since no efficient chemotherapeutical agent has been discovered the only preventive measure which remains is the maintenance of an immune equine population. This object may be achieved by the persistent application of the method of immunization which has recently come into general use with encouraging results. But it is necessary to sound a note of warning by pointing out that individual idiosyncrasy will always militate against the production of 100 per cent solid immunity. Moreover, immunity production must be exposed continually to a very severe test, since infection in the field continues to remain quite unchecked. Consequently, " breakdowns," which will be a source of great disappointment and possibly severe financial loss to individual owners, will be encountered from time to time and must be anticipated. If the proportion of " breakdowns " can be consistently maintained at a figure of less than 1 per cent, then it may be claimed confidently that immunization has been an unqualified success and that the horse- and mule-breeding industries have received the maximum benefit from the application of a prophylactic measure which, by itself, must be the least effective weapon in the armoury of the epizootologist. Although progress along the lines of research at present being followed is continually being reported, a consideration of the gaps in our knowledge and the difficulties that remain to be overcome will show that the final solution of the horsesickness problem is not within sight.

In conclusion, it is necessary to emphasize that no review of this problem would be complete without reference to the outstanding pioneer work that was carried out by the late Sir Arnold Theiler. Measured by present standards, the technique available to his hand was somewhat crude; yet the conclusions he drew from the results obtained, using a limited number of horses, were so unerringly accurate as to appear to have been prompted by genius or inspiration. Only the solidity of this groundwork has made possible the many additions that have been made, and it will always remain a matter of regret that Theiler was not more intimately associated with the present developments in the problem which he made peculiarly his own.

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A Rickettsia-like Organism of the Conjunctival Epithelium of Cattle.

By J. D. W. A. COLES, Onderstepoort.

In 1931 the author described a Rickettsia-like organism in the conjunctival epithelium of the sheep, and assigned to it the name *Rickettsia conjunctivae*. It was suggested the organism was probably the cause of an infectious conjuctivitis. Recently in 1936, Donatien, in a personal communication, stated he had found apparently the same organism in Algeria, in the eyes of sheep affected with specific ophthalmia.

In 1935 the author noted the presence of a Rickettsia-like organism in the conjunctival epithelium of goats suffering from conjunctivitis and keratitis.

In 1935 the author, while in the United States of America, rediscovered the intracellular structures described in Germany in 1910 by Uhlenhuth and Böing, in the conjunctival epithelium of pigs. The material examined by the author was provided by Dr. J. D. Ray of Omaha, who made smears of conjunctival scrapings from pigs suffering from conjunctivitis. A paper dealing with this parasite will appear later.

In 1933 the writer mentioned in a letter to *The Veterinary Record* that he had found a Rickettsia-like organism in the conjunctival epithelium of the ox; the letter was illustrated by two photomicrographs, both of which are reproduced here. This paper is intended to provide as full a description as possible of the parasite in the ox.

The organism has been studied in smears of conjunctival scrapings from cases of ophthalmia. The smears are air-dried, fixed by immersion in absolute alcohol for one minute, dried and stained with Giemsa (1 drop per 1 cc. aq. dist. for 1 hour).

The conjuctival epithelium of the ox often stains more intensely with Giemsa than does that of the sheep and goat; for this reason the smears are frequently stained for only 30 to 40 minutes instead of one hour. If the cytoplasm stains too deeply the parasites are more difficult to find.

It is not easy to scrape off the epithelium from the inside of the upper eyelid of a normal eye, but in cases of conjunctivitis the epithelium strips without difficulty.

Description of the Parasite.

Situation.

The habitat is essentially intracellular, but the nucleus is not invaded. Free-lying forms do occur, but they have probably all originated within the cytoplasm of conjunctival epithelial cells. Free forms are liberated when a cell is broken down during the preparation of the smear or, possibly, when the infected cell breaks up of its own accord.

Morphology.

Pronounced pleomorhpism. The following types occur :—

(a) *Round forms.*—These are usually 0.3 to 0.6 /u in diameter, and very often each is surrounded by a chromophobic halo about 0.4 /u wide. With the halo, the diameter is thus between 1 and 1.4 /u with an average of about 1.2 /u. Most of the round forms are solid, but some show a fairly clear centre. The halo accompanies the round form, more than any other form.

(b) *Bipolar forms.*—Generally these are 1 to 1.5 /u in length and 0.5 /u broad. Rarely they are 2.0 /u long. The chromatoid material is aggregated at the ends and is very thin along the sides. The centre is clear. Halos are often seen.

(c) *Bacillary forms.*—These are approximately the size of the bipolars. Some reveal the chromophobic halo. Some are slightly curved. Some reveal a dense speck of chromatoid material situated centrally or almost centrally. The organism bulges slightly to accommodate this dense speck.

(d) *Triangular forms.*—Apart from their slight tendency towards a trianguar shape, these could be grouped as round forms.

(e) *Dumb-bell forms.*—These are sometimes not uncommon in a cell, and suggest the possibility of multiplication by binary fission. They are about 1.5 to 2.0 /u long.

Arrangement.

Sometimes the cytoplasm of the whole cell is packed loosely with the parasites. Sometimes the organisms are spread over one half of the cell. Sometimes there is a marked tendency to colony formation. Fig. 5 shows a typical colony, spread out probably as a result of mechanical fores during the preparation of the smear. Fig. 3 shows a rather unusual form of colony, which is very similar indeed to the inclusions of trachoma and inclusion blenorrhoea (or swimming-bath conjuctivitis); it even hugs the nucleus. When halos are conspicuous they often form a clear network between the chromatoid granules.

More often than not, the parasites are very difficult to find. Frequently in a smear only one or two infected cells can be discovered. Success is more likely if smears are made immediately lachrymation has become noticeable. When the signs of ophthalmia are marked, it is often most difficult to detect the organism.

Staining.

Giemsa's stain is excellent; various shades of red and blue are seen. Generally speaking the smaller compact organisms are reddish and the larger forms, such as the bipolars, tend to be blue.

Fig. 2 reveals that ordinary bacteria are stained more intensely.

With a limited number of suitable duplicate smears, the parasite has been found to be gram-negative and non-acid-fast.

Effect on Tissues.

The presence of the organism is usually associated with a local

increase of neutrophiles. The infected cell is not obviously swollen, but it does seem to degenerate and rupture.

Multiplication.

The presence of dumbbell forms suggests the possibility of binary fission.

Transmission.

The vector is unknown. The parasite can be transmitted directly from eye to eye with an incubation period of three days, but no clinically discernable symptoms develop. However, it should be noted, that every attempt made so far in South Africa to transmit the disease specific ophthalmia of cattle has failed.

Association with Disease.

It is impossible as yet to state that the organism is the cause of bovine ophthalmia. But there seems to be a close relationship between the two, inasmuch as the parasite can be found during the early phases of the disease if a diligent search be made for it.

SUMMARY.

An organism has been described which is minute, pleomorphic, intracellular, gram-negative, and non-acid-fast. It does not stain as deeply as ordinary bacteria. With Giemsa, some individuals stain red and some epithelial cells of the ox, often showing a tendency to form " colonies ", epithelial cells of the ox, often showing a tendency to form ' colonies ", and appears to be intimately associated with the disease known as specific ophthalmia.

Apart from the fact that no arthropod vector has yet been found, its characteristics are all those of a Rickettsia, and the name *Rickettsia conjunctivae bovis* is provisionally proposed for it.

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DESCRIPTION OF PHOTOMICROGRAPHS.

1. 1400 X. Conjunctival epithelial cell of ox showing numerous Rickettsia-like organisms.
2. 1400X. Ditto. Note the presence also of contaminating bacteria.
3. 1700 X. A " colony " of organisms, very similar to the inclusions of human trachoma and inclusion blenorrhoea. Note how the " colony " presses on the nucleus.

4. 1400 X. An infected conjunctival epithelial cell. Erythrocytes were present in the smear.
5. 1400 X. A conjunctival epithelial cell showing a distinct "colony" spread out slightly.
6. 1400 X. Rickettsia-like organisms restricted to half of the cytoplasm of a conjunctival epithelial cell.
7. 1400 X. A massive infection of adjacent conjunctival epithelial cells, with organisms lying free due to rupture of the cells.
8. 1700 X. Infected conjunctival epithelial cells of a calf.

