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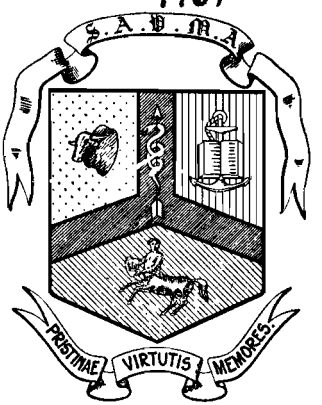

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DIE SUID-AFRIKAANSE
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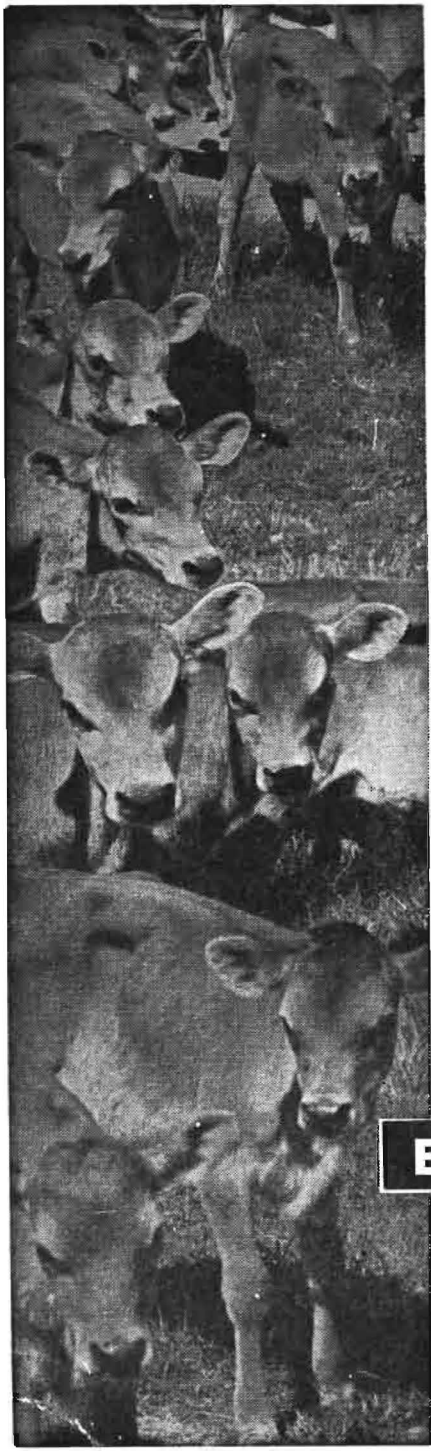

Unieke nuwe Pfizer-inspuiting bestry onvrugbaarheid by beeste ... verhoog mate van bevrugting

EMBRYOSTAT *

Die mate van bevrugting van moeilike telers en repeteertelers word grootliks verbeter as hulle in die skede of in die baarmoeder ingespuit word met Embryostat—'n unieke formule wat deur Pfizer vir die eerste maal beskikbaar gemaak is en deeglik getoets is oor die afgelope 3 jaar.
Embryostat werk bakteriese infeksie in die baarmoeder teë; *die oorsaak van meer as* 40 *persent van die onvrugbaarheid by beeste*—en lei tot uitmuntende kanse vir bevrugting waar die moontlikheid voorheen swak was.
Met Embryostat word teelkoste derhalwe verminder en dit het gesonder troppe tot gevolg.

*Wat die wetenskaplikes sê oor EMBRYOSTAT **

Embryostat inspuitings het 80% bevrugting gelewer by diere wat voorheen nie wou bevrug raak met minder as drie dekkings per dier nie. 83% bevrugting by 280 repeteertelers.
(Embryostat in die skede ingespuit onmiddellik na bevrugting) 81% bevrugting by 24 diere met 'n voorafgaande rekord van 3.2 onsuksesvolle dekkings.
(Embryostat ingespuit 24-72 uur na bevrugting.)

EMBRYOSTAT*

om onvrugbaarheid by beeste te bowe te kom

Pfizer *Wetenskap vir die welsyn van die wêreld*

* *Handelsmerk van Chas. Pfizer & Co. Inc.*

Vir verdere besonderhede, skryf aan: Pfizer-laboratoriums Suid-Afrika (Edms.) Bpk., Afdeling Landboukunde, Posbus 7324, Johannesburg.

DIFFERENTIAL DIAGNOSIS OF TRAUMATIC RETICULO—PERITONITIS.†

O. Dietz.*

Introduction:

Already thirty years ago Richard Goetze recommended rumenotomy for removing foreign bodies from the reticulum of cattle. It was also a well-recognized fact that quite a number of other diseases of cattle presented identical or similar symptoms distinguishable clinically only with difficulty, if at all, from gastritis. The primary diseases of the rumen—for example, frothy bloat, simple bloat, acidosis, intoxications by noxious feed—can be distinguished with certainty from gastritis on anamnesis and clinical symptoms. Diseases of the uterus (especially torsio uteri), pyelonephritis and trichostrongylosis hardly call for consideration in the differential diagnosis, as they are easily recognized by means of modern clinical and laboratory methods. On the other hand, conditions such as primary and secondary ketosis, atony of the omasum, intussusception, abomasal dilatation and torsion, or abomasal displacement, and rupture of the diaphragm, evoke symptoms similar to gastritis, and may take the same acute or chronic course and produce similar secondary symptoms. Therefore a differential diagnosis frequently is very difficult for the practitioner. The following report is the result of personal observations made in our surgical clinic over the last 10 years—all on cows presented because of a suspicion of a foreign body. The method of examination used allows a sound differential diagnosis to be made: hence it is described in detail.

Examination procedure:

1. Examination of the circulatory system. This entails determination of:

(a) rate, quality and rhythm of pulse;
(c) degree of congestion of the scleral vessels;
(c) the colour of the mucous membranes;
(d) degree of venous stasis in the jugular veins;
(e) cardial and pericardial pathology as revealed by auscultation and percussion of the cardiac region.

Such an examination of the circulatory system not only allows conclusions to be drawn on the general status of the animal; secondary symptoms of traumatic gastritis can be diagnosed as well. As examples may be quoted: (*a*) purulent ichorous pericarditis, where the pulse rate ranges from 120 to 140, pericardial splashing sounds are heard,

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stasis in the jugular veins is observed, a definitely enlarged area of cardiac dullness exists and the disease runs an acute course; (*b*) fibrinous pericarditis, where the pulse rate is 100—120, the cardiac sounds are muffled (so-called "fibrin armoured heart"), stasis in the jugular veins, and enlarged area of cardiac dullness are present as before and the disease runs an acute to sub-acute course. As differential diagnosis tuberculous and leukotic pericarditis must be considered. By contrast, bradycardia is a symptom observed in the early stage of abomasal displacement.

2. Examination of the respiratory system. Artificial arrest of respiration is employed; the lungs are auscultated and percussed. Such an examination may indicate the presence of advanced pulmonary tuberculosis, or of grazing emphysema of cattle, or, when gastric sounds are audible, of diaphragmatic hernia.

3. Examination of all the palpable lymph nodes. The lymphomatous form of leukosis or tuberculosis may be diagnosed from widespread enlargement of the lymph nodes. Swelling of one or some lymph nodes indicates a regional disease. If there is widespread enlargement of lymph nodes and at the same time pericardial friction sounds, one must think of leukotic pericarditis, or tuberculous pericarditis if the tuberculin test is positive. Examination of the blood will decide the diagnosis.

4. The examination of the digestive tract consists of an external and a rectal palpation. With the external examination one can determine:

(*a*) the number of ruminal movements per minute;
(*b*) the degree of filling of the rumen, and nature of its contents,
(*c*) the area of hepatic dullness;
(*d*) pain on percussion in the area of the reticulum;
(*e*) pain on percussion in the area of the omasum;
(*f*) possible displacements, e.g. of the abomasum, by auscultation of the ventral ruminal region.

Further tests for foreign bodies are executed: Head's lines and zones test, spinal pinch, and the staff test (pressure on the xiphoid region by means of a rod). Finally, the results of examination by means of the metal detector have to be taken into account. Auscultation of ventral ruminal region for detecting a possible displacement of the abomasum and the test for abdominal rigidity are not to be omitted during the external examination of the abdomen. Upon rectal palpation the gynaecologic status is determined first of all. Then the peritoneum is carefully palpated for possible adhesions (tuberculous, fibrinous or purulent peritonitis). The iliac and mesenteric lymph nodes are palpated to complete the examination of the lymph nodes. Kidney and bladder are examined for size and presence or absence of pain. In cases of dilatation or torsion of the abomasum froth-filled intestinal loops are felt on the right side cranial to the pelvis. A suspicion of intussusception is aroused by the presence of a solid sausage-shaped mass as well as inflated loops of small intestine.

Whenever anamnesis and clinical picture (e.g. odour of breath, enlarged hepatic dullness, yellowish mucous membranes) are in the least suspicious, examination of the urine for acetone bodies, blood pigment (haemoglobin), sugar and protein should be undertaken—even under conditions of private practice—and the urinary sediment should be examined for the presence of cells and bacteria. When ketones appear in the urine, blood sugar determination will indicate the severity of the disease.

The blood picture may allow one to draw conclusions with regard to leukosis; a nuclear shift to the left in the leukocyte picture with accompanying leukocytosis possible indicates a traumatic pericarditis or diffuse peritonitis.

Under predisposing environmental conditions (pasture and region) faeces examination will be necessary to diagnose trichostrongylosis, fascioliasis or metastrongylosis.

The procedure of examination described here does not pretend to be complete; however, it cannot be omitted when other diseases are to be distinguished from traumatic reticulo-peritonitis.

Ketosis

At the outset on should distinguish between the syndrome of traumatic gastritis with secondary ketosis on the one hand and primary ketosis on the other. According to our own statistical studies, about 3% of all cattle suffering from traumatic gastritis show signs of secondary ketosis at the same time. Diseases of the abomasum are often followed by secondary ketosis. As a rule, those cows, already suffering from traumatic gastritis and concomitant anorexia for several days, are affected (ketosis of hunger). Secondary ketosis can also appear in cases of progressive peritonitis. The diagnosis of ketosis can be proven by the presence of ketones in the urine, with simultaneous lowering of blood sugar values.

There is scarcely any doubt that primary ketosis occurs in cattle. At most, it is not clear which of the many recently advocated methods of therapy is the best. We are all familiar with the primary ketosis (the so-called ketosis of hunger or small farmers' disease) in emaciated, badly fed animals—both young and old. We are even more familiar with the ketosis affecting well-fed cows, four to eight years old, in which the disease mostly appears four to eight weeks before or after calving. But these animals can also develop traumatic gastritis with or without secondary ketosis, and here the traumatic gastritis can be aggravated by pressure of the pregnant uterus or by the labour pains of parturition.

Usually traumatic gastritis with secondary ketosis and primary ketosis clinically show the same symptoms. The tests for foreign bodies frequently are strongly positive in primary ketosis, too. The metal detector does not give finality, as the apparatus does not register the presence of non-metallic foreign bodies in the reticulum. The

blood picture does not yield conclusive evidence, as there is always a light deviation to the left and a light leukocytosis in both traumatic gastritis with secondary ketosis, as well as in primary ketosis. The blood sugar values, too, drop in both secondary and in primary ketosis.

In all these cases where traumatic gastritis with secondary ketosis cannot be distinguished from primary ketosis, one should immediately institute therapy, which will at the same time act as diagnostic treatment. Here ACTH is the best; the first three days 100 international units are injected and at the same time 200 ml. propionic acid in the form of sodium propionate daily. A liver-protecting therapy with glucose and amino acids is to be recommended, in addition. Good meadowhay is the food of choice. If the foreign body tests do not become negative, the blood sugar level does not rise, the ketone level in the urine does not disappear, a rumenotomy ought to be executed as a diagnostic operation on the third or fourth day at the latest. In these cases a diagnosis of foreign body peritonitis with secondary ketosis can almost always be made.

Atony of the omasum

Atony of the omasum rarely appears in cattle. Among 750 cases of suspected foreign body gastritis admitted to our clinic during a period of five years, primary atony of the omasum was diagnosed in four per cent. We recognize this as an independent disease in cattle, appearing in a mild and in a severe form. The mild form cannot be distinguished clinically from traumatic gastritis, which in fact, usually causes a secondary omasal atony.

The pulse-rate is between 80 and 100 per minute. Body temperatures are between 38.5°C and 40.0°C. Ruminal motility is slightly diminished. It is remarkable that in primary atony percussion of the reticuum and the test of Head's lines and zones show negative or doubtful results, while the spinal pinch and the staff test are always strongly positive. Pain can often be elicited on percussion of the omasum in both primary and secondary atony and is therefore of no differential diagnostic significance. Ketosis can be excluded by urine examination.

In severe cases of omasal atony, alternate knuckling of the hind feet can be observed from time to time. Symptoms of intoxication are prominent. Body-temperature varies between 40.0°C and 41.5°C. The cardiac sounds are exaggerated; there is only a slight fall of pressure between pulse-beats, which have a frequency of 100 to 130 per minute. All foreign body tests are strongly positive. A definite diagnosis cannot be made—not even by the metal detector for the positive result of an examination by means of this instrument does not mean that the foreign body has penetrated. It is significant that the leukocytosis accompanying traumatic gastritis and any nuclear deviation to the left are absent both in the mild and in the severe cases of primary omasal atony. Details are shown in the following table.

TABLE I

Diagnosis.	Leuko-cytes.	Basophils.	Eosino-phils.	Myeloid.	Juveniles.	Staff cells.	Mature Segmented.	Lympho-cytes.	Mono-cytes.
1. Normal	8.000	0.1	6	—	—	3	35.9	53	5
2. Circumscribed traumatic reticulo-peritonitis	10,607	0.116	4.4	—	—	2.6	49.7	42.8	1.07
3. Traumatic reticuloperi-. . tonitis with complications.	14,290	—	3	—	0.07	6.1	51.7	38.5	0.8
4. Peritonitis and pericarditis	12,113	0.04	1.48	—	0.22	10.34	48.3	42.5	1.3
5. Omasal atony (23 cases)	8.000	0.18	4.5	—	—	3.1	33.4	50.9	0.64

By collating all the clinical and laboratory results, one is able to arrive at a well-nigh correct diagnosis. Finally, diagnostic rumenotomy must be executed to confirm the tentative diagnosis. The immediate treatment is rumenotomy, followed by massage of, and by infusion of paraffin oil into the omasum. For the post-operative treatment ruminal fluid, calcium saccharate and sodium propionate are the best. In this way we could cure 30 cases within the last three years.

Intussusception

Ileus and dilatation or torsion of the abomasum both evoke symptoms of colic in the same way as acute gastritis, especially in the initial stage. Ileus of cattle is nearly always accompanied by an intussusception of the small intestine. There is very often an intussusception of the jejunum into the ileum; occasionally the tip of the caecum invaginates into the body. Initially, and as a rule, the symptoms of colic are violent. The animals kick with their hind feet, poke at the flands, look round at the abdomen, lie down and get up again. (In an early gastritis attack the same symptoms can frequently be observed, but only for a very short time.) In intussusception the symptoms of colic disappear after six to twelve hours, but severe general disturbances supervene. The pulse rate rises up to 130 and the extremities become cool to the touch due to circulatory insufficiency. The animals are usually recumbent and groan loudly. Symptoms closely resemble those of acute traumatic gastritis. A few hours after appearance of the first symptoms, there is no defaecation. Normal defaecation is replaced by straining and the passage of blood-stained mucus. Rectal palpation is essential for differential diagnosis: a sausage-shaped structure in the right abdominal region associated with tympany of the proximal part of the intestine is pathognomonic. There are cases where the intussusception is so far forward in the abdomen that it cannot be palpated rectally, particularly when the tip of the caecum is invaginated into the body. Diagnostic laparotomy on the right flank should not be delayed.

In cattle this intussusception can last six to nine days. Spontaneous recovery doubtlessly occurs by shedding of the invaginated parts of the intestine. Otherwise resection of the affected parts must be resorted to. We always use end-to-end-anastomosis for resection. Within the first six to twelve hours after onset of the disease correction is possible without resection.

Dilatation and Torsion of the Abomasum

Dilatation and torsion of the abomasum is rarely observed in Germany. Since 1950, I have observed five cases: one of them could only be recognized after slaughter. The clinical picture resembles that of intussusception. The Danes Emsbo[3] and Bischoff[1] have described more than 52 cases. There is a 95 per cent chance that the rotation occurs to the left and through 180—360 degrees along the longitudinal axis of the abomasum. As rule the reticulum and the omasum

are involved as well. Among others, the general symptoms are toxic indigestion, rapid pulse, tenderness over the abomasal area, diarrhoea and ketosis. Abomasal dilatation is apparent on rectal palpation, whether there is a visible swelling in the right paralumbar fossa or not. Both acute and chronic dilatation occur. The acute form usually is the result of a stenosis in the duodenum near the pylorus. The chronic form arises as the result of a paralysis of the neuromuscular complex of the abomasum which is caused by pyloric ulcers or impaction of the abomasum with soil. The disease appears in Spring and a few weeks *post partum*. The observed cases showed either pyloric ulcers, soil packed in the greater curvature of the abomasum, multiple small ulcers in the abomasal and the omasal mucosae, duodenitis, peritonitis, or an anaemic infarct or leukocytic infiltration or the abomasum. All cases had this in common: abomasal dilatation and left torsion of the abomasum, omasum and reticulum. The dilatation is considered to be secondary to one of the lesions just described, and when dilatation has progressed sufficiently, torsion takes place. An early or advanced dilatation and torsion are detectable by careful auscultation and percussion of the right abdomen. Symptoms of colic are rarely present. In the differential diagnosis exudative peritonitis and foetal hydrops must be excluded. Ileus and intussusception, on the contrary, produce acute symptoms of colic. Meticulous rectal palpation is necessary.

The treatment is begun by a laparotomy in the right flank (paralumbar fossa). Then a puncture is made and the contents of the abomasum are siphoned off; thus a more thorough examination can be made for the original cause, and other corrective measures can be taken. In case of torsion, reposition is made. In case of ulcers, symptomatic treatment is given as indicated. Prognosis is good if the animals are presented for treatment early. After reposition, circulatory stimulants and physiological saline solution are to be administered. In case the operation cannot be executed immediately, the dilatated abomasum has to be punctured through the right flank or through the rectum in order to evacuate the gases. Bischoff has observed spontaneous correction after such puncture.

Abomasal displacement

Recently displacement of the abomasum has appeared more frequently in Germany. The largest part of this organ cames to lie to the left and ventrally under the rumen between the rumen and left abdominal wall. According to Rosenberger and Dirksen[4], this disease occurs in a proportion of 1 to 100, compared to traumatic gastritis. The aetiology of abomasal displacement is not yet clear. Feeding and purely mechanical influences, such as advanced pregnancy and parturition, are supposed to play a role. The symptoms are those of sub-acute to chronic indigestion. According to the clinical symptoms, and the course of the disease, it could be mistaken for a somewhat atypical or chronically relapsing traumatic gastritis. The following symptoms are important fot the diagnosis: capricious appetite,possibly

bradycardia, passing of small quantities of darkly coloured, greasy faeces, more or less distinct abdominal rigidity and especially clear abomasal sounds independent of the activity of the rumen and perceptible in the left paralumbar fossa or further forward. (See procedure of examination). Reposition of the abomasum is the only treatment.