[Numbers 3 and 8 are reproduced by courtesy of *The Veterinary Record.*]

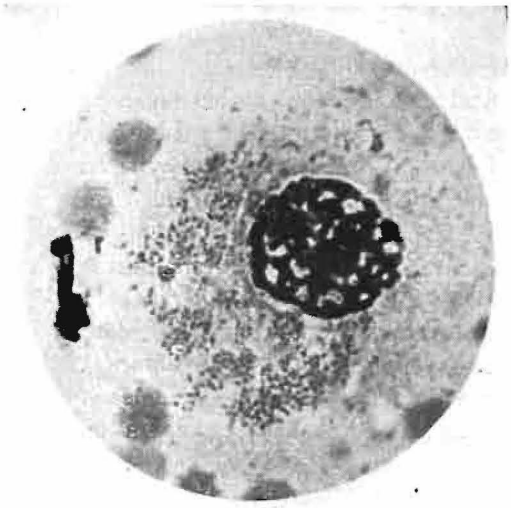

FIG. 1.

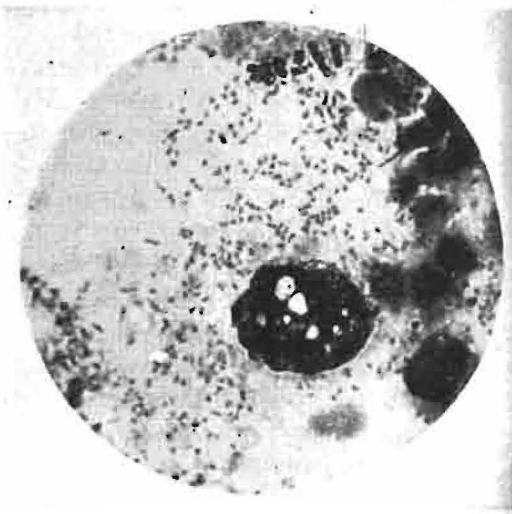

FIG. 2.

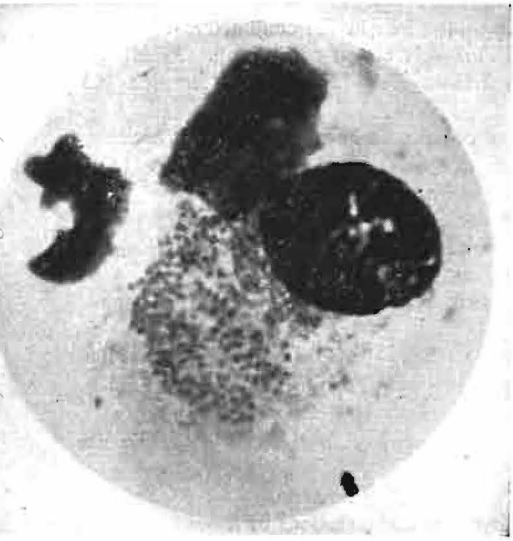

FIG. 3.

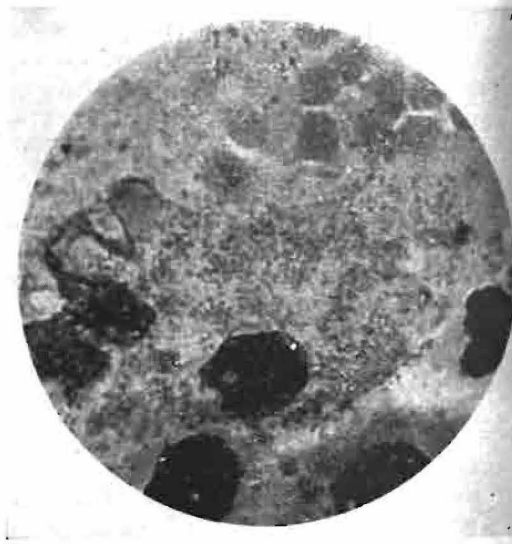

FIG. 4.

FIG. 5.

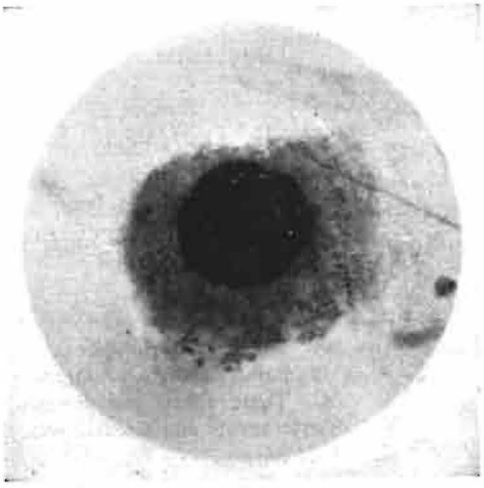

FIG. 6.

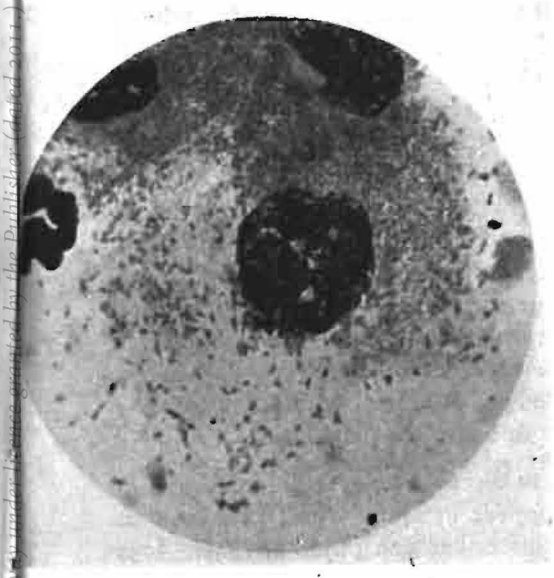

FIG. 7.

FIG. 8.

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Differential Diagnosis in Plant Poisoning.*

By DOUW G. STEYN, Onderstepoort.

CONTENTS.

I. INTRODUCTION.

The question is often asked : 'What are the symptoms of plant poisoning in stock ?" The inevitable reply is that in plant poisoning we may meet every symptom that may be evinced in affections of the nervous system, internal organs, muscular system, skin, and even the hoofs. The variety of symptoms, which may be induced not only by different poisons, but also by the same poison taken in varying quantities and under different conditions, is evident from the contents of this paper. Indeed, the same poison may exert opposite effects on the system, depending on the size of the dose. The symptoms and post-mortem appearances in peracute, acute, sub-acute, and chronic poisoning with the same toxic substancet may, and almost invariably do, differ to a remarkable degree. Indeed, it would be a very easy task to make a definite diagnosis of poisoning and to trace the causative agent if any one poison induced at all times and in all circumstances only certain definite symptoms and post-mortem appearances. Unfortunately this is not the case, and, with very few exceptions, a wide knowledge not only of toxicology but also of diseases with symptoms and post-mortem appearances similar to those seen in cases of poisoning is required in order to enable us to make a reliable diagnosis. Further, a knowledge of the distribution of the poisonous plants is of great assistance to us in our diagnosis.

In this paper an attempt is made to discuss some of the mineral and vegetable poisonings in which may appear symptoms and post-mortem appearances similar to thoset seen in infectious and other diseases. It is obvious that for lack of space only diseases and poisons most commonly met with in South Africa can be briefly considered.

*) Paper read before the Spring General Meeting of the South African Veterinary Medical Association held at Onderstepoort on the 29th and 30th October, 1936.

II. History.

Let me say at once that a detailed and reliable history is of very great importance in the investigation of suspected cases of poisoning or, for that matter, in the investigation of any disease.

The history of an outbreak of disease in stock is, as a rule, supplied to us by the owner or the person in charge of the animals concerned. You will know that in many cases the unreliable or even untruthful information given to us by the persons concerned renders a definite diagnosis extremely difficult.

The following characteristics of a disease lead us to suspect poisoning : (a) a large number of animals taking ill or dying at the same time; (b) severe purging; and (c) occurrence of death soon after the drinking of water.

The sudden death of one or a few animals is almost invariably considered to be suspicious of poisoning. However, it is obvious that the possibility of anthrax should also be considered in such cases.

In outbreaks of infectious diseases it is a general though not invariable rule that only a few animals take ill at the same time and that more cases follow later on. The significance of fever is discussed under III (C)—" Toxic agents and diseases with similar symptoms ". Suffice it to say here that it is well known that fever is a characteristic symptom of infectious diseases.

III. Symptomatology.

A. *Sudden deaths.*

When I speak of sudden deaths I apply the term in its strict sense and not as it is used by many farmers. You will know that many of them inform us that their animals have died suddenly when this has by no means been the case. Many stock-owners see their animals only once a week or once a month and any animals which are found dead are stated to have died suddenly.