Diaphragmatic Hernia

Finally, diaphragmatic hernia of cattle[5] must be mentioned. Diaphragmatic hernia, or more correctly, rupture of the diaphragm, rarely occurs in cattle. About 50 cases have been described in the German literature; only about 15 of them could be diagnosed *intra vitam*. It is nearly always blunt trauma with simultaneous increase of intra-abdominal pressure which causes rupture of the diaphragm. The injury can possibly be caused by a foreign body. In all cases the rupture occurred in the right part of the diaphragm followed by a prolapse of parts of the reticulum into the pleural cavity. In our clinic eight cases of diaphragmatic hernia were diagnosed during the last 5 years. In each case the symptoms of foreign body reticulitis were seen. Diagnostic symptoms of diaphragmatic hernia are:

1. tympany with frothy bloat and violent ruminal movements;
2. dysphagia and repeated vomiting of ruminal contents into the crib: (both symptoms are present in disturbances of the gastro-intestinal tract, especially in the case of constriction of the diaphragmatic rupture during respiration);
3. disturbance of respiration and circulation in case of compression of the lungs, of the heart, and of the large blood-vessesls especially when a prolapse of the whole reticulum into the pleural cavity has occurred;
4. intestinal and gastric sounds within the right pleural cavity.

Treatment in most cases of diaphragmatic hernia is not possible. Between the prolapsed part of the reticulum and the rupture of diaphragm strong adhesions are rapidly formed. We succeeded in breaking down these adhesions. We did not succeed, however, in repairing the rupture of the diaphragm--not even under insufflation anaesthesia and application of muscle-relaxants and thoracotomy. We concur with other authors, that it is useless keeping an animal alive when, upon rumenotomy, one third or more of the reticulum had prolapsed. Digestion does not improve in any way; such an animal becomes emaciated and must be slaughtered after one to two months.

Conclusion

We can definitely say that there exists quite a number of gastroenteropathies of cattle with a clinical picture similar to that of traumatic reticulitis. It is possible to distinguish most of them clearly from one another by meticulous clinical investigation. The leukocyte picture and examination of urine and faeces are good diagnostic aids. In case of doubt one should perform diagnostic laparotomy on the right or left flank in good time and according to the state of each case.

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A BRIEF OUTLINE OF RADIOGRAPHY.

D. H. G. Irwin*

Definition

Radiography is the use of X-rays, or Röntgen Rays for securing images of body organs and tissues on a photographic plate. Such a photographic negative is called a Röntgenogram, Radiograph or Skiagram.

Introduction.

This paper deals with the barest outline of radiography. Its aim is to enable the uninitiated to make radiographs, without danger to man, patient and machine, and to provide a skeleton which further reading may adorn. The subject may be considered conveniently under the following headings: historical account, the nature and properties of X-rays, generation of X-rays, X-ray machines, accessory equipment, preparation and positioning of patient, exposing the plate, fluoroscopy, the dark room and film development, the elements of reading skiagrams and X-ray hazards and protection.

Historical.

In 1895 a Bavarian physics professor, W. C. Röntgen, discovered "eine neue Art von Strahlen", which he called X-rays. In the second decade of this century, increasing use of X-rays was made, especially in the medical field. The discovery of the properties of a high tension vacuum tube made the use of X-rays much more accurate and valuable. This is called the Coolidge tube, after its American originator.

The Nature and Properties of X-rays.

X-rays are similar to radio, light and heat waves but are of infinitely short wavelength ($\pm 10^{-8}$mm.) and far beyond sensory perception. The gamma rays of radium are somewhat similar in wavelength and properties. Like light waves, those of Röntgen travel in straight lines, and grow weaker according to the square of the distance. X-rays possess the ability to

(i) excite *luminescence* in certain substances (e.g. zinc sulphate, barium platino-cyanide), a property used in fluoroscopy and on intensifying screens (*vide infra*);
(ii) render gases conductive to electricity, *ionisation*;
(iii) exert a *photographic effect* on the emulsion of a photographic plate;
(iv) influence living cells, *a biological action*;
(v) *penetrate matter*; the degree of penetration is a factor of the atomic number of the material.

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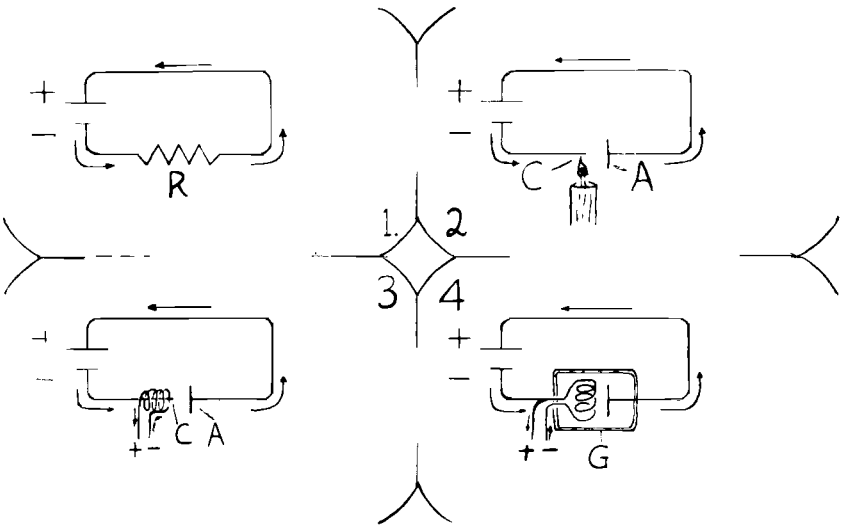
On the fluoroscope screen dense bodies show as *dark* areas, whereas on a radiograph they show as *light* areas.

GENERATION OF X-RAYS.

In an electric circuit, electrons flow from the —ve to the + ve terminal of the battery (see fig. 1). This flow accelerates with an increase in the potential difference or voltage across the terminals of the battery, whilst increase in resistance R, slows it.



Figs. 1—4: Diagrams of Electric Circuits.

A: Anode.
C: Cathode.
G: Hard glass tube.
R: Resistance.

Should the circuit be broken the flow of electrons will cease. The electrons dancing around at the end of wire attached to the — ve terminal (C in fig 2.) seek to break loose. Should they momentarily do so a + ve charge is created and the electron (a — ve charge) is pulled back. If C is heated by a flame (fig. 2) or electrically (fig. 3) the excursions of the electrons away from C become greater and greater and may possibly jump the gap to A, which is attached to the + ve terminal. The molecules of air between C and A impede the transit of electrons across the gap unless the voltage is very great and the gap very small. If, however, C and A, and a little of the wire bearing them are enclosed in a glass tube from which the air is evacuated, the electrons are more labile and flow is facilitated. Such a tube is called a *diode* (fig. 4). This is the basis of a host of electrical tubes. Should the surface of C, the *cathode* be coated with barium oxide for example, the cathode electrons may be made more labile by shining a beam of light upon it. This is the basis of sound reproduction from the sound tract of a movie film.

An X-ray tube is a specially constructed diode. If the voltage between C and A (the *anode*) is very great (40,000—150,000 volts, 40—150 Kv.), the electrons will strike A at very high speed. A little of this energy is transmuted to X-rays, but most (99.9%) is lost as heat. Coolidge designed the first tube capable of producing X-rays of a consistent and practically useful type. Modern X-ray machines use a Coolidge tube, of which fig. 5 gives a semi-diagramatic representation.

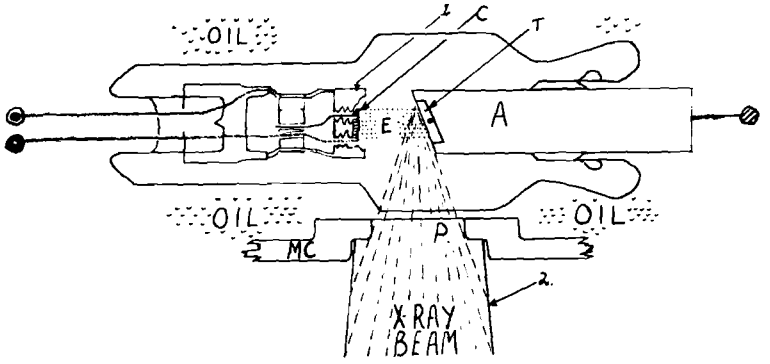


Fig. 5: Semi-diagrammatic sketch of a Coolidge Tube.

A: Anode.
C: Cathode (a tungsten filament).
E: Electron Beam.
MC: Metal can, enclosing Coolidge Tube in an oil bath.
P: Glass port whence X-Rays emerge.
T: Tungsten target.
1. Focussing cone, to channel electrons boiled off C.
2. Cone to reduce irradiation hazard.

The domestic electricity supply is normally an alternating current with a potential of 250 volts. This potential must be raised to that required to operate the X-ray tube (usually about 80,000 volts) by means of a transformer. This consists of a primary coil (P–C), and a secondary coil (S–C) (see fig. 6) which is provided with a low potential tapping (LPT) for heating the tungsten filament. The high tension terminal (H.T. fig. 6) may usually be set in any one of three possible positions, therby altering the Kv. The low potential tapping (LPT. fig. 6) heats the cathode and makes the cathode electrons more labile, by supplying a current between 5–100 milliamps (ma).

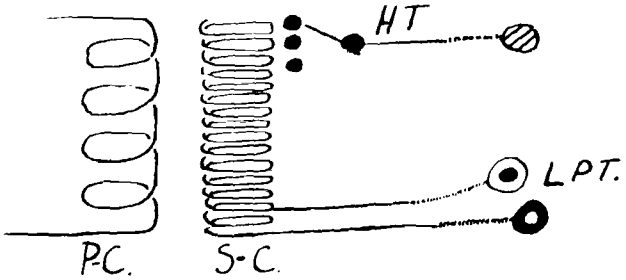


Fig. 6: Diagram of a Transformer.

HT: High Tension lead, set to maximum.
LPT: Low Potential Tapping to heat cathode.
S.C.: Secondary Coil.
P.C.: Primary Coil.

For highest efficiency a direct current should be applied to the X-ray tube (otherwise only half the alternating current cycle can be used). Alternating current is changed to direct current by rectifying tubes. One such arrangement of rectifying diodes is shown in fig. 7.

Whereas the polarity of the leads coming from the secondary coil of the transformer changes from positive to negative and back 50 times a second, the polarity of the two points C and A remains constant. The diodes in Fig. 7 have the cathodes marked ——→ and their anodes marked ——|.

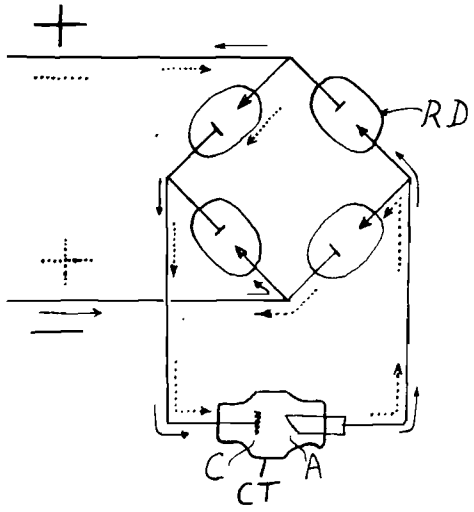


Fig. 7: Diagram illustrating Current Rectifying Apparatus.

A: Anode.
C: Cathode.
C.T.: Coolidge Tube.
R.D.: Rectifying Diode.

X-RAY MACHINES.

An X-ray machine is composed of three main units:

TRANSFORMER.	RECTIFYING TUBES	COOLIDGE TUBE.

The wiring up to and including the primary coil of the transformer carries normal domestic current and voltage: it is called the ordinary or *low tension circuit*. The current beginning with the secondary coil of the transformer and leading to the rectifying tubes is the *high tension circuit*. It is rare nowadays to encounter an apparatus which is not shockproof, but beware of one which is not.

When the electrons liberated from the cathode (the tungsten filament) strike the anode at high speed the essential criteria for production of Röntgen rays are met. Much energy is wasted in the form of heat and in order to draw this heat away as quickly as possible, the anode is made of a thick copper rod. Heat is conducted away from the target (see below) along this rod to be dissipated—for example from metal fins immersed in oil.

In spite of whatever cooling device is used, overheating may occur with destruction of the tube (the price of replacement of a modest 15 ma tube is around R150) if too long exposures are used or too frequently over a short time.

The site of impact of the electrons on the anode is the target, and although of the toughest tungsten, this pits after long use. This disadvantage is overcome fairly successfully by building a so-called *rotating anode* (fig. 8). The target area is thereby multiplied considerably, since the whole circumference of the oblique surface acts in turn as the target. The anode is rotated by an electric motor.

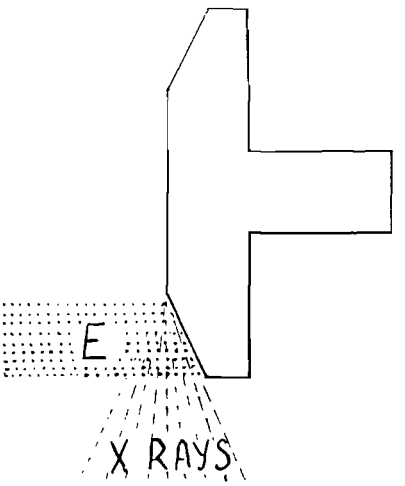


Fig. 8: Diagram of a Rotating Anode.
E: Electron Beam.

When many hundreds of radiographic examinations are done, as in tuberculosis and silicosis investigations in human subjects, a special apparatus is used. This incorporates a rotating anode, and the radiographic image is cast onto a fluoroscopic screen, which is photographed automatically by a 35mm. camera. In this way the cost per exposure is greatly reduced.

X-ray machines used in modern veterinary practice fall into three main groups.

1. Portable: for use both in and away from the surgery.
2. Mobile: for use in consulting rooms and e.g. in operating theatre.
3. Fixed: For use only over a fixed table.

Most machines operate on four variables—the kilovoltage, milliamperage, time and distance all being adjustable. This allows latitude for various techniques under the wide variety of circumstances arising in veterinary practice. Some fairly popular machines, however, operate on a fixed 15 ma and 45 kv., leaving only the time and the distance adjustable.

The temperature of the oil surrounding the tube may not be allowed to rise above 100°C, lest excessive heat destroy the apparatus. Usually a thermometer is built in, and should be checked frequently during busy sessions.

ACCESSORY EQUIPMENT.

To obtain consistently good radiographs the following are useful:

The Table should be lead covered, and provided with cleats for the attachment of sash cord, which, together with sand bags, are useful for positioning the patient, so obviating the necessity for anyone to hold the animal. Thus undue exposure of assistants is avoided.

In radiography the dense tissues (e.g. bone) of the patient absorb more of the X-ray beam than do soft tissues, and varying degrees of change occur in the plate emulsion. Part of the beam is, however, deflected by the object, giving rise to rays scattered from their original course, resulting in *background fog*. A *stationary grid* (see fig. 9) may be used to intercept the scattered rays, and reduce fogging. Strips of one m.m. high lead foil are interposed with radiotranslucent material.

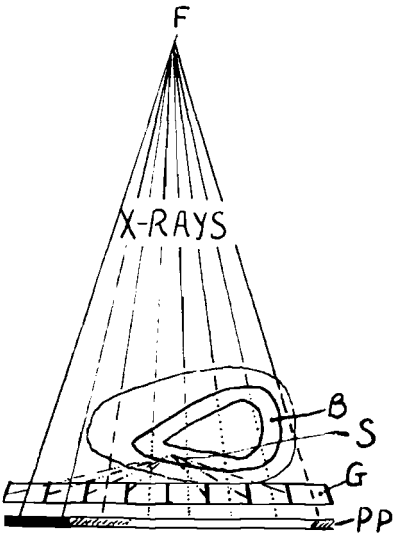


Fig. 9: Diagram showing a Transverse Section of a Limb being Radiographed; a Stationary Grid in Use.

B: Bone.
F: Focus; an imaginary spot on the target.
G: Stationary grid, with lead strips absorbing scattered radiation (represented as coming from a single point S).
P.P.: Photographic plate showing varying degrees of exposure (casette not shown).

The stationary grid produces a series of fine white lines across the film, which is somewhat of a disadvantage.

The *Potter-Bucky* diaphragm is a more advanced anti-fogging apparatus. It moves automatically during the exposure so that shadows of the lead foil are not produced.

The disadvantage common to both of these is that exposure times must be increased about four times. It is ironical that the greatest use for the grid or diaphragm is in thick objects, which cause the greatest scattering in rays, but that the X-ray tube might already be strained to the maximum to penetrate the object, not leaving enough penetration or power to overcome the resistance offered by the grid. Carlson uses a grid when his object is 11 cm. or thicker.

A *timing clock* is built into the switch which operates the Coolidge tube. It is graduated up to a maximum (usually) of 8 seconds, the first of which is subdivided into tenths of a second.

Cones and diaphragm may be fixed to the tube port to channel the rays within a narrow field: their main use is as a precaution against irradiation of radiographers and bystanders, and to limit irradiation of the patient (see 2. fig. 5).

Filters are coin-like discs, usually of aluminium, which may be interposed between tube port and the object. These subtract the longer wave length X-rays (which contribute little to image formation) and reduce needless irradiation of the patient.

Preparation of the Patient.

A poor radiograph is not only undesirable, but may be worse than no radiograph, by being misleading. Sedation, general anaesthesia, emptying of the gut and administration of a contrasting agent may be necessary to produce a good radiograph.

Sedation is often of great value, whilst *general anaesthesia* is necessary to prevent movement of the patient when longer exposures are employed; Drury, Dyce and Merlen[6] go so far as to say that in large animal work, restraint is our most common limiting factor, it being more important than the physical properties and limitations of the machine.

The contents of the intestinal tract may make interpretation of radiographs difficult. Emptying the gut is accomplished in several ways before radiography. 01. Ricini is commonly used among the oral laxatives. Emetics may be useful[17] or parenteral drugs, e.g. carbachol choline. An enema is a favourite method of emptying the large bowel before radiography of the lower abdomen, pelvis etc., whilst gas in the intestines may be reduced or eliminated by injecting pituitrin half an hour before exposure.

Contrast Media.

Contrast media are materials having a different radiographic density to the surroundings of the structures to be examined and are used to delineate cavities and organs.

Contrast media may be used in the form of gases, suspensions or solutions. Gaseous contrasting media include oxygen, hydrogen, air and carbon dioxide. By injecting such a gas into cavities their outline may be determined. Uses include definition of joint capsules, peritoneum and bladder. They are dark on the film.

Contrasting suspensions include salts of barium and bismuth. They are white areas on the film. They are used especially in the digestive tract, but rarely before a control film has been made (i.e. one taken before administration of contrast medium). Barium salts are perhaps the better, but bismuth preparations are quite satisfactory and are very much cheaper.

These salts may be given as a drench in suspension or dosed in solid form—e.g. in a gelatine capsule. They line the gut, and may be used to show irregularities in the rugi ventriculi in gastric ulcers for example. These media may also penetrate cloth or spongy rubber balls showing up these foreign bodies. Segments of tape worms may even be demonstrated.

Sicard and Forestier[14] first used iodized poppy seed oil in contrasting soft tissues in radiography. This substance is not used in bronchography, since it persists in the alveoli and may produce iodism, but has many other uses as a contrast medium.

Most radiological contrast agents in current use are special organic iodine containing chemicals. They have helped considerably to extend the range of usefulness of X-rays for diagnosis. Diodine, Iodoxyl, Propyliodone, Phenobutiodil (in tablet form), sodium salt of diprotrizoate, acetrizoate and diatrizoate and sodium iodide are examples[7].

Depending upon the organ to be shown up, a particular contrast medium is selected. Materials excreted by the kidneys are used for pyelography, for example. These media are available in various forms again depending upon their proposed function: arachis oil, as oral tablets and intravenous solutions of varying strength is available. Contrast media have made possible the following range of procedures; angiocardiography, cholecystography, cystography, cystourethrography, pyelography (intravenous and retrograde techniques available), salpingography, myelography, sialography, and for determining tracts of fistuli and sinuses.

Precautions should be taken against iodism, and alpha radiation, e.g. from "Thorotrast".

Positioning of Patient.

In general the positioning of the patient is governed by four simple rules:

1. The ray source should be point-like.
2. The distance from ray source to plate should be long.
3. The object and plate should be close together and parallel.
4. The rays should fall perpendicularly onto the plate.

Since the images cast by X-rays on the plate obey (almost) the same rules as shadows from a light bulb, the above rules become self evident, see fig. 9. It remains only to recall those anatomical facts which will help fulfil these criteria. (Obviously a clinical diagnisos should be attempted before making radiographs).

Standard Positioning Techniques for Small Animals.

A. *Hard tissues.*

Head.—Make the dorso-ventral plate (d—v) with head precisely horizontal and extended. Centre rays* on the dog's "stop". For the lateral plate (lat.) exactness is again essential.† For the anterior-posterior plate, (a—p) place the occiput against the casette, and by tapes maintain the nose vertically upwards (mouth closed or open).

Hare[9,10] describes the "normal" dog and cat skulls.

Encephalograms are made by injecting air into the cisterna magna after withdrawal of cerebrospinal fluid.

Vertebral column.—Do short sections at a time. For v–d lie the patient on its back. For lat., use lateral recumbency, with dorsal spinous processes in a straight line. Hoerlein[11,12] discusses vertebral radiology including myelography.

Shoulder region.—For p–a the tube port is aimed horizontally with patient standing or in lateral recumbency. For lat., use lateral recumbency: draw limb well forward to be clear of chest shadows.
Humerus: *radius-ulna*: *carpus*, *tarsus* and *distal bones*: Straight forward d–v. and lat. exposures.

Elbow.—Lat. is straightforward. The d–v is usually more informative but relatively difficult. Position the patient on sternum, with limb fully extended and olecranon upon the casette. Shoot X-rays slightly posteriorly to paralell the bearing surface of the radius.

Pelvis and *upper femur*: V–d obtained in the ventral position, with limbs extended and paws rotated medially (to ensure the femoral neck being parallel to the plate). For lat., use lateral recumbency.

Radiographs in two planes is the usual minimal requirement.

B. *Soft Tissues.*

The Cervical region: Oesophagus, pharynx, larynx and trachea, lateral views only. Reduce radiographic energy used in hard tissue plates (see exposure table) by lowering Kv (perferably) or time. Usually done when seeking a foreign body.

Thorax: Prevent furring due to respiratory motion, i.e. obtain a "still rib cage" by: (a) Using a short exposure of $\frac{1}{4} - \frac{1}{30}$ second; (b) occluding the external nares, (c) cause hyperventilation by applying a sharp burst of artificial respiration or administration of oxygen inhalation; or (d) take advantage of the apnoea accompanying pentothal induction.

Oesophagus: Since it is on the left side, put that nearest the casette. Usually a contrasting suspension is indicated.

Stomach: Empty the gut. A radio-opaque foreign body may be present, so employ a control firm. Then take a series $\frac{1}{2}$ hr., 1 hour., 3 hours etc., after contrast meal.

* A lead washer suspended from the tube port makes a convenient plumbline for centering.

† A carpenter's T—square will be found useful here.

Intestines: Empty gut. Control film, then contrast media per os, or per rectum. Make exposure as necessary judging from first film.

Liver: Outline fair on low exposure. Contrast media, billigraphin, phenobutiodil etc., will show biliary tree. Cholangiography: medium injected along the hepatic duct via duodenum.

Gallbladder: Shown by contrast media.

Uterus: Shows up whitish; use lateral exposures for pyometra and pregnancy. For endomentritis and salpingography, use v–d exposure and contrast media[3].

Bladder: Lateral (from either side) will show radio-opaque calculi. Contrast media of gas or 10% NaI, "Lipoidol" (iodized poppy seed oil) injected via urethra, or one of the excretory contrast media given intravenously or intramuscularly, (Uropaque etc.).

If rupture is suspected (after trauma, e.g. fractured pelvis) injected contrast (air or iodine) preparation will not define a cavity.

Kidneys: Withhold food and water 12 hours pre X-ray, give laxative 6 hrs. pre X-ray and 5–10 units pituitrin ½ hr. pre X-ray. Light anaesthesia and then, for example inject 30 ml. diodrast over 4–5 mins. i.v. X-ray at 10–15 min. intervals (using long T, high ma and low Kv).

THE EXPOSURE.

The amount of radiographic energy (R.E.) reaching the plate determines the chemical change in the emulsion—i.e. the greater the energy the blacker the resulting film.

$$RE = \frac{\text{Voltage (Kv)} \times \text{Current (M. amps)} \times \text{Time (Secs.)}}{\text{Distance}^2 \text{ (inches or cm.)}}$$

M.amp can be accurately determined from the milli-amperemeter. Time is set by mechanically operated time switch (can be preset). Distance is set by actual measurement, from tube port to plate.

Kv., however, is difficult to standardise between various machines, and an exposure for each machine must be worked out.

By increasing the Kv., the penetrating power of the rays is increased, and (usually) contrast is diminished; lowering Kv. has the opposite effect. If Kv. is altered, one of the other settings must also be altered to maintain proper radiographic density.

The following rules of exposure will be of use when, perforce, one of the factors is altered:

Where D = distance; M = milliamperage; = T Time and
K = Kilovoltage.

(i) $M_1 : M_2$ as $D_1^2 : D_2^2$

or

The M required for a given exposure varies directly as D^2.

(ii) $M_1 : M_2$ as $T_2 : T_1$
or
the M required for a given exposure varies inversely to T.

(iii) $T_1 : T_2$ as $D_1^2 : D_2^2$
or
the T required for a given exposure varies directly as D^2.
Kv. is rarely changed on the machine, but when it is, a table of variations is consulted on

(*a*) how much T is increased when Kv. is reduced and
(*b*) how much T is reduced when Kv. is increased.

When grids (Stationary or Potter-Bucky) are used the R.E. must be increased about four times. When intensifying screens are used, R.E. may be reduced.

In order to give a guide to exposure a table is presented (see Table I). Unless otherwise indicated, distance and milliamperage are set at 30 inches and 15 respectively. It is assumed that standard intensifying screens are used, without grid or Potter-Bucky diaphragm.

Before exposing the plate it is wise to attach metal markers to the casette indicating patient in clinic serial number and left and right or medial and lateral.

FLUOROSCOPY.

The source of radiation is usually arranged below the table, with the patient on the table and the screen held in line over this:

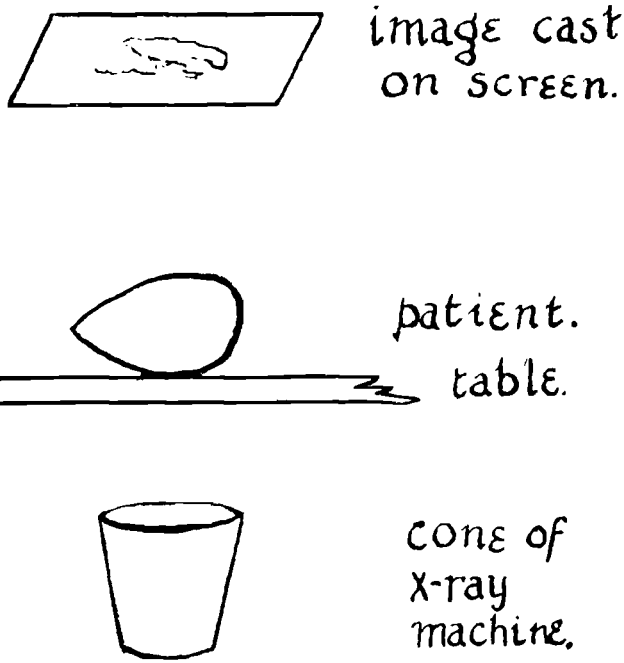


Fig. 10: Arrangement for Fluoroscopy.

TABLE I

ROUGH GUIDE TO RADIOGRAPHIC EXPOSURES IN VETERINARY PRACTICE.

	Cat & small Dog Kv.	M. amps.	Time Secs.	30 lb. Dog Time Secs.	60 lb. Dog Kv.	M. amps.	Time Secs.	90 lb. Dog Kv.	M. amps.	Time Secs.	300 lb. Pony, Calf Kv.	M. amps.	Time Secs.	Dist. inches.	450 lb. Pony, Calf Kv.	Ma.	Time Secs.	Dist. inches	Adult Horse, Bovine Kv.	Ma.	Time Secs.	Dist. inches
1. Head D-V	40	15	¼	⅜	50	15	½	50	15	⅝	60	10	1¼	30	60	10	1¼	24				
2. Head Lat.	,,	,,	⅜	½	,,	,,	½	,,	,,	¾	,,	,,	1	,,	,,	,,	1	,,				
3. Cervical Vert. D-V	,,	,,	⅜	½	,,	,,	½	,,	,,	⅝	,,	,,	1¼	,,	,,	,,	1⅛	,,	60	10	3	24
4. Cervical Vert. Lat.	,,	,,	¼	⅜	,,	,,	½	,,	,,	¾	,,	,,	1	,,	,,	,,	¾	,,	,,	,,	3	,,
5. Thorax V-D	,,	,,	¼	⅜	,,	,,	⅝	60	10	¾												
6. Thorax Lat.	,,	,,	⅛	¼	,,	,,	⅜	,,	,,	½												
7. Abdomen V-D	,,	,,	⅜	½	,,	,,	⅝	,,	,,	1												
8. Abdomen Lat.	,,	,,	¼	⅜	,,	,,	½	,,	,,	¾												
9. Pelvis V-D	,,	,,	⅜	½	,,	,,	½	,,	,,	1½												
10. Pelvis Lat.	,,	,,	½	⅝	,,	15	⅝	,,	,,	1½												
11. Shoulder & C1–TI joints.	,,	,,	¼	⅜	,,	,,	¼	50	15	½					,,	,,	3	,,				
12. Humerus Lat.	,,	,,	¼	⅜	,,	,,	¼	,,	,,	½												
13. Radius-ulna	,,	,,	⅛	¼	40	,,	⅜	,,	,,	⅜	60	10	½	24	,,	,,	¾	24	60	10	¾	,,
14. Pes	,,	,,,	⅛	¼	,,	,,	⅜	,,		½–¾	,,	,,	½	30	,,	,,	½	,,	,,	,,	¾	,,
15. Femur	,,	,,	¼	⅜	50	,,	½	,,		½–¾	,,	,,	1½	,,								
16. Stifle joint	,,	,,	¼	⅜	40	,,	½	,,	,,	½–¾	,,	,,	1½	,,	,,	,,	1	,,	,,	,,	1½	,,
17. Tibia-fibula	,,	,,	⅛	¼	,,	,,	⅜	,,		⅜	,,	,,	1	,,	,,	,,	¾	,,	,,	,,	1	,,
18. Sialograph.	As for 1 & 2			1 & 2	As for 1 & 2			As for 1 & 2			As for 1 & 2				As for 1 & 2							
19. Metrography	As for 7 & 8			7 & 8	As for 7 & 8			As for 7 & 8														

This table is designed for a machine limited to 60 Kv, and where high-speed intesifying screens are used.
Where Distance is not given, please assume 30".

Advantages.

Movement can be appreciated—e.g. swallowing of opaque substances, which will give an idea of oesophageal abnormalities. Removal of fish hooks from the oesophagus is also a favourite use for the fluoroscope. Certain bone operations and checking reductions are greatly facilitated by the fluoroscope.

Disadvantages.

No permanent record of the examination is available for future reference.

The time permitted for fluoroscopy is short -since the generating tube cannot be run too long. This may prevent perception of details which would be seen when studying a skiagraph at leisure.

The exposure hazard with fluoroscopy is up to 1,000 times that involved in standard radiography[4].

THE DARK-ROOM; LAY-OUT AND PROCEDURE.

Since a dark-room is essential to good radiography it should be a deliberately planned work space and not an adapted cupboard.

The following plan is satisfactory, and will meet the requirements of most radiographers.

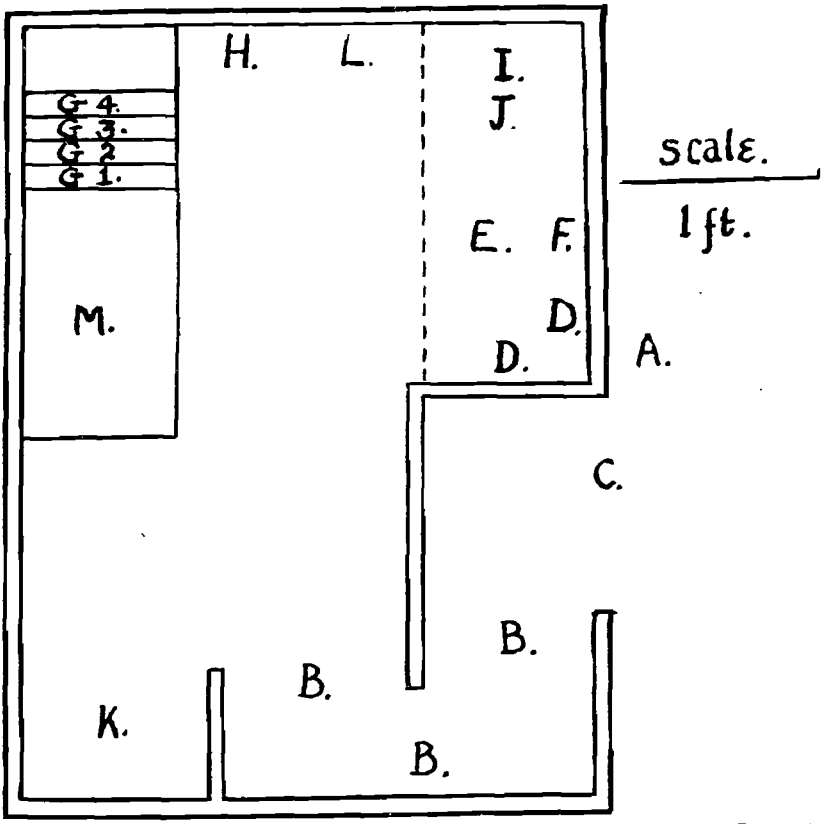


Fig. 11: Dark-Room Plan. (Scale as indicated). (See text for Legend). (Plan drawn from that in use in the Department of Surgery, Faculty of Veterinary Science, Onderstepoort).

A. Switch to safe light—conveniently situated near entrance, provided with a small pilot light.

B. Angled passage, with walls painted black. No light will get into dark room when curtain is drawn too.

C. Curtain.

D. Wall brackets bearing film holders. Film holders are of two types, the slotted variety—preferred—and the film clip action holder which is tricky to operate in the dark and damages the plates. Holders are usually in 3 sizes to fit the standard film sizes. These are 8″ × 10″, 8″ × 12″, 12″ × 15″.

E. Work space: This is an uncluttered shelf space, 4′ × 2′, and 2′ 9″ from the floor. The recently exposed film is removed from the casette and placed in a film holder. Light is provided by F. the safe (red) light fixed to the wall.

G_1. Is the developing tank. The film in its holder is placed in this tank so that the whole film is immersed, moved briskly up and down twice or three times (to remove bubbles sticking to it) and left hanging on the supports provided.

All the tanks G_1—G_4 are of enamel, stainless steel or bitumous compound. The solutions should be kept at 60–70°F for standard results. If the temperature is outside these limits the developing and fixing times are altered according to a table available from dealers. More costly apparatus may be obtained which has a heating apparatus and a thermometer, or thermostat.

If the developer is too hot, it may fog the plate, if too cold the action is delayed or prevented. Essentially the process is the action of an alkaline solution on the silver emulsion of the plate. If the developer is old, the chemical action of development is delayed, if it is too strong only the outer layer of the emulsion is developed. Mix the developer at about 4 weekly intervals, more frequently if used often. The addition of KBr will restrain development at the surface, and tends to keep the 'whites' clear. Keep the developer covered when not in use, to prevent excessive O_2 adsorption.

A new X-ray developer, designated PRA, is available; this allows a shorter radiographic exposure time, which reduces the radiation hazard and also gives clearer pictures with less "blurring". A longer development time is necessary to compensate.[8]

Once the film is in the developer, the timing clock H, is set to 5 minutes (more or less according to solution temperature).

Whilst waiting for the clock to ring, a new film is removed from the stack of films at I. New film, in its yellow-paper cover is removed from its box and the lid closed again. Without touching the plate (film) itself, but only the paper cover, the film is placed in the casette, J. One casette of each of the three sizes is kept here, always ready loaded. A casette is a film holding device, composed of an aluminium frame with a bakelite centre, much like a picture in a frame. The frame bears

hinges on the reverse side, hinging an aluminium flap, which when closed provides a light-proof compartment for the film. Sliding clips keep the flap firmly closed except when reloading.

Casettes are usually fitted with *intensifying screens*. These are specially prepared sheets, coated with calcium tungstate fixed to the inside of the flap and to the bakelite screen. They fluoresce when exposed to X-rays, and as their name signify, intensify X-ray action on the plate. It is imperative that these screens are not soiled or traumatized in any way, because any damage will be reflected on all film exposed between these screens thereafter.

Soon after the casette has been reloaded the clock will ring. Remove the film in its holder from the developer and place in G_2, the stopping bath. No further development will occur. Now place momentarily in G_4 the washing tank to remove any trace of developing solution (developer and fixer are mutually incompatible, and traces of one in the other upsets the desired chemical processes). Now place in G_3 and leave for 5 minutes or longer. G_3 is the fixing tank, containing sodium thiosulphate or hypo. X-ray film is essentially composed of small specks of silver suspended in a gelatine emulsion on a celluloid sheet. The hypo removes all unreduced silver, leaving metallic silver in the emulsion.

If the fixer is too acid, X-ray plate shows a rash—add Na_2CO_3. If the fixer is too alkaline, the plate appears milky—add acetic acid. The hypo must be carefully washed off the film by placing in G_4, the washing tank again, lest hypo crystals form and ruin the film.

The last remaining letters in the diagram of a dark room are:

K. storage cupboard and

L. the exhaust fan, drawing air from the adjoining room (which usually houses the X-ray machine) and discharging it into a flue leading up and out of the room.

M. is a rack over the sink for drying films.

EXAMINATION AND INTERPRETATION OF RONTGENOGRAMS.

Place the film on a viewing screen provided with shutters to cut off light showing beyond the plate margins. A comfortable chair and a suitably darkened room complete the physical requirements. Examine the various structures in definite order, starting with the soft tissue outline, then the soft tissues, then the bones. Seek out and evaluate radiotranslucent and radio-opaque forms.

Whilst examining the soft tissues note:—

(i) The heart, aorta, pulmonary arteries, liver, kidneys, and the testicles, which show as whitish areas on the film. The spleen outline can sometimes be seen in T.S. and is faintly white.

(ii) The trachea and bronchi, (also such hollow viscera as stomach, intestines etc.,) sometimes show up dark due to the air they contain.