In referring to sudden deaths we must differentiate between isolated cases and large numbers of deaths. The differential diagnosis is much more involved in the former circumstance than when a large number of animals have died suddenly or within a short period. The death of a single animal may be caused by almost any poison taken in large amounts and also by many diseases.

We must distinguish between (a) outbreaks of disease characterised by sudden deaths which continue to occur in a herd or flock for a prolonged period in the course of which very few or no animals are seen sick, and (b) outbreaks of disease which set in with sudden deaths but in which a comparatively large number of animals in due course exhibit symptoms during varying periods before they die.

The number of possible diseases that could be grouped under (a) is much smaller than those which fall under (b). Under group (a) anthrax, gifblaar (*Dichapetalum cymosum*) poisoning, gousiekte (*Vangueria pygmaea* poisoning) and "geilsiekte" (hydrocyanic acid poisoning—mainly through eating wilted grasses) should receive first consideration. Needless to say, bloodsmears and—in cases where animals are autopsied—also spleen smears should be taken in all cases of suspected poisoning. The examination of blood- and spleen-smears even from animals in which we have made a definite diagnosis of poisoning with some agent or other will save us a lot of worry and unpleasantness on many an occasion. I am thinking more especially of cases of poisoning where legal proceedings are instituted.

Anthrax may be excluded or confirmed by means of blood-smear examination and "geilsiekte" by analysis of the stomach (ruminal) contents for the presence of hydrocyanic acid. It should be borne in mind that hoven is a characteristic symptom of "geilsiekte." In cases of "gifblaar" poisoning, death in most cases occurs within a very short time after the plant has been eaten and portions of "gifblaar" leaves are, in most cases, still detectable in the stomach (ruminal) contents. However, this is not the case with "gousiekte" which has a long period of latency. In poisoning with the "gousiekte-bossie" animals may die from a week to a few months after having eaten the plant. A characteristic feature in the history of outbreaks of "gifblaar" poisoning is that the animals die very soon after having drunk water, whilst in "gousiekte" sudden deaths continue in the herds or flocks for weeks in spite of the grazing having been changed repeatedly. Another feature of "gousiekte" is that the highest mortality occurs in pregnant animals and in animals which are excited, driven, or worked. I should state that oxen which have eaten "gifblaar" may also drop down dead while being worked.

In very chronic cases of "gousiekte" the heart-walls are thin and fibrotic, and in less chronic cases small greyish fibrotic areas are macroscopically discernible in the otherwise normal or in the flabby heart-muscle. In many cases of "gousiekte," however, neither macroscopic nor microscopic lesions are detectable in the heart-muscle or any other organ.

With regard to group (b), that is, outbreaks of disease which set in with sudden deaths but in which symptoms are seen in later stages of their course, a large number of diseases may be concerned. I need not say very much here about diseases concerned in this group, as a number of diseases resembling cases of poisoning and a large number of cases of poisoning with plants and minerals are discussed in the course of this paper. It should be borne in mind that sudden deaths may occur in many cases of poisoning where very large quantities of almost any poison have been taken.

B. *Pathognomonic symptoms.*

It must be understood that the symptoms stated below to be pathognomonic for certain poisons should not in each and every case be taken as a definite indication of that particular poison. The pathognomonic symptoms should be considered in conjunction not only with the other symptoms present but also with all the information gained from the autopsies and the history of the disease. In suspected plant poisoning the distribution of poisonous plants should be given due consideration. It should also be borne in mind that the character of the symptoms induced by any one poison depends on a large number of factors and may vary to a marked extent.

For more detailed information about the undermentionetd poisons see " III C—Toxic agents and diseases with similar symptoms ").

(a) *Arsenic :* profuse, and at times haemorrhagic, diarrhoea; partial, and eventually complete paralysis setting in in the hind-quarters in cases of acute and subacute arsenical poisoning. Compare tulp and slangkop poisoning discussed under III (C) (1).

(b) *Cotyledon poisoning* (krimpsiekte, nenta) : torticollis, which is however absent in many cases of Cotyledonosis.

(c) *Crotalaria burkeana* (Stywesiekte-bossie) : elongated hoofs. Compare " three-day stiffsickness " and aphosphorosis discussed under III C (m).

(d) *Crotalaria dura* (Jaagsiekte-bossie) poisoning : in the beginning of the disease there may be very laboured respiration with subcutaneous emphysema (not in all cases), while the general state of health of the animal is not much affected. Later on general icterus and " staggers " similar to that seen in *Senecio* poisoning may develop, depending on the quantity of plant ingested and the rate at which it has been consumed.

(e) *Dichapetalum cymosum* (gifblaar) poisoning : sudden death within a short time after having drunk water.

(f) *Diplodia zeae* poisoning : constipation, paresis and paralysis in animals grazing on reaped mealie lands.

(g) *Equisetum ramosissimum* (horsetail, drilgras or dronkgras) poisoning : as a rule nothing abnormal is noticed in the general behaviour of the affected animals until they are excited, driven, or worked, when they fall into shivering fits and may die.

(h) *Geigeria* (" vermeersiekte ") poisoning : a typical but by no means constant symptom of *Geigeria* poisoning is vomiting.

(i) " *Geilsiekte* " (hydrocyanic acid form) : General cyanosis, hoven, staggering (" drunkenness "), dyspnoea, and sudden death.

(j) *"Kaalsiekte"* (alopecia) : *Chrysocoma tenuifolia* (bitterbossie, brandbossie, beesbossie) poisoning in kids and lambs. The most characteristic symptom is loss of hair. See discussion on "Kaalsiekte" under III C (g).

(k) *Malva parviflora* (kiesieblaar) poisoning : the same remarks made under *Equisetum ramosissimum* also apply here.

(l) *Matricaria nigellaefolia* (staggersweed) poisoning : pushing against stationary objects is a characteristic symptom.

(m) *Senecio* poisoning : the symptoms are those seen in "dunsiekte" in horses (loss in condition, wandering about aimlessly, "staggers") and Molteno cattle disease (persistent diarrhoea associated with loss in condition and marked straining and in some cases "staggers").

(n) *Strychnine* : clonic convulsions of the whole body and legs at short intervals with legs extended and head drawn backwards.

(o) *Tribulus* poisoning : symptoms of "geeldikkop" : general icterus and symptoms of photosensitisation. See also "dikoor" under III C (d).

(p) *Vangueria pygmaea* (gousiektebossie) poisoning is characterised by sudden deaths especially among pregnant animals and among animals which are excited, driven, or worked. Mortality (sudden deaths) continues to occur for weeks in affected herds or flocks in spite of repeated changes of the grazing.

C. *Toxic agents and diseases with similar symptoms.*

See the remarks in the first paragraph under III B. concerning information in addition to the symptoms mentioned below.

(a) *"Gifblaar", "gousiekte", "geilsiekte"* and *anthrax* are characterised by sudden deaths. The differential diagnosis concerning these diseases is discussed under III A. It has already been mentioned that sudden deaths may be caused by a large number of toxic agents and also by infectious and other diseases (peracute lamsiekte, heartwater, anaplasmosis, etc.).

(b) *Lamsiekte and lead, arsenic, Diplodia, Cotyledon,* and *Epaltes alata* poisoning.—Paresis and paralysis are symptoms frequently met with in lamsiekte, subacute and chronic lead poisoning, subacute and chronic arsenical poisoning, Diplodia poisoning and Cotyledon poisoning. Very frequently we see paresis (difficulty in standing and ataxy) in poisoning with *Epaltes alata,* and rarely paralysis.

(c) *Matricaria nigellaefolia* and *Diplodia zeae* poisoning.—Difficulty in rising, knuckling-over at the fetlock joints, muscular incoordination, and constipation are symptoms frequently seen in Matricaria and Diplodia poisoning. In Diplodia poisoning the

knuckling-over occurs in the majority of cases in the hind legs, whilst it is the reverse in cases of Matricaria poisoning. I need hardly mention that "pushing" is a typical but by no means constant symptom of Matricaria poisoning.

"Nodding of the head" is sometimes seen in outbreaks of Matricaria poisoning and is an exceptional symptom in Diplodia poisoning. This phenomenon is probably due to rhythmic contractions of the brachiocephalic and sternocephalic muscles.

(d) *"Geeldikkop" (Tribulosis), "dik-oor", Othonna pallens* and *copper sulphate* poisoning.—The symptoms seen in cases of Tribulosis and "dik-oor" in sheep, namely general icterus, photosensitisation, and stasis in the gastro-intestinal tract, should be considered as a symptom-complex capable of being induced by a number of agents rather than as pathognomonic symptoms. It has been definitely proved that a species of Tribulus (Tribulus terrestris L. ?) is one of the causes of the "geeldikkop" symptom-complex. However, some of you will know from your experience in the field that this symptom-complex has been repeatedly recorded on farms where no Tribulus was to be found. In the Transvaal and Orange Free State, where outbreaks of "geeldikkop" have been investigated, I have described the disease as "dik-oor" in order to differentiate it from the true "geeldikkop" caused by Tribulus. It is impossible to state, as yet, what the cause (or causes) of "dik-oor" is. Reports of other types of "dikkop" not associated with Tribulus have also been received from farmers and some of our colleagues.

Both in natural and experimental cases of *Othonna pallens* poisoning, swelling of the head may be seen and it is possible that this may be associated with general icterus in the more protracted cases of poisoning. The swelling of the head is however not due to oedema (photosensitisation) but to the accumulation of air in the subcutaneous tissues as a result of ruptured alveoli caused by extreme laboured respiration.

Also in cases of sub-acute and chronic copper poisoning symptoms (general icterus and photosensitisation) simulating those seen in "geeldikkop", may be seen. Such symptoms were observed at Onderstepoort in a number of experimental cases of chronic copper sulphate poisoning in sheep.

It should be mentioned here that symptoms of photosensitisation may occur in many cases where the efficiency of the liver is decreased and where the animals have at the same time access to feeds rich in chlorophyll. In the course of his investigations into photosensitisation Dr. Quin was able to produce cases of photosensitisation by ligating the bile duct and at the same time supplying the animals with feeds rich in chlorophyll.

(e) *Domsiekte and Othonna pallens (springbokbos) poisoning.*—The symptoms [pronounced apathy, perhaps more suitably described as " stupidness "; standing with drooping head in the same spot for hours, etc.—Domsiekte in pregnant ewes by S. van Rensburg, Jour. S.A.V.M.A. Vol. I, 1927, p. 58—60] seen in "domsiekte" and in *the less acute cases* of Othonna pallens poisoning may resemble each other to a remarkable degree. In experiments conducted by me at Onderstepoort with Othonna pallens I was able to produce in sheep a few cases of poisoning which were indistinguishable, symptomatically and pathologically, from "domsiekte" as recorded in pregnant ewes. I should mention that the most typical case of "domsiekte" was produced in a pregnant ewe, which had received a small quantity of the plant daily on a few consecutive days.

I am not suggesting that all cases of "domsiekte" are necessarily caused by the eating of comparatively small quantities of Othonna pallens : the point I wish to stress is that in areas where this plant occurs there is a possibility of the two diseases being confused. Outbreaks of "domsiekte" have repeatedly been reported from areas where this plant abounds. Arrangements are being made for further investigations into the nature of the disease especially as it occurs under natural conditions.

It should be mentioned that the symptoms in "domsiekte" resemble those seen in acetonaemia, a disease occurring mainly in animals in an advanced state of pregnancy.

(f) *Equisetum ramosissimum (horse-trail, drilgras, dronkgras), Malva parviflora (kiesieblaar), Cotyledon (plakkies, nenta), Cynanchum obtusifolium and C. africanum (klimop), and Transvaal slangkop (Urginea burkei) poisoning.*—Trembling (shivering) of the whole body or certain groups of muscles and paresis and paralysis are frequently noticeable in poisoning with these plants. Torticollis, which may persist for weeks and even months, is characteristic of Cotyledon poisoning. In a few outbreaks of Slangkop poisoning involving a few hundred sheep I have seen four cases of torticollis resembling that seen in Cotyledonosis.

(g) *Chrysocoma tenuifolia (bitterbossie, beesbossie, bitterkaroo, brandbossie) and Thallium poisoning.*—Loss of hair or wool is a symptom typical of poisoning by either or both of these plants. In the case of Chrysocoma poisoning only suckling kids and lambs are affected as the poison passes into the milk. On one occasion I have seen an outbreak of alopecia in the six to eight months old cross-bred lambs of sheep in the vicinity of Byenes-

poort, Pretoria district. The country is of the bush-veld type. I was unable to establish the cause of the alopecia. Mr. B. van der Vyver, Government Veterinary Officer, Pretoria, brought this outbreak of alopecia to my notice. The main difference in the character of the Byenespoort cases of alopecia and those caused by Chrysocoma are (1) the age of the affected lambs and (2) the nature of the loss of hair or wool. In the former case the loss of hair commenced along the back and not a single case was seen where the affected lambs had become completely bald, whereas in alopecia caused by Chrysocoma loss of hair or wool sets in almost invariably on the lateral and caudal aspects of the hind-quarters with complete or almost complete alopecia in a few days.

(h) *Senecio and Crotalaria poisoning.*—It is possible that the symptoms induced by the poisonous species of Senecio and Crotalaria dura (jaagsiektebossies) and even by Crotalaria burkeana (stywesiektebossie) may resemble each other to a remarkable extent depending upon the quantity of plant eaten and the rapidity of consumption. I am thinking specifically of those cases where the liver is the organ most affected by these three plants (acute and subacute parenchymatous nepatitis followed by cirrhosis). In such cases it is not uncommon to see general icterus (slight or even absent in the more protracted cases) and symptoms of " staggers ".

(i) *Crotalaria poisoning and " teff phthisis".*—The symptoms, post-mortem appearances and histology of Crotalaria dura poisoning (jaagsiekte) and the so-called "teff phthisis" in horses may resemble each other to a marked extent. Pronounced laboured respiration, a chronic dry cough, and a chronic indurative and desquamative broncho-pneumonia may be present in both diseases. " Teff phthisis" is a chronic broncho-pneumonia which occurs in horses stabled over long periods (years) in dusty and badly ventilated stables. It is obvious that the feeding of dusty feeds (hay) to animals may also cause the disease. Mr. R. Clarke, Government Veterinary Officer, Bethlehem, has very recently investigated a few cases of "teff phthisis" in horses. Dr. C. Jackson, Onderstepoort, examined the specimens submitted by him and described the lesions present in the lungs and liver. The specimens were collected from a twenty-two year old horse and the cirrhosis seen in the liver is probably due to the animal's advanced age.

(j) *Acokanthera spectabilis and Acokanthera venenata (poison bush) poisoning and heartwater.*—The symptoms (nervous symptoms, diarrhoea) caused by these two plants may in some

cases resemble those seen in heartwater. Examination of smears prepared from the intima of the jugular vein and blood inoculations will assist in making a definite diagnosis.

(k) *Strychnine and Sarcostemma viminale (spantou-melkbos) poisoning.*—In experimental cases of Sarcostemma poisoning in sheep at Onderstepoort I have on a few occasions seen convulsions resembling to a remarkable degree those seen in cases of strychnine poisoning.

(l) *Fluorine and arsenical poisoning.*—Loss in condition, digestive disturbances, and exostoses may be present in cases of chronic arsenical and fluorine poisoning.

(m) *Poisoning with arsenic, tulp (tulip) (species of Moraea and Homeria) and Transvaal slangkop (Urginea burkei) and Natal slangkop (Urginea macrocentra).*—Diarrhoea and weakness (paresis) in the hind-quarters are symptoms very frequently seen in acute cases of tulp, slangkop, and arsenical poisoning. However, similar symptoms may also be caused by many members of the liliaceous family other than slangkop and by amaryllidaceous plants.

I would like to remind you that the symptoms and post-mortem appearances in heavy outbreaks of conical fluke infestation in sheep and trichostrongylosis in blackhead Persians may resemble to a remarkable degree those seen in cases of poisoning by gastro-intestinal irritants.

Acute arsenical poisoning may be excluded or confirmed by analysing the urine and faeces of affected animals or the internal organs of animals which have died.

Elevated temperatures, especially in cases where high temperatures are recorded, are regarded by many as definite proof that the animals concerned are not suffering from poisoning. This is by no means the case, especially in poisoning with gastro-intestinal irritants where fever is frequently present as a result of acute gastro-enteritis. In cases of poisoning with Dipcadi glaucum (malkop-uit, wilde-ui, wild onion) I have recorded temperatures of up to 107.6° C. in sheep. There are also poisons which do not cause an elevation of temperature through acute gastro-enteritis but by virtue of their action on the centre of heat-regulation.

In cases of poisoning with Dipcadi glaucum an acute ulcerative gastro-enteritis may be seen resembling that found in poisoning with corrosives.

(n) *Aphosphorosis, "three-days stiffsickness" and poisoning with Crotalaria burkeana.*—In the acute stages of poisoning with Crotalaria burkeana the symptoms (stiff-sickness) may resemble

those seen in aphosphorosis and "three-days stiff-sickness". In the "sandveld" it is not an uncommon occurrence for animals suffering from aphosphorosis to develop elongated hoofs even resembling the latter stages of poisoning with Crotalaria burkeana.