Whilst examining skeletal structures:—

(i) Recognize the bones on the plate, and determine the age, breed and sex of the patient if possible.

(ii) Correlate density between soft and hard tissues to determine "soft bone" (as in Siamese kittens etc.).

(iii) What bones, and what parts of those bones show changes from the normal? (Osteogenic sarcomas are most apt to involve the ends, especially the distal end of the shaft. Ewing's sarcoma involves the centre of the shaft).

(iv) Are changes primarily in the cortex or within the medulla?

(v) Is the lesion margin sharply defined or not? (Sharp margins suggest a benign tumour. Rough or furred margins suggest infection or malignant tumour).

(vi) Is the lesion confined to the shaft, or does it invade the epiphysis or joint? (Osteomyelitis rarely crosses an epiphyseal line. Tuberculosis may invade the joint. Carcinoma of a bone does not invade the joint).

(vii) Is the lesion destructive, proliferative or both?

(viii) Is there associated disease of soft tissue?

(ix) Hyaline cartilage is radiotranslucent, so where bones of a joint appear abnormally close, it may be assumed cartilage is lacking—pathognomic of joint disease.

The sesamoid bones and the os penis provide difficulties unless familiarity is gained. Since there is no veterinary radiologic atlas, difficulty arises in evaluating epiphyseal lines, e.g. that of the crista tibialis. Compare the opposite limb when in doubt. The sacroiliac articulation may be mistaken for a fracture. The clavicle of the cat (rarely in the dog) may appear to be a foreign body in the oesophagus, whilst the scapular spine in cats may appear to be a needle in the thorax.

In undisplaced and impacted fractures the plate reveals a dense black irregular line. Haematomas show as a dense white area: after 5–7 days fine wavy calcification lines may appear. The callus of periosteal origin shows faintly 10 days after fracture, whilst that between fracture ends is only seen by the 18th day. The amount of callus is proportional to the damage and displacement of the fragments, yet the better the reduction the sooner callus will appear. No visible callus appears within a joint capsule.

At 16–20 days sufficient callus may be present for discontinuing splintage, but this may be apparent radiologically only if Kv is reduced from the usual normal value to the "soft picture" setting.

Lead sheets may be used to protect half the film in a casette from X-rays whilst the other half is exposed. Thus two radiographs can be made on one plate. Since the proximal part of the femur is more heavily muscled than the distal end, a lead sheet moved distally from the mid-femur during an exposure will provide a uniformly intense femur image.

X-Ray Hazards and Protection.

All individuals are equally sensitive to X-rays, unlike ultra-violet exposure, to which darker skinned individuals are more resistant than fair individuals. Over-irradiation causes progressive and cumulative damage resulting in:

(i) Genetic mutations (described in Drosophila by Miller in 1927).

(ii) Premature senescence, with life expectancy reduced $6\frac{1}{2}$ years (in careless radiographers). Repair, especially of bone marrow spleen and blood vessels, is retarded.

(iii) Leukemia (incidence in radiologists is nine times the norm).

(iv) Osteogenic malignancy: seen in young subjects (before epiphyses unite) upon repeated joint X-rays.

(v) Radiodermatitis, usually malignant epithelioma.

The composition and function of specialized cells alter with lower doses of irradiation than are necessary to produce changes in macro- and microscopic anatomy.

These facts should be sufficiently awe-inspiring to validate meticulous precautions in radiography. For example, maximum weekly exposure allowable in Canada was 500 mr. in 1947, this figure being progressively reduced to 96 mr. in 1957. The latter is in line with the recommendations of the International Committee of Radiological Protection, which allows 500 mr. per year.

The veterinarian using X-rays is morally and legally responsible for adequate protection to himself, his patients and his assistants, The following points need attention:

1. *The X-ray machine* should have the rectifying tubes and the Coolidge tube immersed in oil within a stout metal case. The tube port should be well shuttered or coned.

2. *Protective clothing*—leaded gloves and apron must be worn by all persons within 10 feet of the patient unless shielded behind a leadlined door. This is provided with a lead glass window and is situated at the control desk.

3. *Patient control*, by sedation or anaesthesia, and patient positioning by sand bags and sash cords are valuable. If possible protect patient's gonads with lead sheeting. Since X- irridiations of foetuses invite mutations, use radiography in pregnant patients in emergencies only.

4. For *fluoroscopy* accommodate the eyes to darkness by wearing red glasses $\frac{1}{2}$ hr. before examination, and accommodate pupils to a completely dark room. This reduces time needed for fluoroscopy (and irradiation hazard) and wear on the tube, and facilitates diagnosis. Leaded gloves may be used for palpation under the screen.

5. *Monitor badges* should be worn by all radiography personnel. These are checked at a physics laboratory, and charts of exposure are recorded.

ACKNOWLEDGEMENTS

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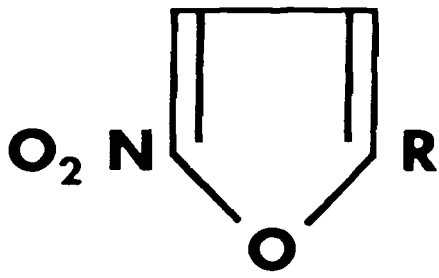

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PNB 0982

COMPARATIVE MEDICAL STUDIES OF CHRONIC DEGENERATIVE DISEASES AS A VETERINARY PUBLIC HEALTH ACTIVITY

Martin M. Kaplan.*

(This paper, presented at the WHO/FAO/CCTA Seminar on Veterinary Public Health, Nairobi, Kenia, 24 November—3 December, 1960, was submitted, inter alia, to the Jnl. S.A.V.M.A. *for publication. "It is hoped thereby to inform and interest certain sectors of the veterinary profession in another dimension of potential contributions of the veterinary profession to public health. WHO activities in comparative medicine, as delineated in the following document, will be concerned mainly with initiating and co-ordinating, internationally, research in selected areas in this field.")*

(Received for publication 2nd *Feb.* 1961).

Comparative medicine can be defined as the study by comparison and contrast of biological phenomena in health and disease in various animal species, including man. Such studies are not new, forming a part of ancient as well as modern medicine with respect to anatomy, physiology, pharmacology, etc., as well as to communicable and other diseases. Their incorporation as part of veterinary public health[1] activities, however, is a recent development in that they comprise a co-ordinated and directed application of comparative medical studies to major disease entities of man.

Chronic degenerative diseases are emerging as the most pressing medical problems of the present and future, consequent upon the steady subjugation of acute communicable diseases now in the course of accomplishment in most parts of the world. Comparative medical studies of acute communicable diseases, and of infectious agents in general, retain a high level of importance to public health, but consideration here will be limited only to the principal chronic degenerative diseases (some of which may have a communicable aspect), notably cancer and cardiovascular diseases. Other chronic conditions such as muscle, bone, joint and metabolic disorders will be touched upon only briefly.

For the purposes in question a distinction must be drawn between experimentally induced diseases of the chronic degenerative type in animals, and those conditions which occur spontaneously. A vast amount of work and attention is understandably being given to experimentally produced diseases, especially in laboratory animals, and the pragmatic results obtained fully justify such an approach so that its theoretical advantages and limitations need not be considered here.

* Chief, Veterinary Public Health, WHO, Geneva.

[1] Veterinary public health has been defined as "the field of activity which protects and advances human well-being by utilizing the combined knowledge and resources of all those concerned with human and animal health and their interrelationships" WHO Tech. Rep. Ser. 111., 1956).

(It might be noted in passing, however, that certain of the common cardiovascular diseases of man are not at present experimentally reproducible in animals—e.g. rheumatic fever—while experimentally induced diseases may not be duplicates of the human condition—e.g. hypertension and atherosclerosis.) Such experimental work will undoubtedly continue to receive considerable attention and support in the future. The particular and unique contribution of comparative medical studies as a part of veterinary public health activities is derived from the stimulation of research, collection and analysis of data on *spontaneous* disease processes in *domestic* animals (and to a lesser extent wildlife) referable to analogous diseases in man. The lines of division indicated above, viz. spontaneous versus induced disease and domestic in distinction to laboratory animals, should not be treated too rigidly, because all possible areas of investigation must be entered if leads so indicate. The arbitrary demarcations are made in part for practical considerations, i.e. the reasonable possibilities of accomplishment by veterinary public health workers. This does not lessen the obligation, however, of such workers to be fully aware of developments in related areas of scientific activity which may find application in investigations amenable to a comparative medical approach allied to veterinary public health work.

The rationale for comparative medical studies in a veterinary public health context may be summarized as follows:—

1. Spontaneous disease processes such as cancer and cardiovascular diseases are biological phenomena common to many species of animals, and it may be safely assumed that these conditions are broadly comparable to those observed in man.

2. Studies of these diseases in domestic animals lend themselves uniquely to epidemiological types of investigation. Thus environmental factors common to man may be segregated and studied from the standpoint of their possible influence on aetiology.

3. A wealth of material is readily obtainable in abattoirs, veterinary clinics, and from the carefully kept records of animal groups (herds or flocks) of similar or contrasting genetic, age and nutritional backgrounds. The latter factors, amenable to study, may be operative in a particular disease process.

4. The life span of certain animals physiologically resembling man, i.e. dog, telescopes that found in man, thus reducing the period of time needed for study of age-associated components.

5. Species of animals differ in anatomical and physiological details which may result in individual expressions of similar disease processes related to structural or functional variables distinguishing certain species. The existence of these variables, when combined with a detailed understanding of them, may well shed light on the specific factors involved in certain disease conditions.

6. Finally (and obviously) animals can be experimented with more easily than man for the investigation of any leads of particular interest.

As mentioned previously, the two major problems confronting human medicine with respect to chronic diseases are cardiovascular disease and cancer, and WHO has been examining these fields from the point of view as to how research in animals might be intensified on an international scale for possible light such research may shed on analogous human problems. These diseases are considered briefly below, followed by a short reference to other chronic degenerative conditions.

A. Cardiovascular Diseases

While there is a large amount of scattered knowledge of cardiovascular disease conditions in different animals, a systematization of this knowledge is lacking and the use of epidemiological techniques to analyse environmental and other influences rarely has been applied.

The possibilities have been surveyed by WHO scientific advisory groups for undertaking and co-ordinating comparative cardiovascular studies pertinent to major human problems in this field. WHO has sought to determine where its unique co-ordinating function may be applied most profitably, and is focusing attention on a few specific problems which it might undertake to investigate, keeping in mind practical limitations of specialists and funds now available. At the same time, it hopes to stimulate long-term studies through collaborating centres and by fostering the training of a few specialists so that base-line data might be assembled over the course of the next few years.

Particular attention will be given to (1) pilot surveys of naturally occurring atherosclerosis in swine, cattle, sheep, poultry and wild birds; (2) the examination of hearts from wild and domestic animals in Uganda to determine if a cardiomyopathy common to man in that area occurs also in animals; and (3) a "prospective" study in a dog colony (beagles) where several hundred dogs would be followed very carefully through their entire lives for the development of spontaneous cardiovascular disease. This study would be incorporated into observations on these dogs now being held for other purposes.

There are many analogous cardiovascular conditions in man and animals which deserve study. For example, with reference to the questions of arterial hypertension and pulmonary heart disease, it would be of interest to study more closely the phenomenon of natural high blood pressure found in giraffes and turkeys. Also, the so-called "brisket disease" found in cattle living in high altitudes is no doubt comparable to high altitude disease in man.

The following are some cardiovascular diseases and clinical syndromes noted in animals* which may be considered analogues of certain human conditions:

1. *Idiopathic pericarditis*
   Pericarditis with effusion in dogs.

2. *Cardiomyopathies*
   Fatal syncope (plötzlicher Herztod) in swine.
   Round heart disease in poultry.

See Acknowledgements.

3. *Valvular heart disease*
   Chronic proliferative valvular fibrosis in dogs.

4. *Congenital heart disease*
   Dogs, swine and calves for surgical research.
   Dogs and swine for genetic research.

5. *Pulmonary heart disease*
   Brisket disease in cattle.
   Dirofilaria immitis infestation in dogs.
   Heaves in horses.
   Hypertrophy of the pulmonary muscular arteries in cats.

6. *Arterial hypertension*
   Naturally occurring hypertensive disease in dogs.
   Naturally occurring hypertensive disease in monkeys.
   Physiological high arterial pressure in turkeys and giraffes.

7. *Congestive heart failure*
   Naturally occurring congestive heart failure in dogs.

8. *Cardiac arrhythmias and conduction disturbances*
   Naturally occurring atrial fibrillation in horses, cattle and dogs.
   Physiological atrioventricular block in horses.
   Naturally occurring Wolff-Parkinson-White syndrome in cattle and dogs,
   Naturally occurring bundle branch block in dogs.

B. Cancer

Neoplasms of domestic animals may be studied from the aspect of aetiology (e.g. genetic, carcinogenic, endocrinological or viral causal agents), histopathogenesis, histopathology, biological behaviour, epidemiology and geographical distribution, and chemo- and radiotherapy.

Species differences:

The most immediately striking feature of cancer in domestic animals is the difference in incidence and site of origin between the various species, and as compared with man.

Thus, tumours of some importance in the *horse* include melanomas of the skin, carcinoma of the glans penis, teratoma of the testis, squamous-cell carcinoma of the eyelid and of the cardiac portion of the stomach, and carcinoma of the nasal cavities and sinuses.

A common malignant neoplasm of the *ox* is lymphosarcoma (lymphatic leukosis), and others of importance include squamous-cell carcinoma of the conjunctiva, which is particularly encountered in the United States; on the other hand, cancer of the mammary gland of the cow is very rare.

Neoplasms appear to be rare in *sheep*, which are largely slaughtered young, but two of importance amongst these rare tumours are liver-cell tumours (unrelated to fluke disease or to cirrhosis), and more or less generalized lymphosarcoma.

In the *pig*, which is also largely slaughtered when young, tumours are rarely seen. The commonest tumour appears to be more or less generalized lymphosarcoma, while embryonal nephromas also occur.

In the *dog*, in London, the most important and common cancers are cutaneous melanomas, malignant tumours of the mammary gland, carcinoma of the tonsillar epithelium, intestinal lymphosarcoma and lymphatic leukosis.

In the *cat* similarly they are squamous-cell carcinoma of the tongue and the oesophagus, carcinoma of the mammary gland, sarcoma of bone and visceral lymphosarcoma.

In the *fowl*, the predominant neoplastic process is leukosis in its various forms.

It will be seen that some tumours are important in both man and domestic animals, while some are of importance in one, and of little or no importance in the other. The significance of these differences need study.

These differences in incidence and site may extend to breed and sex within a species; thus, limb bone sarcomas are largely restricted to the large breeds of dog, and upper alimentary tract cancer in cats is almost entirely a disease of castrated males.

In considering a possible explanation of these variations in incidence, it is stressed that in this field, as in that of cardiovascular and other diseases, there is a need for a systematic summary of available knowledge of species differences of an anatomical, histological, physiological, biochemical or biological nature, as these must influence any interpretation of observed differences.

These factors might underlie differences in (a) aetiology (e.g. susceptibility to carcinogenic action, perhaps due to differences in metabolic rate and metabolic pathways,) (b) histogenesis (e.g. of melanomas in man and dog), (c) clinical course and malignancy (c.f. seminoma in man and dog—only rarely metastasising in dogs). However, many of the species differences in incidence of tumours may be due to such factors as different mode of life (e.g. herbivorous or carnivorous, more or less close association with man, town or country habitat, etc.), and perhaps especially by age of death or slaughter.

A study of aging processes and of neoplastic disease in animals, which are normally slaughtered for food when young, but would be allowed to live out their life-span, should be encouraged. This could be done, for example, in the case of cattle in India.

At the moment, there are a number of examples of tumours of domestic animals that appear to be ripe for more intensive study, from one or more angles (e.g. aetiology, histopathology, etc.), but it is to be expected that further study in parts of the world that are at present largely unknown in respect of animal tumours might well reveal others that would also be rewarding subjects.

The general course of events will probably be that broad surveys in certain countries or areas will reveal or confirm that certain tumours

there are of particular or even unique importance. These special tumours will then be more intensively studied as spontaneous tumours, and from this study indications will arise of certain experimental investigations that would seem likely to yield information of a specific or a general significance.

The fact that certain tumours of man are of little or no significance in domestic animals also provides an opportunity for investigation: to account, for example, for the rarity of mammary cancer in cattle, of prostatic cancer in dogs, of gastric cancer and lung cancer in all species, of uterine cancer in bitches (which are prone to endometrial hyperplasia), and so on. It is clear that man is probably just as special a case as any of the species of domestic animals in the pattern of incidence of his common tumours.

Tumours that might repay special study now:

1. Lymphosarcoma and allied conditions (leukemias) in all species
2. Carcinoma of bladder in cattle in certain areas of abnormally high incidence (e.g. Turkey).
3. "Cancer eye" and "horn core" cancer of cattle.
4. Melanomas of horse, ox and dog.
5. Alimentary and lung tumours of dogs and cats, e.g. geographic distribution of lung tumours; carcinoma of tonsil of the dog, and mouth, tongue and oesophagus of cat, with particular reference to atmospheric pollution.
6. Testis tumours, bone sarcomas, transmissible venereal tumour, mammary neoplasms and mast cell tumours of the dog.
7. "Jaagsiekte" of sheep.

C. Muscle, Bone, Joint and Metabolic Diseases

Information on this group of diseases is scattered amongst various specialities. Listed below are some diseases of interest in domestic animals where study should be fruitful as regards disease problems in man.

1. Inherited-congenital dysplasia of the hip in dogs.
2. Osteo-arthritis in cattle and horses.
3. Degeneration of intervertebral discs in dogs.
4. Haemophilic arthropathy in dogs.
5. Pulmonary hypertrophic osteo-arthropathy in dogs.
6. Avian nephritis and visceral gout.
7. Bacterial arthritides in livestock (e.g. swine erysipelas).
8. Tenosynovitis and transmissible synovitis of poultry.
9. Rheumatoid arthritis in swine.
10. Skeletal and articular involvement in brucellosis.
11. Various myopathies in livestock.
12. Diabetes and other endocrine disorders.

It is apparent that the implementation of the outlined activities given previously constitutes a long and difficult task. The challenge, however, must be met head on, with the conviction that a concerted and sustained effort will undoubtedly be eminently worthwhile in terms of adding to our understanding and eventual amelioration of the ravages caused by those premature killers and maimers of man, the chronic degenerative diseases.

ACKNOWLEDGEMENTS

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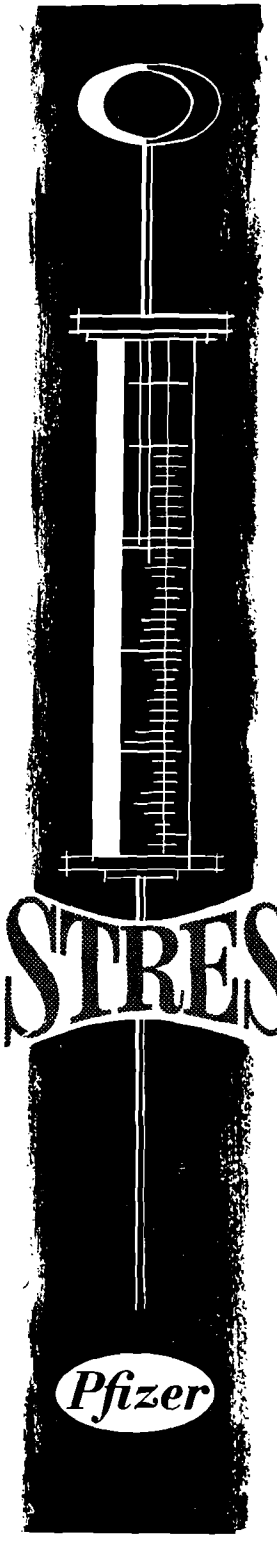

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THE CANCER CELL.