IV. Toxic Agents and Diseases with Similar Post-mortem Appearances.

(For additional information see the remarks under III. B. above.)

(a) *Sudden deaths.*—In areas where "gifblaar" and the "gousiekte-bossie" are to be found we have good reason to suspect these plants in cases where numbers of sudden deaths with negative post-mortem and smear examination occur. But it should be borne in mind that isolated cases of sudden deaths may be caused by many poisons and diseases.

(b) *Lamsiekte and poisoning with lead, arsenic and Diplodia.*—The post-mortem appearances (cachexia, anaemia, gastro-intestinal stasis) found in many cases of chronic lamsiekte, Diplodia poisoning, and chronic arsenical and lead poisoning may resemble each other. If we have an opportunity of examining a number of cases we will in many cases be in a position to make a definite diagnosis. In chronic lead poisoning typical blood changes (anisocytosis, punctate basophilia, polychromasia, poikilocytosis) and a blue line on the gums (not frequently) are seen. Furthermore in cases of chronic lead poisoning in growing animals, radiographic pictures of the bones show a band of increased density at the diaphyseal end of the growing bone which is most marked where growth is greatest. This band is not seen in full-grown animals suffering from chronic lead poisoning. Similar bands are seen in scurvy, in poisoning with vitamin D and elementary phosphorous and possibly also in strontium and bismuth poisoning, but the symptomatology is different. In some cases of chronic arsenical poisoning a chronic indurative periarthritis (thickening of the joints, especially the carpal joint) and an erosive arthritis are seen.

(c) *Tribulosis (geeldikkop) and "dik-oor" poisoning.*—Symptomatically these two diseases are indistinguishable. See further the remarks made under "III. C. (d)." In some cases of chronic copper sulphate poisoning general icterus and photosensitisation are present.

(d) *Heartwater, "domsiekte", and poisoning with Othonna pallens.*—The post-mortem appearances (oedema and hyperaemia of the lungs, hydroperitoneum, hydrothorax, hydropericardium) in some cases of poisoning with Othonna pallens closely resemble those seen in heartwater, whilst in other cases of poisoning with this plant, depending upon the quantities eaten, severe fatty degeneration of the liver as seen in cases of "domsiekte" may be found.

(e) *Cotyledonosis and Cynanchosis.*—In these two diseases the symptoms and post-mortem appearances are, in many cases, indistinguishable. However, it should be borne in mind that over large areas (Karoo) where Cotyledonosis is prevalent, Cynanchum africanum and Cynanchum obtusifolium do not occur. These two plants are mostly found in the bushy regions along the coast.

(f) *Poisoning with arsenic and liliaceous, iridaceous and amaryllidaceous plants.*—The post-mortem appearances met with in cases of poisoning with arsenic and some amaryllidaceous, iridaceous and liliaceous plants [especially tulp (tulip), species of Moraea and Homeria; Transvaal slangkop (Urginea burkei); wild onion (Dipcadi glaucum)] and other gastro-intestinal irritants may be very similar. A suspicion of arsenical poisoning can be confirmed or excluded by means of chemical tests, whilst an inspection of the grazing concerned will assist in the diagnosis of cases suspected of poisoning with iridaceous, liliaceous or other plants.

In all cases of poisoning, both in suspected cases and in those where a diagnosis of poisoning with a definite toxic substance has been made the necessary specimens of animal organs, etc., should be submitted for analysis. As stated before, blood- and spleen-smears and, if necessary, also smears prepared from the intima of the jugular vein, should be examined in all cases of disease or death.

V. Histology.

The examination of blood- and spleen-smears is of great value in the distinguishing infectious diseases (anthrax, anaplasmosis, redwater, etc.) from poisoning. Heartwater may be excluded or confirmed by the examination of smears prepared from the intima of the jugular vein and by the subinoculation of blood into susceptible animals.

It is only in the case of very few poisons that we find typical lesions in the organs. In very protracted cases of "gousiekte" (Vangueriosis) fibrosis of the heart-muscle is evident. I should, however, state that in many cases of "gousiekte" no induration of the heart-muscle was seen upon histological examination.

"Blood lagoons" in a liver which also shows evidence of an acute parenchymatous hepatitis are considered typical of Senecio poisoning. It should, however, be borne in mind that these lesions are frequently seen in acute and sub-acute cases of Senecio poisoning and that cirrhosis of the liver follows on these lesions. The point I would like to stress is that in chronic Seneciosis we meet with a type of cirrhosis of the liver which is indistinguishable from the cirrhosis caused by many different poisons. In very many cases of sub-acute and chronic poisoning there

is cirrhosis of the liver and in most cases of acute and sub-acute poisoning there is fatty degeneration of the parenchymatous organs, especially the liver.

An acute parenchymatous hepatitis, followed by cirrhosis in the more protracted cases, also occurs in poisoning with Crotalaria dura and Crotaria burkeana.

In a number of experimental cases of poisoning in horses with Crotalaria dura at Onderstepoort no true symptoms of " jaagsiekte " (laboured respiration) were seen but only symptoms of " staggers " and general icterus attributable to an acute parenchymatous hepatitis. It is for this reason that we should consider the possibility of both seneciosis and crotalariosis in cases of suspected " dunsiekte " where species of Senecio and Crotalaria dura occur in the same area. As far as we know the latter plant occurs only in Natal.

SUMMARY.

The similarity of the symptoms, post-mortem appearances, and histological lesions in infectious and other diseases with those of plant and mineral poisoning is discussed.

BOOK REVIEWS.

Ross & Gordon's *Internal Parasites and Parasitic Diseases of Sheep* * is a book intended primarily to inform veterinarians and laymen in Australia regarding the worm parasitic diseases of sheep in that country and of these it gives a most detailed account. The worm parasites of sheep not occurring in Australia are referred to more briefly. However, as the book is written by two parasitologists who have a very wide knowledge of sheep, it will be most useful also outside of Australia.

There are three main sections, the first dealing with flatworms (Trematoda and Cestoda), the second with roundworms (Nematoda), and the third with the collection and preservation of worms and methods of clinical diagnosis. Then follow (i) a short appendix on parasites of rabbits and the relation of the native fauna of Australia to parasites of sheep, (ii) a glossary of scientific terms for the layman, (iii) a short bibliography of important articles on worms in sheep, and (iv) a good alphabetical index..

* *The Internal Parasites and Parasitic Diseases of Sheep. Their treatment and control,* by I. C. Ross and H. McL. Gordon. Angus & Robertson, Ltd., Sydney, 1936. Pp. ix + 238, 35 figs. and maps, 46 plates. 25s.

The book is well illustrated and of particular interest are a number of maps showing the distribution of sheep in relation to rainfall, the altitude and slope of certain pastoral areas, and the distribution of individual parasitic diseases in Australia.

Being written by two specialists of high standing in this subject, the book is, as one would expect, an excellent and useful piece of work, remarkably free of the usual small errors which creep into any book; and the few that were noticed are not of great importance. The *Gaigeria* egg is, for instance, grouped with the eggs of other strongyles as indistinguishable from them. In the discussion on the toxicity of carbon tetrachloride no mention is made of liver lesions, hypoglycaemia, the comatose condition usually seen before death—the animals are stated to show symptoms of acute abdominal pain—and the importance of feeding carbohydrates.

Whether there are conditions in Australia which would be responsible for such differences in the symptomatology of carbon tetrachloride poisoning is perhaps doubtful, but the book brings out one point very clearly, *viz.* that even parasitic diseases at times behave differently in different countries. The reviewer would like to mention a few points of difference from South African experience. *Moniezia expansa* is not thought to cause serious effects, and even in the case of lambs the authors are doubtful whether this tapeworm is fatally harmful. Mass infections with *Cysticercus tenuicollis* causing death in the intrahepatic stage do not appear to be known in Australia: in South Africa they occur not infrequently. A rather interesting state of affairs is seen in connection with Trichostrongylosis: in Australia it is a disease of merino lambs under 18 months old; the characteristic symptom is a persistent black diarrhoea (the worm is popularly known as the "black scours worm"); the worms are believed to kill the animal through irritation of the intestinal mucosa which results in the exhausting diarrhoea. In South Africa the worm is of practically no significance in Merinos, but is the most fatal parasite of Persian and other breeds of hairy sheep, causing apparently an intoxication. There is seldom any diarrhoea—a "black scour" of lambs is always found to be due to young nodular worms passing out of the nodules into the lumen of the intestine. For treatment, the bluestone-nicotine mixture is recommended according to the publications of Gordon (1935) and McEwen (1935). The fact that this mixture has been used in South Africa since 1929 according to the recommendations of Mönnig (''Farming in South Africa", September 1929) appears to have escaped notice in other countries. This mixture is stated not to be more efficacious against *Haemonchus* than a bluestone solution. In South Africa bluestone solutions have never given satisfactory results, while the addition of nicotine makes all the difference against *Haemonchus*.

The authors unfortunately reproduce an illustration of Veglia, showing a sheep with symptoms of intussusception, as a case of oesophagostomiasis. It has since been definitely learnt in South Africa that intussusception is not connected with oesophagostomiasis.

In general, however, parasitic diseases of sheep behave similarly in all countries and the book will find a useful field of application wherever sheep and their parasites have to be dealt with.

H. O. M.

The object of Dr. Hall's book, *The Control of Animal Parasites,* *) is to review the present state of our knowledge in regard to the control of parasitological problems. "The control of parasites is treated as a form of warfare, and a body of formulated military principles has been used in this book in analysing our control problems. This procedure, while novel, proves to be extremely useful, and the writer, with 30 years' experience in parasitology, has found that this method of dealing with parasite problems develops the facts in a situation, indicates the strength and weakness of our position, and shows what should be done much better than do the casual methods of attacking problems with which hs is familiar and which are customarily employed" (from author's preface). While it may strike one as being a regrettable admission of the primitive nature of man, who is still best able to grasp the significance of a situation when it is presented to him in terms of warfare, the method of presentation may, in the present stage of man's mental development, be very effective.

The book opens with a chapter on strategy and tactics, an exposition of military principles and their application to the control of parasites.

Each of the succeeding chapters deals with a particular parasite problem and is illustrated with an instructive diagram showing the available forces, such as artillery (prophylactic measures) shelling the snail, mosquito and flea intermediate hosts, while the lack of ammunition for the infantry (chemotherapy) is frequently in evidence.

The method of presentation emphasises the weak points in our present knowledge of parasite control and gives a good general review of the whole position.

H. O. M.

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*) *The Control of Animal Parasites. General Principles and their Application,* by M. C. Hall. Pp. 162. Illustrated with diagrams. 1936. The North American Veterinarian, Evaston, Illinois, U.S.A.

THE ASSOCIATION.

Minutes of Council Meeting held at Polley's Hotel, Pretoria, on 11th September, 1936.

Present : Mr. C. J. van Heerden (chair), Drs. P. J. du Toit, R. D. Thomas, H. H. Curson, H. O. Mönnig, Messrs. G. v. d. Wath, and S. W. J. v. Rensburg (Secretary).

Apologies for absence were submitted on behalf of Messrs. S. T. A. Amos and F. J. Carless.

(1) **Late Sir Arnold Theiler.**—The Chairman referred to the severe loss the Association and the Profession had sustained through the death of Sir Arnold Theiler. The meeting rose and stood in silence as a mark of respect.

(2) **Minutes of Council meeting held on 18/6/36** having been circulated were taken as read. After the Chairman had pointed out that merely the question of subsidised motor transport and not S. & T. rates would be discussed at the Spring General Meeting, these minutes were confirmed.

(3) **Matters arising from these Minutes.**

(a) *Scale of Charges for Veterinarians.*—The Secretary reported that no replies had as yet been received from the N.V.M.A. in England and Irish Free State. Decided to leave this matter until the desired information had been received.

(b) *Captain Clapham.*—Letter read from the Adjutant-General stating that the Minister of Defence had not yet been able to consider the application for an interview. Decided to send a reminder if no reply has been received by October 2nd.

(c) *Arrear Subscriptions.*—The Secretary reported that of the two members whose cases were considered at the last meeting one had since paid all his arrears while the other had paid off a substantial portion. Decided to take no further action.

In the case of another member, G. J. de Wet, whose subscription was more than three years in arrears, it was decided that a registered letter be sent in accordance with rule V (b) of the Constitution.

(d) *Resignations.*—A letter from Mr. W. McKie resigning as a member was read. This was accepted with regret. The Secretary also read a letter from Mr. J. A. Maybin withdrawing his resignation. Agreed to accept this.

(e) *Expert Witness Fees.*—The Secretary stated that a reply had been received from the Maatschappij voor Diergeneeskunde in Holland, but not from the R.C.V.S. Decided to leave the matter until the latter had also replied.

(f) *Veterinarian, Germiston Municipality.*—The Secretary reported that a memorandum drawn up by the responsible committee had been submitted to the M.O.H. Germiston and that Mr. J. G. Boswell had been appointed as a part-time veterinarian to the Germiston Municipality.

The meeting was of the opinion that the Association should not directly approach Springs and Randfontein Municipalities with regard to the appointment of veterinarians, but that the Secretary and Dr. Mönnig should get into personal contact with the responsible officials of these two Municipalities respectively.

(g) *Sale of Akiron.*—A letter was read from the distributors of Akiron intimating what had been done with regard to the complaints submitted, and it was decided to take no further action.

(h) *Motion by Mr. Runciman.*—It was agreed to leave this until replies had been received from the various overseas organisations.

(i) *Spring General Meeting.*—The Secretary reported that the responsible committee had fixed the meeting for the 29th and 30th October, and that the programme would be issued by the end of September.

(j) *Griffith Evans Memorial Fund.*—A letter was read from the Registrar of the University College of North Wales thanking the Association for the donation of £5 5s. toward this fund.

4. **13th International Veterinary Congres.**—Dr. du Toit stated that the next conferencence is to be held at Zürich in August, 1938, and that every country taking part has to appoint a National Committee which has to consider the programme and the appointment of reporters as far as that country is concerned. It was decided that the Council S.A.V.M.A. act as the National Committee for South Africa with Dr. du Toit as Chairman.

The Council then resolved into a meeting of the National Committee.

Council subsequently resumed.

5. **Widow of Veterinarian A.**—Letters were read from Dr. de Kock and Mr. v. d. Linde indicating the misfortunes that had befallen Mrs. A. and the bad state of her health which had necessitated two severe operations. It was decided to send her a donation of £10. This to be transmitted through Major Keppel.

Dr. du Toit asked to be excused from the meeting.

6. **Cruelty to Animals.**—A letter was read from the Director of Veterinary Services asking for the appointment of a committee to represent the Association in a discussion with representatives of the Division

on the question of cruelty to animals from the point of view of what should be considered cruelty in operative surgery.

Drs. J. G. Bekker, G. G. Kind, and J. I. Quinn were appointed. This committee to report to the S.A.V.M.A. in due course.

7. **New Members.**—The names of Messrs. J. H. Fourie, M. C. Lambrechts, and W. G. van Aswegen were submitted. Agreed to recommend their acceptance to the Spring General Meeting.

8. **Mr. L. R. Morford, M.R.C.V.S.**—A letter from the Secretary N.C.V.S. was read enquiring after the whereabouts of Mr. Morford. Decided to ask members who were able to supply the desired information to communicate with the Secretary, S.A.V.M.A.

9. **Peter Kaiser.**—The Secretary submitted a cutting from the "Star" of 21st August containing a report of a court case in which the accused is alleged to have stated that he was a veterinary surgeon by profession. The Secretary explained what efforts had been made to gain information about this man but without success and stated that he had referred the matter to the Veterinary Board. This was approved of.

10. **Complaint by Mr. Runciman.**—A letter from Mr. Runciman was read and it was decided to ask him to obtain further evidence with a view to submitting the matter to the Veterinary Board, for action against the parties concerned.

1. **Complaint by Mr. C. H. Sharpe.**—It was decided to refer this complaint against a Maritzburg chemist to the Veterinary Board with a strong recommendation that the matter be handed over to the C.I.D. for investigation.

12. **Late Mr. J. D. Borthwick.**—A letter from Miss H. Borthwick was read in which she thanked the Association for sympathy and wreath.

13. **Legal Problems.**—Dr. Thomas referred to the contributions which had been generously made to the Journal by Mr. Bresler in the past and indicated that Mr. Bresler was still prepared to assist the Association. The Chairman suggested that any veterinary legal problems which any of the members may have be submitted to Mr. Bresler for consideration and reply.

14. **Assistant Secretary.**—The appointment of Mr. J. G. v. d. Wath in place of Mr. M. H. V. Brown was approved.

The meeting concluded at 10.15 p.m.

Minutes of Council Meeting held at Polley's Hotel, Pretoria on 18th October, 1936.