Gilles de Kock.*

(*Received for publication* 15 *March*, 1961.)

Today investigations are being carried out on a vast scale to study the cancer cell in respect of its cytoplasm, nucleus and organelles, such as the mitochondria, Golgi complex, chromosomes, etc. The experimental approach involves cytological, biological and chemical aspects. In this review of the cancer cell it will only be possible to refer to a few of these aspects. Reference will also be made to the studies on the cytology and biology of the Ehrlich ascites tumours in albino mice, carried out at the Liesbeek Cancer Institute[3].

The ultra-structural research on cells has made great progress within recent years; phase contrast, darkfield, X-ray, and above all electron microscopy, have played a prominent part. Brachet and Mirsky[1] refer to the new developments regarding the microstructure of inanimate as well as living matter. They maintain that the electron microscope has replaced all others as a means of discovering and studying the finer details of cellular structure. Its resolving power is more than a hundred times greater than that attainable with light.

A large number of transplantable and transmissible tumours have been studied in animals, and extensive tumour investigations have been carried out on chickens, rats and mice. The best known avian tumour is the Rous Sarcoma No. 1, the transmissibility by means of cell-free filtrates of which was first described by Peyton Rous in 1911. According to Scharrer and Lochhead[13] phenomena related to neoplastic growth have been studied in invertebrates, and it has also been recognised that the study of plant tumours has yielded significant results. In the transplantable tumours in animals, the relation between susceptibility and heredity has also received wide consideration.

Cowdry[2] refers to differences between cells in a comparatively solid tumour, and cells of a tumour of the same kind after it has been converted into an ascites tumour, in which the cells have become accustomed to a fluid environment and actually undergone adjustments in size and shape. Klein[7] mentions the gradual transformation of solid tumours into ascites tumours. Some of the transplantable mouse neoplasms grow readily in the peritoneal fluid, while others can only be transferred gradually. The Ehrlich ascites tumours of mice (which will be referred to presently) were transformed from a mammary cancer to free tumour cells by continued implantation intraperitoneally, in which medium they multiplied in the accumulated ascites fluid.

It may be pointed out here that tissue culture has also been widely used for the study of cancer cells.

* Liesbeek Cancer Institute, Rosebank, Cape Town.

The metabolism of the cancer cells as determined by the manometric technique is dealt with by Warburg.[14] According to him the cancer cell reveals a low respiration and a high glycolysis rate, whilst normal foetal cells of the mouse embryo show a high respiration rate and an absence of glycolysis. Experimentally, there is a qualitative as well as a quantitative difference between cancer cells and rapidly growing cells of the embryo. He considers how lack of oxygen impairs the cell's respiratory mechanism, resulting in irreversible damage. The energy deficiency set up in the cell, after partial destruction of its normal respiratory mechanism, initiates the increase in glycolysis. Those cells that have an inadequate rate of glycolysis perish. Warburg refers to the work of Goldblatt and Cameron[4], who kept cardiac fibroblasts in a tissue culture with intermittent oxygen deficiency for years, and finally obtained transplantable cancer cells, whereas the control cultures with normal oxygen supply produced no cancer cells.

The average rate of glycolysis in rat cells, for instance, is believed to be much greater than in human cells. The process of cancer production, therefore, starts at a much higher level in the rat and is completed more rapidly than in man. It has been stated that the latent period of cancer production is probably nothing more than the time it takes for the necessary glycolysis to develop after failure of cell respiration, and that this is particularly long in man. It is maintained that glycolytic enzymes are for the most part found in the fluid cytoplasm of the cell.

Warburg is of opinion that chronic intermittent oxygen deficiency is a more important factor in the production of cancer in the body than the continued action of respiratory poisons, such as arsenious oxide. Clinical examples of this effect are innumerable; in these cases the intermittent pressure leads to intermittent disturbance of the blood supply. However, this should not detract from the fact that in so-called occupational cancer a large number of cancer-producing compounds have been incriminated (e.g., 1.2.3.6 dibenzanthracene, 3.4. benzpyrene, etc.).

Attention has been drawn to the respiratory function of the mitochondria in the cytoplasm of the cell. Their importance in the production of cancer cells has received much emphasis during the last few years. It is believed that their respiratory function remains impaired, once it has been damaged. Cowdry refers to their extra-ordinarily sensitive nature, and with some kinds of injury they respond by loss of their filamentous shape and decrease in their number. According to him, the use of the electron microscope has shed some light on the structure of these organelles and other cellular components in the cytoplasm of the cell.

In the cancer cells the nuclear shape and size vary within wider limits than in the tissues from which they develop. The nuclei are less uniformly moulded; the nuclear division is frequently more irregular in cancer cells, and the chromosomes are said to be much more diversified than in the corresponding normal cells.

Viruses and their possible relation to the causation of cancer cells have received a great deal of consideration. The advent of the electron microscope raised hopes of demonstrating virus bodies in infective

extracts of tumours, such as the Rous Sarcoma No. 1.[11] The methods of preparation of infective filtrates produce a multitude of small particles of cellular origin, consequently there is uncertainty as regards the significance of such bodies, when present. Thus far, the results of electron microscopy leave the problem of the relation of virus to malignant growth unsolved.

As stated above, it may be of interest briefly to review some of the results of the cytological and biological investigations carried out at The Liesbeek Clinic with the Ehrlich Ascites tumour cells in albino mice. This tumour is a well established, intraperitoneally transplantable neoplasm in a pure strain of albino mice. It was converted by a series of transfer generations into an irreversible peritoneal tumour.

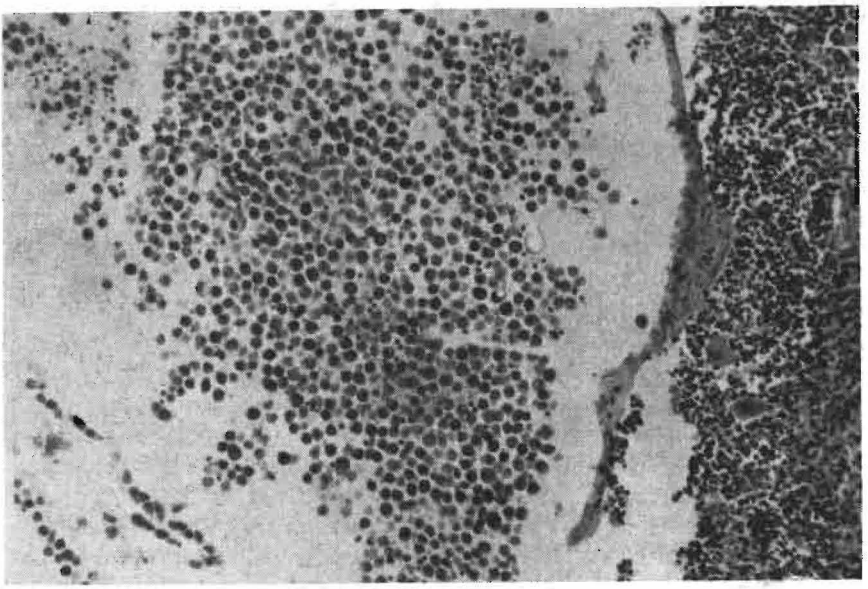
After the implantation of doses of tumour cells varying from 0.5 to 15 million cells, lesions were observed in the peritoneal cavity; subsequently free tumour cells manifested themselves in the increased ascitic fluid. Differences of opinion exist as regards the site of first proliferation of the tumour cells after implantation. Klein[8] stated that multiplication of free tumour cells occurred in the ascites fluid before the 4th or 5th day after inoculation. According to de Kock[3] the peritoneum and mesentery were the sites of earliest lesions, and these were observed from the 6th hour after implantation of 5 million tumour cells. The changes were characterized by a desquamation of the mesothelial cells, congestion, and a diapedesis of the erythrocytes. Besides the proliferating tumour cells, lymphocytes, polymorphs, macrophages and reticulum cells were also present (see plate No. 1). Semi-solid and solid tumours also subsequently manifested themselves, especially in the adipose tissue of the peritoneum.

The ascites fluid in the peritoneal cavity was clear during the early stage of the disease. It then assumed a pink, "milky" appearance, which became well defined by about the 10th day after implantation. The degree of the turbidity of the ascites fluid depended on the frequency of tumour and non-tumour cells.

Initially the tumour cells in the ascites fluid were fairly uniform in size and shape (see Plate 2). They were essentially spherical, and contained relatively large, highly chromatophilic nuclei, with one or more prominent nucleoli. The nuclei varied in shape from spherical to lobulated. Multinucleated cells were also encountered. With Giemsa stain, the cytoplasm was usually a deep blue colour and various phases of mitosis were clearly seen. During the later stages, large tumour cells with irregular mitoses were observed. Degenerative changes became more apparent in these tumour cells as the disease progressed and finally remnants of cells and free nuclei were present.

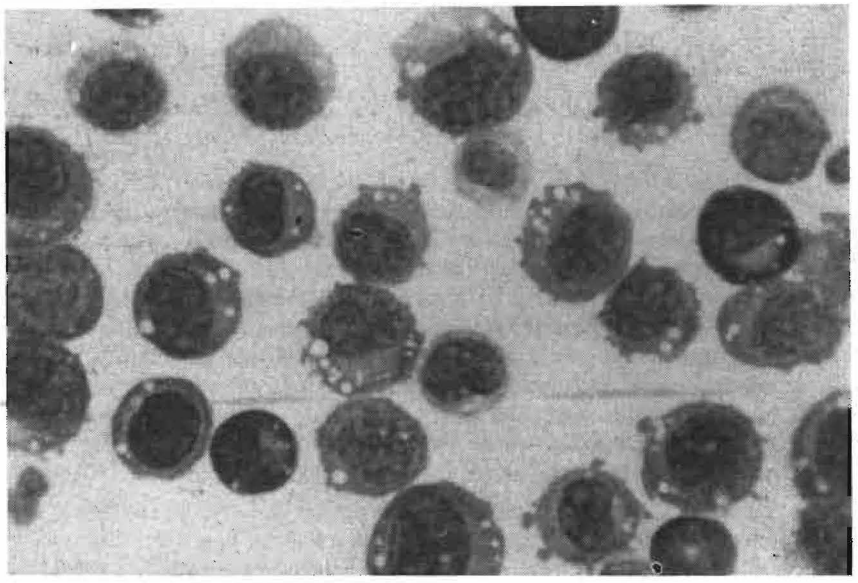
A number of these tumour cells revealed a so-called juxta-nuclear "Hof" in the cytoplasm. In the later stages large tumour cells with a much distended "Hof" were present, the latter occupying the greater part of the cell and pressing the nucleus against the cell membrane This change in the tumour cells is considered by some to represent a degeneration.

PLATE 1.



Mouse No. 549, killed 6 days after implantation of 5 million tumour cells. The section stained with H.E. shows on the capsule of the spleen a fibrin mesh, with tumour cells, erythrocytes, lymphocytes, polymorphs, mesothelials and other connective tissue cells. All the large cells are tumour cells. ×150

PLATE 2.



Mouse No. 550, killed on the 7th day after implantation of 5 million tumour cells. The tumour cells in the ascites smear stained with Giemsa are fairly uniform. Note the frequency of lipid globules in a number of them. There are only a few non-tumour cells present. ×650

Attention has also been drawn to the presence of the so-called lipid globules in the cytoplasm of a certain number of the tumour cells (See Plate 2). Love *et al*[9] suggested that, they be termed lipid globules, until their nature is clearly understood.

At present it is not possible to state to what extent the ascites fluid and the various cells and tissues supply the growth promoting substances for the proliferation of the Ehrlich Ascites tumour cells. Humble *et al.*[6] refer to the association of lymphocytes with malignant tumours, and indicate that probably lymphocytes form a mobile source of enzymes and metabolites actively in demand by growing and dividing cells. Powell[12], in his studies on tissue culture of mouse ascites tumours, refers to the protecting and promoting substances from monocytes, when tumour cells are cultivated in their presence.

Variations in the survival times after intraperitoneal implantation seemed to depend on the number of viable tumour cells injected. The average time with 10–15 million tumour cells from mice 9 days after implantation was about 15 days, with a 100% mortality. With a dose of 5 million cells, it extended in one case up to the 33rd day.

It was difficult to ascertain the cause of death in the majority of these mice. Goldie *et al.*[5] emphasized the complexity of the mechanism of the lethal effect of various tumours on the host. They suggested that with the biochemical approach, the effects elicited by these tumours may have been either, (a) the liberation into the blood stream of material set free by the tumours, or (b) the extraction by the tumour cells of some compounds in the blood stream essential for the proper function of the distant tissues.

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THE LESIONS FOUND AT AUTOPSY IN DOGS AND CATS WHICH MANIFEST CLINICAL SIGNS REFERABLE TO THE CENTRAL NERVOUS SYSTEM

J. D. Smit*

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INTRODUCTION

Nervous symptoms in dogs and cats are quite frequent; one is therefore surprised to find very little reference to their pathology in the literature. In reviewing the literature some reference is made to the incidence of tumours of the central nervous system, but even this information is scanty.

In an extensive report on 1211 neoplasms from dogs, Cotchin[2]) reported only three tumours involving the brain. These cases included a carcinoma of the choroid plexus of the fourth ventricle of a six-year-old Collie bitch, and a malignant meningioma invading the cerebellum of an eight and one half year old bitch. The third tumour was a glioma of the midbrain of a five-year-old Dachshund. He also reported a fibrosarcoma of the nerve sheath of the infraorbital nerve of a five-year-old male Spaniel. In a subsequent publication, Cotchin[3] reported on a further 464 tumours from dogs; not one was found in the brain. Cooper and Howarth[1] examined the changes in the cat brain; of 60 brains examined they found only 4 with lesions. They found an astrocytoma, one oligodendroglioma, one meningioma and a granuloma. In a case report Fankhauser and Wyler[4] described an adenoma of the pituitary gland of a fifteen-year-old Fox Terrier bitch, with consequent nervous and endocrine manifestations. A case of a meningioma of the spinal cord was described by Kramer and Beijers.[6] Kovacs and Bachrach[5] described a case of adenoma of the pituitary as an incidental finding with no detectable nervous symptoms. In a statistical investigation of carcinomata in 440 dogs, Krook[7] did not report any brain lesions. Vaccari[11] reported a case of an oligodendroglioma in a dog. Mulligan[9] stated that one neoplasm involving the pituitary gland was observed in a spayed Fox Terrier bitch, twelve years old. He also stated that few cases of pituitary neoplasms were recorded in the literature up to 1945. Concerning brain tumours, he listed those that had been found without giving actual figures. He emphasized the higher incidence of brain tumours in breeds with a bull strain, such as Boston Terrier, Bulldog and Bull Terrier. Luginbule[8] has studied meningiomas in cats at the Angell Memorial Hospital, Boston. He reported on 8 cases, but quite a few of the tumours were found incidentally without causing any clinical manifestations. No information about the incidence of other lesions in the nervous system is available in the literature at my disposal.

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Observations

The present study is an attempt to analyse the causal factors in those dogs and cats presented at the Angell Memorial Hospital, Boston, with nervous signs as the main complaint. From a statistical point of view the analysis will not be very accurate, because the cases selected for autopsy are not necessarily representative of the total incidence of any disease. To illustrate this point, one may mention nervous signs caused by canine distemper. Only a small percentage of such cases was studied by autopsy. Nevertheless, analysis of cases in which an autopsy was done, may be of some value. The information can best be appreciated if presented in the form of tables. In Tables I, II and III an analysis is given of all the cases showing nervous signs, as encountered during the three yearly periods, July 1959—June 1960, January—December 1958, and January—December 1957, respectively. During these twelve-month periods, the respective total numbers of autopsies were 376, 521 and 621. The total number of nervous cases were 56, 63 and 59 respectively. Expressed as percentages of total number of autopsies, the figures are 15.5%, 12% and 9.5% respectively.

In Table IV a more detailed analysis is given of all the tumours affecting the central nervous system. All the cases for the three years are grouped together. The tumours are classified into three groups; primary tumours, invading tumours and metastatic tumours.

Table V summarizes the incidence of lesions affecting the pituitary gland.

Discussion and Conclusions

In trying to evaluate these figures in relation to the literature, one is struck by the significantly higher incidence of lesions in the central nervous system found at Angell Memorial Hospital, compared with those reported in the literature. In an attempt to explain this apparent higher incidence, one should consider various factors. Firstly, relatively more aged animals are seen at the Hospital. Another factor to consider is the popularity of the Boxer Breed in this area, especially some years ago. Another explanation may be the fact that a detailed examination of the brain is carried out at every autopsy. This is not always the case at other institutions.

In scrutinizing these figures one comes to the conclusion that infections contribute the highest number of cases with nervous signs. Under this heading are included virus, bacterial and fungal infections. The virus infections are divided into distemper and a second group which, on histological grounds, is considered to be of virus origin. This classification is based on the typical perivascular lymphocytic cell infiltrations which are usually associated with virus infections. The bacterial infections are usually responsible for a purulent meningitis and/or encephalitis. Cryptococcus is the organism involved in the cases produced by fungi. Tumours are responsible for the second largest group of cases. Under the next group, classified as "no lesions",

cases with marked clinical nervous signs, usually intermittent convulsions or fits, are included. These cases are usually clinically diagnosed as epilepsy. Very careful histological examinations fail to reveal any pathological lesion. The lesions are most probably of a histochemical nature and the ordinary histopathological techniques are not able to show them up. The heading "Vascular Lesions" includes cases of haemorrhage, thrombosis, emboli and focal areas of fibrosis, probably the result of old haemorrhages. The most common congenital defects are hypoplasia of the cerebellum and hydrocephalus. Hypoplasia of the cerebellum is a common hereditary lesion in cats. In dogs, the only breed involved was the German Shepherd.

The incidence of these causes vary during the years under consideration but for all practical purposes the order of incidence remains the same. The higher incidence of infections in 1957 may be attributed to personal factors in selecting cases for autopsy.

The number of tumours involving the central nervous system is worthy of note, especially in view of the paucity of information in the literature. Records of pituitary involvement are rare. The frequent involvement of the pituitary in this series of cases is, therefore, surprising. This may even be more significant, if one takes into consideration that only cases, where the pituitary was apparently the main defect, are included. Many cases with minor lesions, especially vascular lesions, are encountered. The wide variety of lesions and the divergence of symptoms are also very interesting. Of great interest is the incidence of lesions encountered in various breeds. To evaluate this critically one should do it on a percentage basis of all patients seen at the hospital, but even that may not give a true picture. Realizing that statistically it may not be sound, one is inclined, nevertheless, to conclude that the incidence of primary tumours of the central nervous system is much higher in the Boxer than in any other breed. The number of tumours in Boxers almost equals the total of all other breeds.

Another conclusion that one can draw is, that by far the most common tumour in the central nervous system in the cat is the meningioma. Furthermore, the incidence of meningiomata is much higher in cats than in dogs. Other primary brain tumours are comparatively rare in the cat. In an attempt to analyse the age incidence of these tumours, one encounters difficulties and the figures do not entitle one to draw definite conclusions. If one arbitrarily classifies the dogs in age groups above and below ten years, the totals are nine and eight, respectively. The only conclusion that one can draw from this is that they occur as frequently in relatively young animals as in aged animals.