Present: S. T. Amos (Chair); C. J. van Heerden, A. M. Diesel, H. H. Curson, A. C. Kirkpatrick, H. O. Mönnig, A. D. Thomas, C. Jackson, G. v. d. Wath, S. W. J. van Rensburg (Secretary).

Apology was submitted by Dr. Jackson on behalf of Dr. du Toit.

(1) **Minutes of Council meeting held on 11th September, 1936,** having been circulated were taken as read and were confirmed.

(2) **Matters arising from these Minutes:**

(a) *Scale of Charges for Veterinarians.*—The Secretary stated that no reply had as yet been received from the N.V.M.A. in Great Britain and Ireland. Accordingly decided to let this matter stand over.

(b) *Captain Clapham.*—The Secretary reported that owing to the indisposition of the Minister for Defence, no further steps had been taken to obtain an interview for the deputation.

(c) *Expert Witness Fees.*—It was decided to let this matter stand over pending receipt of a reply from the R.C.V.S.

(d) *Cruelty to Animals.*—The Secretary read the report submitted by the Committee which was appointed to discuss this matter with representatives of the Division of Veterinary Services. In view of the importance of the subject it was decided that the report be circulated to Council members, and that the matter be put on the agenda for discussion at the next Council meeting.

(e) *Mrs. A.*—A letter was submitted from Mrs. A. thanking Council for the donation. Another letter from Maj. Keppel indicating how urgently assistance was needed in this case was also read.

3. **Benevolent Fund.**—The Chairman pointed out that as the fund at the moment stood at only £152, yielding interest at about £5 per annum, it was not possible to assist necessitous cases, and strongly urged that a special endeavour be made to increase the fund by voluntary contributions. After full discussion it was decided that—

(a) The profits derived from the Group Insurance Scheme be devoted to the Benevolent Fund.

(b) The Fund be given prominence in the Journal and a special appeal be made to members to obtain donations by all possible means.

(c) The Chairman bring the position of the Fund to the notice of members attending the General Meeting the next day and appeal to them for voluntary contributions.

4. **Mrs. B.**—A letter was read from Mr. J. H. R. Bisschop intimating that a fund was being raised to cover Mrs. B.'s medical and hospital expenses and asking for a contribution from the Benevolent Fund. In view of the appeal to be made for voluntary contributions, it was decided to donate £1.0.

5. **Constitution.**—A Committee consisting of Drs. Monnig, C. Jackson, and R. Alexander and the Secretary was appointed to completely revise the Constitution and to consult the legal advisers where necessary.

6. **General.**

(a) *Dr. Curson* resigned as convenor of the Parliamentary Committee. Mr. v. Heerden was appointed Convenor instead.

(b) *Mr. R. du Toit.*—It was decided that the Association record its appreciation of the services rendered by Mr. R. du Toit during the period he served as secretary. The present secretary and assistent secretary were appointed to make a suitable presentation to Mr. du Toit.

(c) *Courtesy Title.*—After considerable discussion it was decided that the rules of the Constitution be adhered to in the discussion on the Courtesy Title at the General Meeting.

(d) *Engraving of Eighth Hussars.*—Dr. Curson informed Council that he had removed the engraving of the Eighth Hussars and that he had it in his safe-keeping.

(e) *Veterinary Inspectors' Association.*—Dr. Thomas drew attention to the title of the newly-formed association of stock and assistant stock inspectors and pointed out that it might lead to confusion. It was decided that Mr. Diesel interview the Committee and point this out to them.

The meeting closed at 11.45 p.m.

Minutes of the 31st General Meeting of the S.A.V.M.A. held at Onderstepoort on 29th and 30th October, 1936.

Present: S. T. A. Amos (President); J. H. Mason, H. Theiler, D. Coles, P. Robertson, A. D. Thomas, P. S. Snyman, L. Blomfield, J. Nicol, J. Quinlan, F. B. Wright, M. Sterne, E. M. Robinson, L. W. Rossiter, J. G. Boswell, R. Paine, H. H. Curson, L. T. Edwards, P. R. B. Smith, D. G. Steyn, M. Bergh, C. v. E. Mare, J. H. B. Viljoen, J. R. Scheuber, H. O. Mönnig, Mrs. J. A. Robinson, Miss V. Amos, N. H. Boardman, J. H. Schoeman, H. P. Steyn, J. H. L Cloete,. T. F. Adelaar, J. H. R. Bisschop, H. Graf, C. Nilson, P. J. du Toit, J. G. Bekker, J. R. Frean, I. P. Marais, W. O. Neitz, A S. Canham, W. S. B. Clapham, O. T. de Villiers, K. Schulz, C. Jackson, N. F. Viljoen, J. G. Williams, J. Quin, C. J. van Heerden, P. J. J. Fourie, A. Matthew, J. J. G. Keppel, J. J. v. d. Westerhuizen, J. A. Thorburn, J. L. Dickson, M. M. Neser, A. M. Diesel, J. Zwarenstein, G. Schmid, G. J. de Wet, R. Alexander, V. Cooper, A. E. Lund, B. Runciman, J. Walker, B. v. d. Vyver, M. W. Henning, F. J. Dunning, G. C. van Drimmelin, G. J. Watt, M. C. Robinson, B. S. Parkin.

The Secretary read the notice convening the meeting. Apologies for absence were received from Messrs. F. A. Verney, N. T. v. d. Linde, F. C. Gavin and A. McNae.

The Chairman in opening the meeting referred to the loss the profession had sustained through the death of three of its most prominent

members, *viz.*, Sir Arnold Theiler, Mr. J. D. Borthwick and Mr. W. J. B. Green. The meeting stood in silence for a few moments as a mark of respect.

1. **Minutes of the 30th General Meeting held on 11/4/'36.**

These having been published in the Journal Dr. Alexander proposed and Dr. Mason seconded that they be taken as read and confirmed. Unanimously agreed.

2. **Matters arising from these minutes.**

(a) *Commission of enquiry into veterinary services.*—The Secretary reported that the matter had been fully discussed by Council, and that it was found that owing to shortage of staff the time was not opportune for going further with it at present. Agreed.

(b) *Motion by Mr. Runciman.*—As Mr. Runciman had not yet arrived it was decided to leave this matter over.

3. **New Members.**—The following were proposed and unanimously accepted : J. M. Fourie, M. C. Lambrechts and W. G. van Aswegen.

4. **Resignations.**—From W. E. Hearn, W. McKie. Accepted.

5. **Arrears.**—The Secretary reported that all those members who should have been reported to the meeting under Rule 7 (b) had recently paid either whole or part of their arrear subscriptions.

Benevolent Fund.—The Chairman pointed out that this Fund stood at only £152 and he stressed the urgent need of increasing this amount by voluntary contributions. An urgent appeal for assistance by this fund had been made, but unless there were voluntary contributions forthcoming it would not be possible to consider further appeals from deserving cases. He also explained the decision arrived at by Council the previous evening with regard to the steps to be taken to increase the fund, and stated that a list would be circularised asking for voluntary contributions.

6. **Motion by Dr. Quinlan.**

" In view of the fact that the Autumn General Meeting deals entirely with business matters which can be equally well dealt with by Council, it is resolved that the Autumn General Meeting be no longer held, and that the Constitution be altered by substituting " once " for " twice " and deleting " autumn and spring "—rule 10 (a)."

Dr. Fourie seconded.

Dr. Alexander proposed that the following amendment be added to the motion : " That the present Council should hold office for 18 months and the new Council take over at the end of the next Spring Meeting."

Mr. Coles seconded.

The motion and amendment were passed without opposition.

7. **Courtesy Title.**—The Chairman stated the position with regard to the referendum, pointing out that over 50% of the members did not vote. He pointed out the constitutional position, and indicated that, since many members had come to the meeting to discuss this matter, a discussion would be allowed but no vote be taken at this meeting.

Dr. Fourie proposed that the standing rules be waived and the question be discussed *de novo*. This was seconded by Dr. Alexander and carried by a great majority.

Mr. N. F. Viljoen read a copy of his memorandum dated 6th November, 1935, giving the reasons for his proposal for the adoption of the Courtesy Title.

Mr. D. Coles submitted the report of a Faculty Committee appointed to consider means whereby the D.V.Sc. can be brought within the reach of all graduates. Copies of this report were distributed to the members present.

After considerable discussion :

Dr. Alexander proposed that another referendum be carried out under the aegis of the Council, and that an impartial resume of the discussion just concluded as well as copies of Mr. Viljoen's memorandum and Faculty Committee's report be supplied to every member. Mr. Coles seconded. This was carried without opposition.

The Chairman pointed out that the matter was one which concerned every veterinarian in the country and suggested that the referendum be not confined to members of the Association but that all registered veterinarians should be entitled to vote. This was agreed to.