The incidence in the different sexes is not very clear, either. The number of males and females is more or less equal. The number of entire males is higher than the number of castrated males and the number of spayed females is higher than entire females. This tendency may be due to the relative numbers of a particular sex seen at the hospital, or kept as pets in the area. The same holds true in the case of the cats, where castrated males contribute the major portion of meningiomata.

NERVOUS CASES, 1959/60 TABLE I.

	Box.	Bos.	Span.	Ter.	Shep.	Collie	Poodle	Spitz	Ir. Set.	L. Retr.	Beagle	Chi.	Dob	Basset	Grey H.	Blood H.	Bull	Cats	Tot. Cats	Tot. Dogs	Tot.
INFECTIONS.																					
Distember.	1	1					1		1				1	1		1				7	
Virus.				1											1			3	3	2	
Bacterial.	1				1	1												2	2	3	
Fungus	1																			1	
																			5	13	18
VASCULAR LESIONS																					
CONGENITAL LESIONS.				1		1	1						1				1	1	1	5	6
Hydrocephalus												1								1	
Cerebellar hypoplasia																		1	1		
																			1	1	2
No LESIONS			2	1						1			1							5	5
TUMOURS.																					
Primary Tumours.																					
Astrocytoma.	3																			3	
Oligodendroglioma	1	1																		2	
Meningioma.			1										1					2	2	2	
																			2	7	9
Invading Tumours																					
Adenocarcinoma					1	1														2	
Sp. cellcarcinoma			1																	1	
Chondrosarcoma.				1																1	
																				4	4
Mestastatic Tumours																					
Mammary carcinoma.					1															1	
Thyroid carcinoma.	1																			1	
Spleen: endothelioma.					1															1	
																				3	3
PITUITARY																					
Adenocarcinoma	1	1																		2	
Purulent inflammation.								1												1	
Haemorrhage.	1																	1	1	1	
																			1	4	5
SPINAL LESIONS.																					
Abscess.																		1	1		
Fracture								1												1	
Disc protrusion.											1									1	
Lymphoma.																		1	1		
																			2	2	4
	10	3	4	4	4	3	2	2	1	1	1	1	4	1	1	1	1	12	12	44	56

NERVOUS CASES 1958 TABLE II

	Box	Bos	Span	Ter	Shep	Dach	Col	Pood	Spitz	Shel-tie	Beagle	Fox H	Husk	Dal-mat	Cat	Tot	Tot	Total
INFECTIONS.																		
Distemper	1			1				1		1		2					6	
Virus			1		1			1							1	1	3	
Bacterial				1				1							1	1	2	
Fungus															1	1		
																3	11	14
VASCULAR LESIONS		1		2	1	3	11 1	14 1	1						2	2	7	9
CONGENITAL LESIONS.																		
Hydrocephalus																	2	
Cerebellar hypoplasia	1	1			3											3	3	
																3	5	8
NO LESIONS.		2			1			2			1	1			3	3	7	10
TUMOURS.																		
Primary Tumours.																		
Astrocytoma																		
Oligodendroglioma	2																2	
Meningioma	1				1										6	6	2	
																6	4	10
PITUITARY.																		
Cyst																		
Haemorrhage			1														1	
Malacia	1						1										1 1	
																	3	3
SPINAL LESIONS.																		
Oesteosarcoma													1				1	
Abscess															1	1		
Fracture															1	1		
Disc Protrusion			1		1	1			1		1			1			6	
																2	7	9
	6	4	3	4	8	1	2	6	2	1	2	3	1	1		19	44	63

NERVOUS CASES. 1957 TABLE III.

	Box	Bos	Span	Pug	Wein	Ter	Shep	Dach	Col.	Pood	Spitz	I. Set	Shel	L. Retr.	Afgh.	Beag.	Chi.	Cat	Total Cats	Total Dogs	Total
INFECTIONS.																					
Distemper	2		1			2		1		2		1	1							10	
Virus			1			1	1		1	3				1	1			2	2	9	
Bacterial			1													1				2	
Fungus	1																	1	1	1	
																			3	22	25
VASCULAR LESIONS.											1									1	1
CONGENITAL LESIONS.																					
Hydrocephalus	1	1	1																	4	
Cerebellar hypoplasia																	1	3	3		
																			3	4	7
NO LESIONS.			2			1		2						1						6	6
TUMOURS.																					
Primary Tumours																					
Astrocytoma		1		1	1															3	
Meningioma	1					1												3	3	2	
																			3	5	8
PITUITARY.																					
Adenoma						3														3	
Cyst		1					1			1										3	
Haemorrhage			1																	1	
																				7	7
SPINAL LESIONS.																					
Granuloma																		1	1		
Disc protrusion			1				2	1												4	
																			1	4	5
	5	3	8	1	1	8	4	4	1	6	1	1	1	2	1	1	1	10	10	49	59

BRAIN TUMOURS. TABLE IV.

	Boxer	Boston	Span	Airedale	Pug	Weim	Ter.	Shep	Dachs	Collie	Cats	Age yrs.	Sex		Total Cats	Total Dogs	Total
PRIMARY TUMOURS.																	
Astrocytoma		1				1						8	SF				
					1							5	F				
	1											3½	M				
	1											7	M				
	1											13	F				
	1											12	SF				
	1											5	M				
												9½	SF			8	8
Oligodendroglioma.																	
	1											8½	SF				
								1				7	M				
		1										11	F				
	1											10	M				
																4	4
Meningioma																	
									1			11	M				
											1	10	CM				
											1	10	SF				
											1	16	M				
											1	11	SF				
											1	10½	M				
											1	10	CM				
											1	8	CM				
											1	12½	CM				
											1	10	CM				
							1					12	CM				
	1											5	M				
			1									11	M				
				1								3	F				
											1	10	SF				
											1	12	CM		11	5	16
INVADING TUMOURS																	
Adenocarcinoma								1				10	SF				
										1		8	M				
Sq. cell carcinoma				1								12	M				
Chondrosarcoma							1					12	F				
																4	4
METASTATIC TUMOURS.																	
Mammary carcinoma								1				10	SF				
Thyroid carcinoma	1											6	M				
Spleen: endothelioma								1				11	M				
																3	3
	9	2	1	2	1	1	2	4	1	1	11				11	24	35

PITUITARY LESIONS TABLE V.

	Boxer	Boston	Span.	Ter.	Poodle	Shep.	Spitz	Collie	Cat			Age.	Sex	Total Cats.	Total Dogs	Total
Adenocarcinoma																
.....	1											6	M			
.....		1										9	SF		2	2
Adenoma																
.....				1								13	F			
.....				1								12	M			
.....				1								13	M		3	3
Cysts																
.....		1				1						9	F			
.....												2	F			
.....					1							9 mo	M			
.....			1									101	M		4	4
Purulent Inflam.....																
Haemorrhage							1					13	F		1	1
.....												8	SF			
.....				1								10	F			
.....								1				10	M			
.....	1											2	SF			
									1			2	SF	1	3	4
Malacia																
.....	1											5	M		1	1
														1	14	15

SUMMARY

Cases with lesions of the nervous system autopsied during three years are analysed according to the type of lesion. Infections are responsible for the highest number of cases. Tumours form the next biggest group. The incidence of lesions of the pituitary gland is surprisingly high. Primary tumours of the brain are significantly more common in the Boxer breed. Meningiomata are the most common brain tumour in the cat. Age and sex have very little, if any, influence on the incidence of tumours of the central nervous system.

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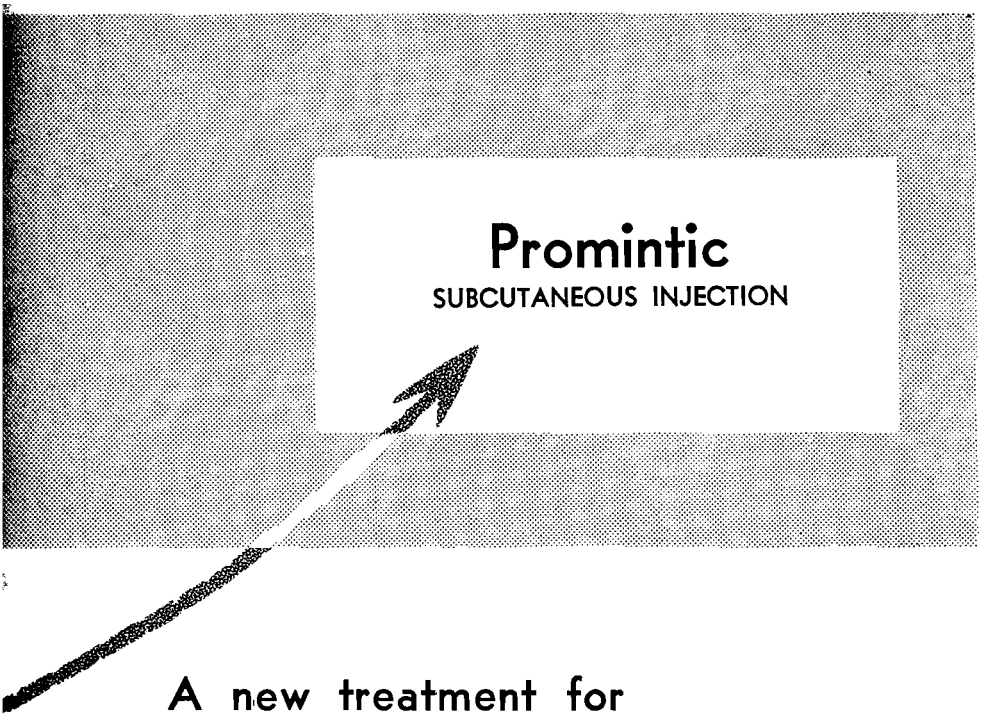

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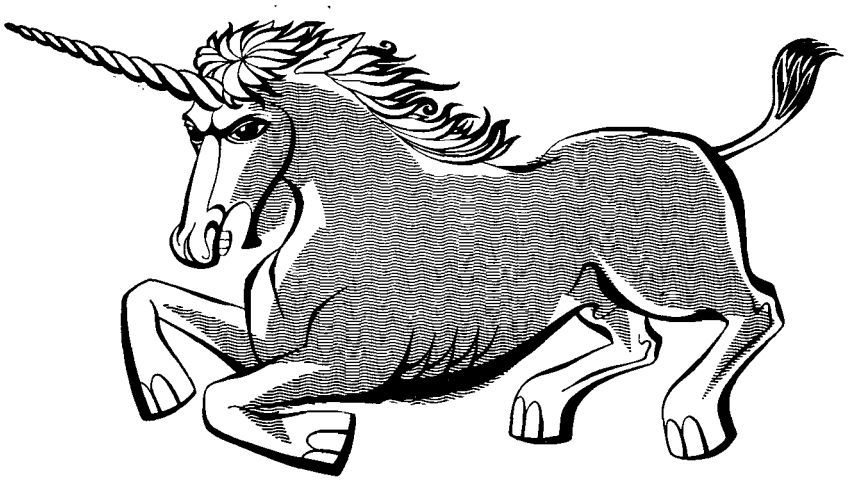

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BOVINE PAPILLOMATOSIS, WITH SPECIAL REFERENCE TO TREATMENT WITH TISSUE VACCINES.

F. B. W. du Casse.*

The bovine papilloma or "wart" is accepted as being caused by a virus or filterable agent, transmissible to calves and horses[1]. The exact mode of transmission in nature is thought to be by direct contact and possibly by arthropod vectors. This condition was found to be widespread in the Natal Midlands, affecting mainly young animals of all breeds between the ages of 3 to 18 months. Dietary deficiencies did not appear to influence the incidence to any extent, as the condition was present on excellently managed farms. Some degree of natural resistance is undoubtedly shown by individuals, as many calves never acquire visible lesions and the degree of infection varied immensely from animal to animal on the same farm.

Three macroscopically different varieties of growths were recognized, these being the pedunculated, the sessile and the filiform types. The lesions varied from single growths to massive conglomerations covering almost the entire body but especially the head, neck and dewlap. Commonly the growths were evil-smelling and suppurating due to incidental bacterial infection and maggot infestation. Secondary complications such as severe growth retardation, and ocular lesions due to growths on the eyelids were common. Heavy infestations definitely appeared to lower vitality and resistance, rendering the patient more susceptible to other common ailments.

All reference books consulted could offer little in the way of treatment except surgical interference, or else held out the hope for spontaneous recovery. Such spontaneous recovery is a well-established fact but unfortunately, in my experience, recovered animals were often an uneconomical proposition due to stunting, and many animals had to be destroyed because of emaciation long before such spontaneous recovery occurred. In many cases it was observed that this spontaneous recovery was delayed for as long as 18 months. Conversely, there are probably more home remedies claimed as a cure for warts than there are for any other disease affecting domestic animals; the lay journals mention numerous such remedies. Undoubtedly, the effect of such remedies is purely co-incidental, spontaneous recovery being the deciding factor.

In an attempt to assess the value of many suggested cures under controlled conditions, field experiments have been carried out over the past four years. To describe all these in detail could serve no useful purpose and only a brief description is given of each. To exclude breed variations, remedies were used on at least two different breeds of cattle at the same time, wherever possible.

* State Veterinarian, Estcourt, Natal.

1. Arsenic.—This is probably the most widely used remedy amongst the farming community and forms the basis of most home remedies.

(*a*) *Externally.*—Arsenic was given an extensive trial use in conjunction with golden syrup, molasses and lard. Treated calves had to be kept isolated because of the danger of licking each other. Bedding had to be watched constantly and changed because of contact contamination. Even so, calves died of arsenical poisoning through licking themselves or contaminated walls. Many months of patient application and care were unrewarding and this line of treatment thus condemned as messy, fraught with dangers and valueless.

(*b*) *Internally.*—Arsenic was extensively tried both per os and intravenously. N.A.B. (M & B) intravenously at recommended doses produced no cures. Per os it was used at the rate of 0.325 gm. daily for a week, then left off for a week, and so on for three months. No improvement resulted in the treated or control cases. In one badly infected 12-month-old Hereford bull, the daily dosage rate was increased by 0.06 gm. each month until after six months the bull was receiving a daily dose of 0.65 gm. of arsenic. Typical symptoms of arsenical poisoning set in and the bull eventually died thereof. In spite of dosage and length of treatment, no benefit as regards wart infection accrued.

2. Anthiomaline (M & B).—This was tried on four calves at the rate of 15cc. intramuscularly every 2nd day for two weeks. To commence with, some quiescence of wart growth activity seemed to occur but this was not maintained even when the course of treatment was repeated after three months.

3. Anthiomaline Plus Arsenic.—Anthiomaline intramuscularly plus arsenic, both intravenously or per os, did not enhance the results of either drug used alone.

4. Calcium Sulphide.—Calves were dosed at the rate of 2 gm. per day for 10 days. This drug has an evil smell, is unpleasant to handle and apparently nauseous. Calves refused to touch any food containing it and objected very strongly to being dosed with it. No beneficial results were observed up to three months later.

5. Podophyllin.—Podophyllin ointment, in both 10% and 25% concentration in liquid paraffin, was used for the treatment of individual warts; the ointment was applied to the neck of the wart twice weekly. Vaseline had to be smeared on the surrounding area to prevent skin burning. Very good results were obtained, the warts often falling off within a month. Unfortunately this remedy is impracticable where large numbers of warts are present or many calves involved. It did not prevent, nor could it be expected to prevent, the appearance of further warts, but it can be fully recommended for the removal of individual warts if surgery is not indicated.

6. FORMALIN, 10%.—This was painted daily on the small warts when they were first noticed. Daily applications resulted in gradual diminution and eventual shedding of these small warts, but the treatment proved time consuming and impracticable in the field if any number of calves was involved.

7. "ELASTRATOR" BANDS.—"Elastrator" rubber rings used for castration of calves and lambs were applied to calf warts. In two animals, 50 warts each were so treated each fortnight. All these warts fell off within 14 days without any undue irritation to the calves, but unfortunately new warts appeared as fast as the old ones were removed. Only warts of a certain size could be successfully ligated by this means and its application in practice is thus limited.

8. BISMUTH SALTS.—Overseas workers have claimed encouraging results in the treatment of warts in both dogs and cattle[2],[3],[4], using bismuth salicylate. Extensive field trials using Bisantol (M & B) were carried out, using a dosage of 20cc. (equivalent to 1140 mgm. of metallic bismuth) weekly for six weeks by deep intramuscular injection. Early results were encouraging; many warts became black and irritant from four weeks after commencement of treatment. Treated calves kept rubbing the warts against tree trunks, etc., often causing extensive wounds. By the eleventh week some 30% of the warts had fallen off, leaving, in many cases, fairly large wounds. No complete cures resulted, but as control calves showed no improvement, the experiments were extended, using dosages of 10cc.. weekly for 3 months, and 20 cc.. twice weekly for 6 weeks. Results were no better at these dosage levels. Three calves, receiving 20c.c. twice weekly, showed symptoms resembling bismuth poisoning, viz. inco-ordination leading to paralysis. One was sacrificed for post mortem examination and although the absorption of this bismuth salt is said to be regular and complete, two unabsorbed pockets of the material were found at the sites of injections. Bismuth salicylate at a dosage level above 1140 mgm. weekly thus appeared to be toxic for calves six monthts old.

A further series of calves was treated, using a fine aqueous bismuth suspension (Chlorobismol, M & B) at the rate of 20cc.. per week for six weeks. Results were no superior to those obtained with the salicylate.

Efforts to obtain supplies of two soluble bismuth salts (bismuth thioglycollate and sodium bismuth butylthiolaurate), said to be successful in human wart treatment, proved unavailing and the salts could thus not be tried out.

The exact mode of action of bismuth salts is apparently not quite clear. They are said to result in inhibition of tissue metabolism, but whether they do this by any essentially toxic effect, or whether this is related to deprivation of blood supply, is not quite clear. The process of the warts turning black and dropping off is identical to that reported in dogs. This indicates necrosis, which can be correlated with the tendency of bismuth salts to produce vasoconstriction.

9. Wart Vaccines.—Various imported wart vaccines available in this country were given extensive trials. No beneficial results could be obtained, even when subcutaneous injection was combined with intradermal injection as recommended by American colleagues.[5] Possibly immunologically different viral strains are present in South Africa.

10. Virus Inoculation.—The theory has long been held that the introduction of the responsible virus into the systemic circulation of an infected animal will result in recovery. Possibly such infection in nature is responsible for spontaneous recovery; the theory cannot be disputed. Proof thereof, under practical conditions, is difficult to obtain. Two methods were tried: (*a*) simply incising an active wart to cause haemorrhage; and (*b*) surgically removing a wart, comminuting it and then rubbing the tissue fragments into the resultant wound. Surgical interference resulted in fairly profuse haemorrhage. Even when the blood was allowed to clot, the process of "rubbing in" the tissue promoted further bleeding. Possibly such haemorrhage prevented the satisfactory introduction of the virus into the systemic circulation, as I could obtain no cures by this method.

To test the theory of recovery upon viral introduction further, warts from four Fries calves were removed, finely cut up, and then well shaken with 50% glycerine-saline. The mixture was then filtered through filterpaper and 5c.c. injected subcutaneously into each calf. All four calves recovered within three months, while control animals showed no improvement.

The experiment was then extended to two other farms, but here only four out of eleven calves recovered completely, while the remaining seven recovered partially; the controls showed no improvement. It was then brought to my notice that in the calves, which had recovered partially, the remaining warts were of the filiform and sessile types only, possibly indicating immunologically different viral strains. At this stage Pearson, Kerr, McCartney and Steele[6], in an excellent article, described results using tissue vaccines in Ireland. It was decided to use their methods with slight modifications in the absence of laboratory equipment. Two young active warts were removed from each calf to be treated, with the necessary care that all varieties of warts present were represented. These were thoroughly cleansed under running tap water, any keratinized tissue cut away and the remainder finely cut up with scissors and added to 50% glycerine saline, using 20c.c. for each calf to be treated. The mixture was thoroughly shaken and then left standing for 2 or 3 days. Thereafter it was strained through muslin and finally filtered through standard filter-paper. The latter process was rather slow and usually required some 18 hrs. Affected calves were given 10c.c. subcutaneously, repeated after 10 to 14 days.

No local or systemic reactions of any kind were encountered in over 200 calves so far treated. The smaller warts commenced to drop off after 14 days, while the larger growths usually required some 4 to 5 months, although usually they could be enucleated fairly easily some three months after vaccination.

Careful controls were kept on four farms. These cases became progressively worse, with no tendency to spontaneous recovery after six months. In all, 106 calves have been treated where a careful follow-up was possible; of these only six failed to respond: a recovery rate of 94%. These figures fully support the excellent results obtained by the Irish workers.

Recently Butler[7] described results using this method. He fully supported the findings of other workers and indicated that the vaccine can be kept easily, remaining fully viable for at least three weeks at room temperature. The vaccine is easily prepared, inexpensive, apparently safe and effective and well worthy of more extensive trials.

Proper homogenisation of the original wart mixture, as described by Butler, together with treatment of infected calves in the early stages of infection, could possibly improve the recovery rate to well nigh 100%.

Summary and Conclusions

An assessment of various methods of treatment of bovine papillomatosis under general farming conditions was undertaken.

No beneficial results whatsoever accrued from the local or systemic use of arsenic, nor from the systemic use of anthiomaline, alone or in combination with arsenic, nor from calcium sulphide, or imported wart vaccines. Bismuth salts had some effect, but no complete cures were obtained. (Bismuth thioglycollate and sodium bismuth butylthiolaurate were unobtainable.)

Podophyllin, 10% and 25% in liquid paraffin, and 10% formalin were both effective when applied locally, but proved impracticable as large scale treatment.

Ligation by means of "Elastrator" bands had limited value in practice.

An autogenous vaccine, simply and easily prepared by mincing representative types of warts and adding 50% glycerine-saline, proved to be highly effective, inexpensive and safe.

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SEASONAL INCIDENCE OF NEMATODE PARASITES OF SHEEP IN THE KING WILLIAM'S TOWN AREA.

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(*Received for publication* 17 *October*, 1960.)

INTRODUCTION

It is not necessary to emphasise the great economic importance of intestinal parasitism to the sheep breeder nor to direct attention to the growing importance of the problem in the light of the changing face of agriculture today.

In the past a considerable amount of work has been done on the identification of the helminths concerned with the result that the identity of at least the more important genera and species in the various regions of the country is known fairly accurately. Based on this knowledge, coupled with the available information of the life cycle and ecology of the parasites, there have been evolved therapeutic and prophylactic measures which have been of material benefit to sheep husbandrymen. Experience has shown that these measures have not always been fully effective. Consequently it was thought that if more accurate data were accumulated on possible seasonal fluctuations in the incidence of the parasites, more effective control measures could be worked out to include alternating the use of drugs with differing parasitic specificity.

With this in view a start was made with an intensive survey at various strategic points throughout the country. One such point was the King William's Town area of the Eastern Cape Province. The survey was started on the 12th January, 1959, but unfortunately owing to unforeseen circumstances cessation of the work some ten months later could not be avoided. Even after so short a period of time it is felt that the results obtained are of sufficient importance to warrant publication.

MATERIAL AND METHODS

The work was carried out on three separate farms, Fort Cox, Dohne and Peninsula, 25 ewes being used for sampling on each farm. Observations were also made on the lambs from these ewes born during the experimental period. The experimental sheep were not subjected to any anthelmintic treatment.

Faeces were collected from each sheep fortnightly. Egg counts were made by the McMaster technique[1] and larval cultures by that of Whitlock[2], the larvae being identified microscopically on a percentage basis. *Nematodirus* eggs were identified separately. From this data the mean egg per gram (e.p.g.) counts for each species was calculated. Daily maximal and minimal temperatures and rainfall were recorded.

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RESULTS

The results for the ewes are depicted histographically in Figure No. 1. The highest mean e.p.g. of faeces is expressed as 100% for each species, and the fortnightly incidence as a percentage thereof.

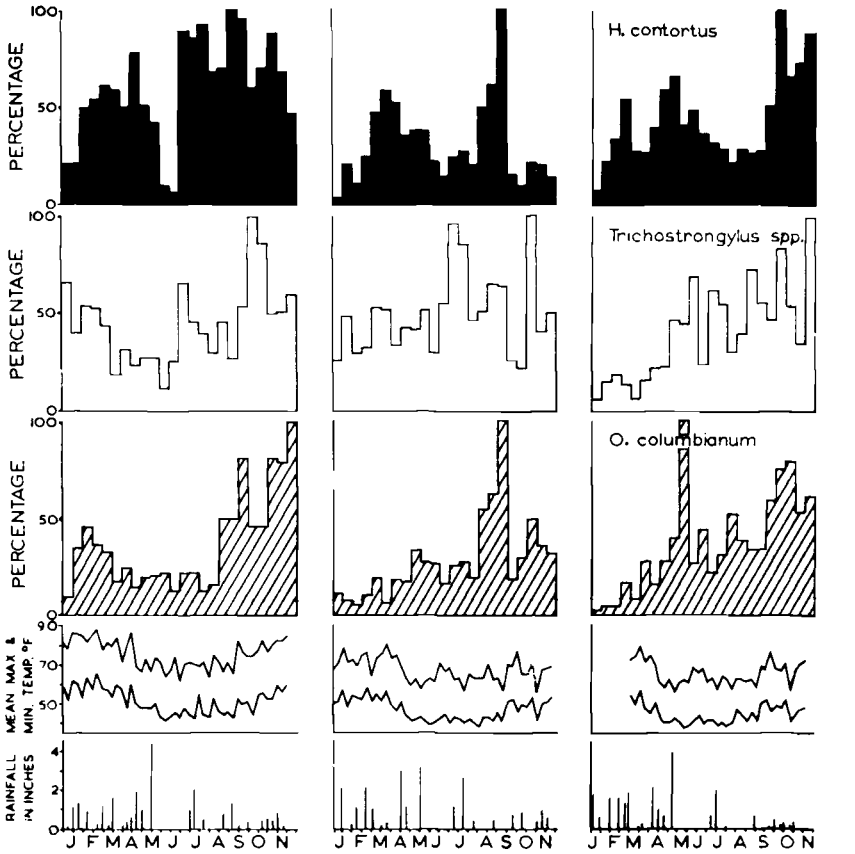

Fig. No1 Fortnightly mean egg per gram counts expressed as percentages of the highest fortnightly mean egg count for each species.

Farm A—Fort Cox.

The experimental animals grazed on natural pastures only. The dominant worm species were found to be the following:—

(1) *Haemonchus contortus.*

As shown in the histogram the e.p.g. at the commencement of the experiment was comparatively low due to the fact that just previously the flock had been dosed with phenothiazine. Thereafter there was a marked rise to approximately the 50 per cent mark at which level the count fluctuated until there was a dramatic drop at the beginning of winter in May. This low level was maintained for a short period of

only one month, when, even before the advent of summer, the e.p.g. rose suddenly to reach a new peak of 1,729 e.p.g. in September, about which level it fluctuated for the duration of the trial.

(2) *Trichostrongylus spp.*

It will be noted that in contradistinction to the findings with *Haemonchus* and *Oesophagostomum*, the egg counts were high at the beginning of the trial. There was a steady decrease until mid-winter, when counts started to rise again to reach a peak of 325 e.p.g. in October.

(3) *Oesophagostomum columbianum.*

Initially, following treatment, the egg counts were low but rose significantly during the late summer months. There was a decrease in the winter but with the advent of summer a sudden increase occurred to reach a peak in November of 463 e.p.g. at the termination of the trial.

From these ewes fifteen lambs were born between 24.6.59 and 4.7.59. From the age of 6 weeks *H. contortus* infection was determined in these lambs. The only other parasite of note encountered was *Nematodirus*. Egg counts throughout were very low.

Farm B—Dohne.

The system of husbandry was similar to that at Fort Cox except that the sheep were grazed on artificial pastures from time to time and in September the flock was moved to grazing which had previously been burnt and subsequently had sprouted vigorously.

(1) *Haemonchus contortus.*

The general trend was similar to that seen at Fort Cox, showing the same general seasonal fluctuations with a peak of 4,910 e.p.g. in September just prior to moving the sheep onto the new "burn", after which there was a dramatic drop to a low level.

(2) *Trichostrongylus spp.*

Except for the finding that there was no tendency for the egg counts to fall in the late summer and autumn the general tendency followed the Fort Cox pattern with a peak of 651 e.p.g. being reached in October. It will be noted that although there was a sudden fall in the egg counts when the grazing was changed, this was of short duration and was followed by a further rise.

(3) *Oesophagostomum columbianum.*

The general trend followed the Fort Cox pattern with a peak of 2,105 e.p.g. in September. Following the change of grazing there was again a dramatic fall apparently of short duration with a tendency to build up progressively.

The ewes lambed towards the end of winter and the most important parasites identified from the lambs were *Trichostrongylus* spp., *Nematodirus* spp. and *Haemonchus contortus*, in that order of frequency, but again the egg counts were low.

Farm C—Peninsula.

The flock grazed throughout the experimental period in one paddock.

(1) *Haemonchus contortus.*

Egg counts rose during the autumn to reach a minor peak in April-May. This was followed by a gradual decrease to be followed in turn by a more rapid rise in spring to reach a peak of 3,193 e.p.g. in October.

(2) *Trichostrongylus spp.*

In spite of fairly considerable weekly fluctuations the general trend was for the egg counts to rise steadily throughout the period of the survey until the highest count, 549 e.p.g. was reached on the concluding day in November.

(3) *Oesophagostomum columbianum.*

Again the general trend was a progressive increase for the duration of the trial with an isolated peak of 458 e.p.g. in May.

Only five lambs were born during the last two weeks of April. Egg counts were higher than on the other two farms, *Haemonchus contortus* reaching a peak in September of 5,003 e.p.g. followed a fortnight later by the highest infestation of *Trichostrongylus* spp. of 234 e.p.g. Infestation by other species as determined by egg counts was insignificant.

Discussion

The winter rains amounting to 3 to 4 inches in both May and July, on all three farms are abnormal for the area, where the winter is usually very dry. The results may therefore not be typical for other years.

Initially egg counts for all species were low, due to the fact that the experimental animals had been treated prior to the survey. The dominant species was *H. contortus*, which showed a rise in autumn, a fall in winter and a major rise in spring. This is in conformity with the findings of Gordon[3] in summer rainfall areas of Australia. The spring rise in egg counts does not appear to have been influenced by the winter rains but rather by the rise in temperature. The spring rise appeared to coincide with the mean maximum temperatures rising above 60°F which in many respects corresponds with the figure of 65°F stated by Gordon[3] to be the critical temperature for this parasite to thrive on pastures.

Some support for this hypothesis was also shown by the autumn born lambs at Peninsula which acquired a high level of infestation. On the other two farms, lambs born in June and those born in July and August only become infested with *H. contortus* in the spring.

The main point of difference in the seasonal incidence with *Trichostrongylus* spp., when compared with the previous species, was the marked rise in egg counts in the winter. Gordon's[3] observations, that the critical temperatures for this species are considerably lower

than those for *H. contortus*, was confirmed. In addition, the abnormal winter rains probably assisted in this winter rise.

Lambs born in autumn and in the winter acquired similar levels of infestations with *Trichostrongylus* spp., indicating that the level of pasture infestation was similar throughout the winter, which was not the case with *H. contortus*.

Although in most respects the seasonal trends of *O. columbianum* were similar to those of *H. contortus* in the ewes, the egg counts were very low when compared with the latter species. After a rise in egg counts in autumn and subsequent fall in winter, counts rose in the spring and early summer. The peak reached in the egg counts in May at Peninsula cannot be explained. The incidence of this species in lambs was too low for any conclusions to be drawn.

One point of interest arose from the examination of the eggs of the genus *Nematodirus*. Both *N. spathiger* and *N. filicollis* eggs were observed. The former species has been considered previously to be the only species of importance in South Africa, the latter having been identified on only two occasions in sheep[4]. The egg counts from this genus were low, but more prevalent in lambs than ewes. This agrees with the observations of Tetley[5] and Thomas[6].

It was interesting to note the dramatic drop in the egg counts of *H. contortus* and *O. columbianum* in the ewes at Dohne when placed in a new camp. The grazing in the new camp was short (2 inches high) and very green as a result of the camp having been burnt some time previously. A possible explanation is the hypothetical presence of an anti-helminthic agent in rapidly growing grass as suggested by Gordon[3].

Summary

1. A survey of nematode parasitic infestation was carried out on three farms in the King William's Town area.

2. Results over one season indicated that the predominant parasite was *Haemonchus contortus*. This showed a seasonal rhythm involving a lesser autumn peak and a major spring peak of egg counts.

3. *Oesophagostomum columbianum* was present to a lesser degree and showed a similar seasonal trend to that shown by *Haemonchus contortus*.

4. *Trichostrongylus* spp. were also present in relatively low numbers. *Trichostrongylus* spp. differed from the previous two species in showing a rise in egg counts during the winter months.

5. *Nematodirus* spp. were present in small numbers in lambs and a small mixed infestation of *Nematodirus spathiger* and *Nematodirus filicollis* was recorded. It appeared that the latter species was more common than had previously been suspected.

ACKNOWLEDGEMENTS.

The author's thanks are due to Drs. Reinecke and Thomas for assistance and advice throughout the survey and also for assistance in the preparation of this paper. Thanks are also due to Mr. B.J.A.S. Schoeman for technical assistance.

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PERSONALIA.

Iain F. H. Purchase, after working for some time with Mr. G. N. Gould at Southampton, was awarded a Research Training Scholarship by the Animal Health Trust. He has entered Trinity Hall, Cambridge, and is working under Professor L. P. Pugh, at the School of Veterinary Medicine.

A son was born to Iain and Mrs. Sheila Purchase on April 2nd, at Cambridge.

H. Graham Purchase leaves at the end of April for the United Kingdom, where he hopes to gain further experience by working as an assistant and taking locums.

C. F. B. Hofmeyer (Onderstepoort) S. W. J. van Rensburg (Onderstepoort) Steve van Heerden (Onderstepoort) and Ted Edwards (Field Section) are overseas attending conferences connected with their specialised interests.

M. J. N. Meeser (Lydenburg) Chas. Belonje (Middelburg C.) and Ernst Kluge have been promoted to the posts of sub-director of Veterinary services.

FACTORS AFFECTING LOSSES OF BENZENE HEXACHLORIDE IN DIPWASH SAMPLES

G. N. Emby and P. J. Gallagher*

(*Received for publication* 20 *March*, 1961.)

INTRODUCTION.

Losses of benzene hexachloride (BHC) are known to occur in dipping tanks. The results of chemical analyses invariably indicate that replenishment of the dipwash is necessary, because BHC is removed by the animals during dipping: a process called "exhaustion". Other mechanisms also contribute to the loss of BHC and Allan[1] attributes these additional losses of BHC in tank washes to the direct or indirect decomposing action of bacteria on the gamma isomer, although Roulston and Schuntner[2] conclude that the bacterial decomposition hypothesis does not afford an adequate explanation of all the BHC losses.

In experimental dipping tanks it is the practice to analyse dipwash samples at frequent intervals and the samples in transit from dipping tanks to the laboratory for analyses often have to travel considerable distances. Bacterial decomposition, reputed by Allan (*loc. cit.*) to be a factor for losses of BHC in dipping tanks, is likely to operate in samples in transit. If this does happen, the analytical results would not reflect the actual strength of the dipwash at the time of sampling. Glass bottles are commonly used to contain these dipwash samples. Their chief disadvantage, however, is that they are easily broken in transit; a more robust type of container is desirable. Polythene containers might reasonably be expected to be suitable.

The object of this investigation was to consider whether, in fact, bacterial decompositon was operative in dipwash samples in sealed containers, and whether polythene containers could replace glass bottles with advantage, or would influence the concentration of gamma BHC in these dilutions.

The gamma isomer of BHC was used throughout this work.

EXPERIMENTAL

1. *Bacterial decompostion of BHC in dipwashes.*

Samples from five experimental dipping tanks in different areas of South Africa were stored in stoppered glass bottles at laboratory temperatures. The BHC content was determined at intervals. The progressive loss on storage is evident in Table 1.

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TABLE I.

BACTERIAL DECOMPOSITION OF BHC ON STORAGE

Time of storage (weeks)	p.p.m. BHC in dipwash				
	Dipping Tank				
	Cool Ray	Tayside	Smiling Valley	Charter Estates	Varschvlei
0	297	284	267	309	312
1	283	274	254	—	294
3	217	173	239	292	250
5½	160	154	202	287	188
11	101	54	157	276	184

These results show losses as high as 81 per cent (Tayside) within 11 weeks' storage. Within 1 week of storage, the average loss, discounting Charter Estates, was 4.7 per cent.

The effect of contaminating laboratory-prepared clean BHC dilutions with proportions of tank washes was investigated when it was found that contamination with 50 per cent of a dirty wash was necessary to bring about a 50 per cent decompositon of BHC within 11 weeks.

2. *Inhibition of bacterial decomposition.*

A 0.2 per cent addition of a tar oil white disinfectant (R.W. coefficient 18–20) was made to a dirty Tayside wash giving previously an 81 per cent decomposition of BHC on storage. Stored and analysed as previously, this wash gave only a 5 per cent decomposition of BHC. A 0.2 per cent addition of sodium chlorate to a similar wash resulted in a 27 per cent decomposition under the same storage conditions, whereas arsenious oxide limited the decomposition of BHC to a maximum of 6 per cent when added to the wash at 0.16 per cent As_2O_3 concentration. This wash was stored for 8½ weeks.

TABLE 2.

THE EFFECT OF POLYTHENE CONTAINERS ON THE CONCENTRATION OF BHC

Condition of dipwash	Clean			Foul		
Samples stored in	Pyrex	Soda glass	Polythene	Pyrex	Soda glass	Polythene
Duration of storage (weeks)	BHC %	BHC %	BHC %	BHC %	BHC %	BHC %
0	0.072	0.072	0.072	0.080	0.080	0.080
1	0.072	0.071	0.047	0.081	0.080	0.069
2	0.072	0.071	0.040	0.081	0.080	0.064
3	0.070	0.069	0.027	0.078	0.076	0.055
4	0.072	0.072	0.025	0.080	0.079	0.055
5	0.073	0.072	0.022	0.080	0.078	0.055
6	0.072	0.071	0.019	0.078	0.078	0.050
8	0.071	0.072	0.019	0.078	0.078	0.043
11	0.072	0.072	0.019	0.080	0.080	0.045
13	0.073	0.073	0.013	0.079	0.080	0.043
15	0.072	0.071	0.011	0.080	0.080	0.044

3. *The effect of polythene containers on the storage of BHC miscible oil dilutions.*

Following the analyses of several dipwash samples from experimental dipping tanks it was observed in several instances that abnormal losses of BHC had occurred. These losses appeared to be associated with the samples contained in polythene bottles. In order to establish whether this association existed, clean and fouled dilutions of BHC miscible oils were stored in pyrex, soda glass and polythene containers. The fouled dilutions were stabilised with 0.16 per cent As_2O_3. Aliquots were analysed at intervals. The results are recorded in Table 2.