8. **Subsidised Motor Transport.**—Mr. van Heerden suggested that the parties interested in this matter should meet to discuss the matter with him at 8 o'clock the next morning. Agreed. The meeting adjourned for tea at 10.45 a.m.

On the resumption—

Mr. B. Runciman proposed :

" That this Association views with grave concern the alarming increase in the number of roaring and whistling horses bred in this country and attributes it to the free and unrestricted importation of unsound sires for stud purposes, a large number of them suffering from hereditary disease, chiefly respiratory infirmities, and this Association feels it to be its duty to bring such to the notice of the Government with a view to prohibiting the importation of unsound horses, and respectfully suggests that no horse or mare be allowed into the country whether for racing or for breeding purposes unless accompanied by a veterinary certificate stating such animal is free from Roaring, Whistling, Side bone, Shivering,

Defective Genital Organs, Bone Spavin, Ring Bone (high or low), Club-Foot or -Feet."

Major F. C. Gavin seconded.

Dr. Quinlan opposed the motion on the ground that there was no proof that roaring was a hereditary disease. The tendency now was to regard it more as sequel to a febrile disease. He pointed out that many diseases which were at first thought to be hereditary had now been shown to be due to nutritional factors. He quoted cases of famous sires that were roarers and were nevertheless used in South Africa with good results, and also submitted letters from veterinary associations in Holland and Ireland in which doubts were cast on the question as to whether roaring is hereditary.

Maj. Keppel mentioned that certificates of good health are required for the importation of horses into South Africa and handed in a copy of Government Notice No. 1650 of 15/11/35.

Mr. Robertson quoted a large number of roarers, notably *Cattrail,* that have been used for breeding in South Africa with good results.

Dr. Alexander stated that there was no evidence to show that roaring is hereditary. By pressing for legislation such as was asked for we would be taking the bread out of the mouths of veterinarians, since breeders should be encouraged to consult veterinarians with regard to the soundness of their animals.

Mr. B. Runciman in replying stated that nobody had made any attempt to show why roaring was on the increase in South Africa. In England no stallion will be registered or retained on the Register for the King's Premium unless it is annually certified to be free from the diseases mentioned in this motion. He could not subscribe to the view that it was largely a sequel to febrile disease and quoted cases of horses bred from roarers that developed the condition without any previous illness.

The motion was carried by 19 votes to 16.

The meeting then proceeded to the scientific section of the programme and the following papers were read and discussed :—

11.50 a.m. Points in connection with Plant and Mineral Poisoning : Dr. D. G. Steyn.

12.30 p.m. " The Epidemiology of Disease " : Dr. E. M. Robinson.

2 p.m. " Sheep Scab " : Messrs. J. L. Dickson and L. C. Blomfield.

3.30 p.m. " The Technique of Electric Ejaculation and Artificial Insemination." Demonstration by Dr. J. Quinlan.

A very successful dinner followed by a dance was held at the Pretoria Country Club in the evening of the 29th October. 43 Members, 33 ladies, and 8 guests attended. The guests were the Mayor and Mayoress, the Secretary for Agriculture and Mrs. Viljoen, the President of the Northern Branch of the Medical Association and Mrs. Russell, and Prof. and Mrs. Kleine.

Friday, 30th October.

9.15 a.m. "Rabies" (a) History, spread and control in S. Africa : Mr. P. S. Snyman.

(b) Desirability of a Zoological Survey : Dr. A. D. Thomas.

On the resumption after the tea interval Mr. H. Theiler handed over to the Chairman a plaque of the late Sir Arnold Theiler, stating that it was his father's wish to leave something personal to the profession in South Africa.

In accepting the plaque the Chairman expressed the Association's appreciation of Sir Arnold's kindly thought, and he then handed it over to the Director of Veterinary Services for safe-keeping at Onderstepoort.

11 a.m. Bacillary White Diarrhoea : Mr. D. Coles. During the discussion on this paper the Chairman protested against the exclusion of private practitioners from testing and stated that the position of the private practitioner should receive due consideration before the scheme is put into action.

12.15 p.m. "Plants which Affect Milk" : Mr. A. O. D. Mogg. Prof. Davel and Mr. Hardy (Superintendent of Dairying) also contributed to the paper. The former indicated how taints could be eliminated from milk, while Mr. Hardy stressed the importance of the subject primarily in so far as our overseas market was concerned.

2 p.m. Symposium on Streptococcic Mastitis :

Physiology of Milk Secretion : Dr. J. Quin.

Bacteriology : Prof. M. W. Henning.

Economic Importance and Diagnosis: S. W. J. v. Rensburg.

Treatment : Dr. I. P. Marais.

During the discussion on this paper several speakers drew attention to the unsatisfactory position with regard to milk control, particularly in so far as the health of the cow is completely ignored by the great majority of municipalities.

The suggestion was made that at the next General Meeting a whole day should be devoted to papers and discussions on clean milk production.

The Chairman at this stage indicated his desire to leave in order to catch his train back to Durban.

Dr. du Toit, in proposing a hearty vote of thanks to Mr. Amos, stated that the latter had come up specially for the meeting at great personal sacrifice and that it was perhaps not generally known that Mr. Amos was on the point of leaving for England for health reasons. He wished him a speedy recovery and safe return.

Mr. C. J. van Heerden took the chair.

General.

(1) *New Member.*—Mr. A. M. Diesel proposed Mr. L. R. Morford. Unanimously accepted.

(2) *Proposals.*—(a) Dr. Alexander and Dr. Quin :

" That it is a recommendation to Council to increase the duration of the S.A.V.M.A. meeting to three days and that one entire day be devoted to a discussion of a subject as a wide symposium from many angles."

Passed unanimously.

(b) Messrs. Coles and Robertson :

" That the President be asked to submit his views on the Bacillary White Diarrhoea programme to Council for consideration."

Passed unanimously.

(c) Further motions of thanks were passed to Mr. v. Heerden for meeting the field veterinarians on the question of motor transport, to the entertainment committee and to the Onderstepoort staff and ladies for their hospitality.

The meeting closed at 5 p.m.

PERSONAL NOTES.

Although Dr. A. D. Thomas has relinuquished the position of Editor of the Journal, he remains a valued and active member of the Editorial Commitee. Dr. Thomas edited the Jouhnal for over five years with conspicuous success. Due to his energy and foresight four years ago, we now enjoy a quarterly publication. The Association owes Dr. Thomas, one of its most faithful servants, a great debt of gratitude.

* * *

Mr. S. T. Amos, our President, shortly after having presided with great success at the Spring General Meeting, sailed for England in November and will be away about four months. Mr. Amos has gone over mainly for reasons of health and we wish him a speedy and complete recovery.

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Dr. H. H. Curson, formerly Professor of Anatomy and Veterinary Research Officer at Onderstepoort, has taken up the post of Deputy Director of Native Agriculture in the Department of Native Affairs. All members of the Association will wish him success in his new work. Dr. Curson is a past Vice-President of the Association and is still active on the Council and its subcommittees.

Mr. W. Orr has resigned from the Veterinary Research Department, Salisbury, in order to take up a post in the Federated Malay States, as Government Veterinary Surgeon at Taipang, Perak.

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Dr. and Mrs. A. D. Thomas are being congratulated on the birth of twin daughters.

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Recent transfers in the Division of Veterinary Services include :—

From Allerton : Mr. R. Clark to Bethlehem, O.F.S.

From Louis Trichardt : Mr. L. T. Edwards to Pietersburg, *vice* Mr. A. E. Lund transferred to Pretoria.

From Port Shepstone : Mr. C. H. Flight to Cape Town, *vice* Mr. A. R. Thiel, transferred to Port Shepstone.

From Umtata : Mr. W. J. Wheeler to Louis Trichardt.

In South-West Africa : Mr. J. A. Maybin from Grootfontein to Omaruru; Dr. G. Schmid from Omaruru to Okahandja; Dr. H. H. S. Sigwart from Okahandja to Grootfontein.

THE BENEVOLENT FUND.

An Appeal to Members.

At the Spring General Meeting the President made an urgent appeal for voluntary donations to the Benevolent Fund, whose assets are only £152 and on which demands are being made by very deserving cases.

As a result of this appeal, almost every member present made a generous contribution, the sum of 47 guineas being collected.

It is felt that many members who were not present at the meeting will wish to contribute their share towards this very worthy cause. The season is most fitting for generosity of this kind, and donations should be sent to the Hon. Secretary Treasurer, S.A.V.M.A., P.O. Onderstepoort, Pretoria.

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