It is evident from these results that no losses of BHC took place when the samples were contained in pyrex or soda glass bottles and that polythene containers are not suitable for holding BHC dilutions. Over a period of 15 weeks in polythene bottles losses of 84 per cent of the BHC can be expected. The losses of BHC from the fouled dipwash, which contained As_2O_3, were not as high as those from the clean dipwash sample.

In order to simulate the shaking which dipwash samples are subjected to in transit from dipping tanks to the laboratory for analysis, and determine whether this accelerated the loss of BHC from dilutions contained in a polythene bottle, clean dilutions of BHC were shaken mechanically in pyrex, soda glass and polythene bottles. Aliquots were analysed at intervals over a period of 23 hours. These results are recorded in Table 3.

TABLE 3.

THE EFFECT OF SHAKING ON THE CONCENTRATION OF BHC IN DIPWASHES CONTAINED IN POLYTHENE BOTTLES

Samples shaken in	Pyrex	Soda glass	Polythene
Duration of shaking (hours)	BHC %	BHC %	BHC %
0	0.072	0.072	0.072
2½	0.072	0.072	0.069
7	0.072	0.072	0.060
10½	0.072	0.072	0.050
15	0.072	0.072	0.039
18½	0.072	0.072	0.032
23	0.072	0.072	0.022

It is shown that within 23 hours, 70 per cent loss of BHC has occurred. Without shaking this loss was obtained only after 5 weeks' storage (Table 2).

A materials balance established that most of the BHC unaccounted for could be recovered from the polythene, in which it was absorbed, by extraction of the plastic with xylene. A small proportion of BHC unrecovered had, in all probability, penetrated to the outside of the container, where it was lost by volatilisation.

Summary and Conclusions

Bacterial decomposition, initiated in dipping tanks, is a factor to be considered when dipwash samples containing BHC are in transit for analyses. It is essential that these samples reach the laboratory as soon as possible following sampling, in order that the analytical results reflect the actual concentration of BHC in the tank at the time of sampling. As_2O_3 (0.16 per cent) when added to dipwash samples inhibits bacterial decomposition effectively. Such a material could be added with advantage to samples when delays in analyses are anticipated.

Polythene plastic absorbs BHC when dilutions of this active ingredient are contained in polythene bottles. It is recommended that this type of container should not be used to hold dipwash samples or other dilutions containing BHC.

ACKNOWLEDGEMENTS

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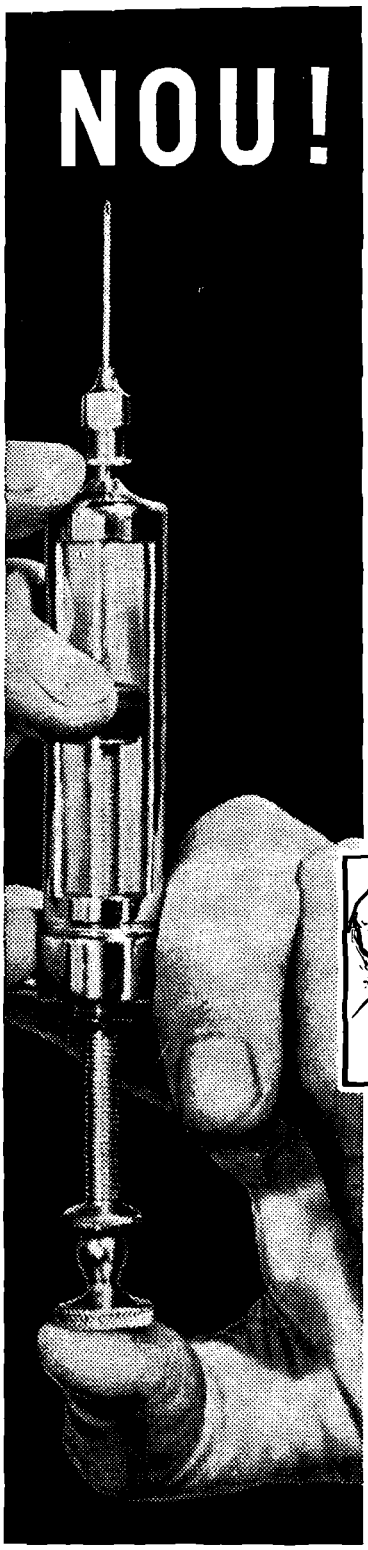

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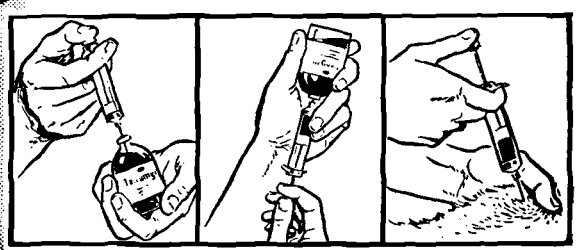

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THE EXCRETION AND STABILITY OF ISONIAZID IN COW'S MILK.

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A. The Excretion of isoniazid in cow's milk

Introduction

In an endeavour to find a more economical method of combating bovine tuberculosis than the slaughter policy, field trials on eight tuberculosis infected herds were conducted, using isoniazid as chemotherapeutic agent.[7] It became apparent that, under optimum conditions, chemotherapy could reverse the infectiousness of most tuberculous cattle within three months, and in many instances much sooner. The antituberculous effect of isoniazid is so great, that its use is indicated in every case in which the immediate slaughter of the tuberculous animal is not feasible because of economical reasons.[8].

The daily therapeutic and prophylactic treatment of hundreds or thousands of cows with isoniazid may lead to the contamination of milk by the drug. Contamination of milk for human consumption with any drug is prohibited.

Isoniazid treatment of cows has no direct influence on milk production or on the taste of the milk. During the field experiments, herds with more than 100 cows in milk received isoniazid at dosages of 10 mg./Kg. body weight for periods of eight to nine months and the milk was delivered to the consumer either as pasteurised milk or fresh milk. There were no complaints by the consumers. It is possible, however, that certain breakdown products of isoniazid can cause tainting of milk, probably depending on the diet of the cattle. Hobbs[4] reported that after prolonged treatment of a dairy herd numerous complaints from milk consumers had been received; namely, that the milk had a bitter flavour and, when heated, gave off a most offensive odour. The complaints immediately ceased when the cows were taken off their daily isoniazid. The cows were fed with silage and byproducts of the cane sugar industry.

The absorption of isoniazid, the distribution in the body and its excretion in urine have been studied intensively on humans and experimental animals. The drug can be detected in the blood by available methods, and can be found in the pleural and the cerebrospinal fluid within three hours after administration. Within the same period it is widely distributed throughout the tissues.

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Camurri[2] dosed patients with 3.2 mg. isoniazid/kilo and found that it passed into the milk of lactating mothers within a few hours. The concentrations were one half to one quarter lower than those detected in the blood at the time. Renovanz and Schattmann[13] determined the presence of the drug in the milk of guinea-pigs after isoniazid treatment as well as in the blood of the suckling. Lass and Bünger[10] reported on the excretion of isoniazid in human milk after dosages of 200 mg. per os. In the samples taken two hours after drug administration they found an average of 2 mcg/ml., and in samples taken seven hours after administration 0.5 mcg/ml. was present, which was 40 per cent to 60 per cent of the bloodlevels of the patients. These pediatricians concluded that an amount of 0.2 mg. per 100 ml. milk was not sufficient to have any effect on the baby. Bromberg *et al*[1] administered 200 mg. isoniazid orally to 5 nursing mothers and determined an average of 0.38 mg/100 ml. milk during the period one to three hours after administration. The latter two teams of workers used the method described by Kelly and Poet[6]. Kleeberg and Weyland[17] studied the serum levels of cattle after oral administration of 10 and 20 mg/Kg. isoniazid and found relatively high and persistent concentrations. A variety of chemical procedures have been described and found useful in determining concentrations of isoniazid in biological fluids.

The present investigations were conducted to determine not only the rate of excretion in milk but also the amounts of isoniazid per pint of milk when it is actually consumed.

Material and Method

Six young Friesland cows, free of mastitis and other diseases, were selected. They were stabled separately, fed on green lucerne and hay and milked only once daily in the morning because they all had a rather poor milk production ($\frac{1}{2}$ to 1 gallon per day). Five of them were weighed and were given a watery solution of pure crystalline isoniazid, per os, at the rate of 10 mg./Kg. body weight. The sixth cow was not dosed and served as a control. Within 15 minutes after milking a 100 ml. sample of each cow was delivered at the laboratory. The dosing was so arranged that milking could always be done in the morning. For practical reasons only the values for samples taken 4, 12, 17 and 24 hours after drug administration were determined, since the tuberculous herds were dosed only once daily during milking time.

The chemical methods described by Deeb *et al.*[3], Hunter[5], Scardi[14], Short[15] and Wagner *et al.*[16] were tested for their suitability in determining isoniazid in milk. None of them could be employed because either the deproteinisation was incomplete or the method was not sufficiently sensitive. Finally a combination of the methods of Short and that of Wagner *et al.* was employed with success. It is as follows:

Milk known to be free of isoniazid was used for the standard solution. 0, 0.2, 0.4, 0.6, 0.8 and 1.0 microgrammes isoniazid per ml. milk were added. Both the standard and the samples to be assayed

underwent the same procedure: The following solutions were consecutively run into a series of 50 ml. test tubes:

15ml. milk;

5 ml. of a saturated $Ba(OH)_2$ solution, well mixed and left for 5 minutes,

5 ml. 9 per cent $ZnSO_4$ solution, well mixed and left for 10 minutes.

The mixture was then centrifuged for 5 minutes at 2,500 r.p.m. and filtered through S & S Blue Ribbon filter paper into clean dry test tubes. To 10 ml. of the filtrate were added 2 ml. of a 0.1 per cent sodium 1:2 naphtho-quinone-4-sulphonate solution and the mixture left in the dark for one hour to allow the colour to develop. The transmission was read at a wavelength of 450 millimicron. The results were obtained with a Lumetron colorimeter, model No. 420-E, using filter B420 and reduction plate 6.

For each determination of isoniazid a separate standard series was used, prepared from the milk of the untreated cow.

Figure 1 shows a typical standard curve.

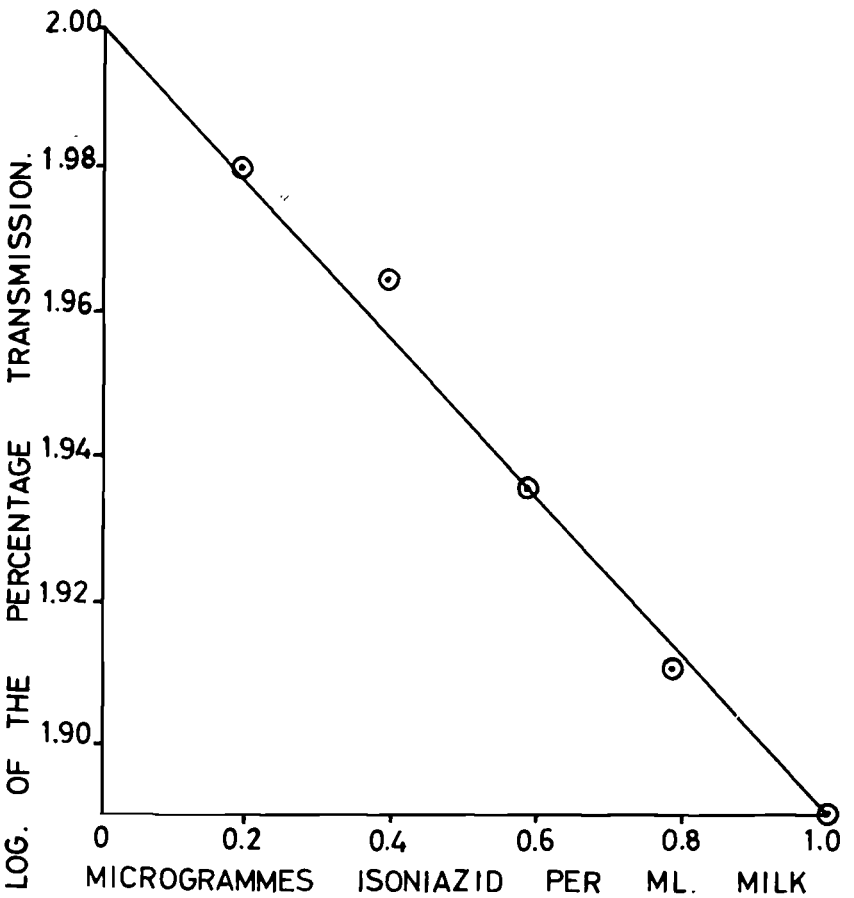

FIG. 1 STANDARD CURVE.

RESULTS.

The results of the milk level assays are given in Table 1.

TABLE 1.

EXCRETION OF ISONIAZID IN MILK FOLLOWING AN ORAL DOSE OF 10 mg./Kilo. BODY WEIGHT.

Cow	Dose of isoniazid in gms.	Time after administration			
		4 hours mcg./ml.	12 hours mcg./ml.	17 hours mcg./ml.	24 hours mcg./ml.
1	3.9	0.407	0.337	0.217	0
2	3.9	0.277	0.120	0.160	0
3	4.1	0.283	0.133	0.137	0
4	4.1	0.203	0.153	0.074	0
5	3.9	0.210	0.213	0.107	0
	Average	0.276	0.191	0.139	0

DISCUSSION

It was established that the levels of isoniazid in milk, as a function of time following an oral dose, vary significantly among the individual animals. It can be assumed that the differences in milk concentrations are largely the result of variations in rate of acetylation by the liver.

An important finding was that the average level of isoniazid in the milk was much lower than the average level in the serum. For example, the serum concentration four hours after dosing was 1.4 microgrammes/ml.[17], compared to the concentration in milk of 0.3 microgrammes/ml.

An even lower isoniazid level can be expected in cows with a normal, i.e. higher, milk production than the cows in this experiment. Only the isoniazid concentration in the milk secreted 12 hours after administration is of practical significance, as that is about the interval between the two milkings in a dairy. One pint of this milk will contain 0.1 mg. isoniazid on an average, provided all cows have been dosed at the rate of 10 mg/kilo. But this will seldom be the case, as a tuberculosis infection rate of 100 per cent in a herd is rare. The milk yielded 24 hours after administration was free of the drug.

It can be concluded that calves receiving milk from a treated dam over prolonged periods will not be influenced by the small amounts of isoniazid in the milk. A calf drinking a half gallon twice a day, which is almost the maximum, will have an intake of 0.5 mg. isoniazid, which is but a thousandth of the therapeutically effective dose. Likewise, any prophylactic effect is very unlikely. The emergence of an isoniazid-resistant strain in a calf already infected with tuberculosis is nearly impossible, since an adequate blood level of the drug is essential for its development. The same considerations apply to humans, drinking fresh milk from treated cows. However, one should discourage the consumption of such milk, especially for children, mainly to protect them from infection with bovine tubercle bacilli.

B. The stability of the drug in milk

For practical and scientific reasons it was interesting to investigate the effect of common procedures of handling and treating milk on the isoniazid levels contained therein. Certain procedures, like pasteurisation and road transport, could only be imitated in the laboratory. Two different concentrations were chosen. The 0.33 mcg./ml. level was to represent the high milk level of a particular cow (No. 1) 12 hours after dosing; the 1 mcg./ml. value was investigated in order to have a better follow-up study of the inactivation of the drug.

TABLE 2.

STABILITY OF ISONIAZID IN MILK UNDERGOING HEATING PROCESSES.

Quantity isoniazid added per ml.	Procedure.	Quantity isoniazid determined after procedure.	
		Mcg. per ml. milk.	% of original amount
(*a*) 1 mcg (*b*) 0.3 mcg	Holding pasteurisation 143°F for for 30 minutes.	0.2 0	20 0
(*a*) 1 mcg (*b*) 0.3 mcg	Short time high temper. 160°F for 20 seconds.	0.9 0.3	90 100
(*a*) 1 mcg (*b*) 0.3 mcg	Short boiling followed by cooling.	0.4 0	40 0

The figures in the 3rd column are the average values of 6 determinations rounded off.

TABLE 3.

STABILITY OF ISONIAZID IN MILK UNDERGOING STORAGE OR TRANSPORT.

Amount added per ml. milk.	Procedure	Quantity in mcg. determined after different periods.				
		1½ hrs.	4 hrs.	10 hrs.	12 hrs.	17 hrs.
(*a*) 1 mcg (*b*) 0.3 mcg	Storage in household refrigerator.	0.8 0.2	0.5 0.1	0.3 —	0.1 0	0 0
		10 min.	20 min.	30 min.	60 min.	120 min.
(*a*) 1 mcg (*b*) 0.3 mcg	Storage at roomtemperature 77—72°F	— 0.3	— 0.3	0.8 0.2	0.6 0.1	0.5 0
(*a*) 1 mcg (*b*) 0.3 mcg	Shaking in imitation of road transport.	— 0.1	— 0	0.3 0	0 —	0 —

The figures in the 3rd column are the averages of two to five determinations rounded off.

Discussion

The investigation revealed that most of the different procedures resulted in the disappearance of the free isoniazid when quantities were added equal to peak milk levels. It must be pointed out that all the determinations were done in the usual laboratory glassware, whereas in practice milk is kept and transported in metal containers and pasteurised in metal tubes. It is also cooled on large metal coolers, first on the farm and then at the dairy plant. Several metals, however, proved to act as catalysers in the decomposition of the active free drug to inactive compounds[11]. Pansy and co-workers[12] reported a gradual loss of active isoniazid in stored liquid culture media which appeared related to the presence of ferric ions and alkaline reaction. One of us (W.) studied the effect of autoclaving aqueous solutions of isoniazid in acid, neutral and alkaline medium and showed that only in acid solution most of the free drug survived unchanged. The chemical structure of isoniazid has open reactive groups which enable various combinations. From the above it is evident that free isoniazid has a much smaller chance to stand the usual procedures in practice than it does in experiment. Conjugated isoniazid has no antimicrobial action. In addition there is the mixture of milk from different farms at the dairy plant to be considered.

Conclusion.

It can be concluded that the amount of isoniazid excreted in cow's milk is of no significance for human health or for any measures concerning the eradication of bovine tuberculosis. It must be emphasized, however, that all milk from tuberculous herds, whether chemotherapeutically treated or not, should be pasteurised.

ACKNOWLEDGEMENTS.

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A PRELIMINARY COMPARISON BETWEEN TWO METHODS OF UREA SUPPLEMENTATION OF WINTER FEED FOR BEEF COWS

R. L. Davidson*[1] and H. S. Purchase[2].

(*Received for publication* 10*th Feb.*, 1961)

Introduction

The object of this preliminary trial was to compare the effects of urea supplementation given in two distinct forms to cattle under moderately good farming conditions. In the one form the urea was compounded in blocks, in the other it was sprayed on hay.

Method

A feeding trial lasting 125 days was conducted during the winter of 1960, using medium grade Hereford cows, divided into three groups, namely, two experimental groups and one control group. In the beginning each group consisted of 13 cows, of which 7 or 8 in each group were suckling calves. During the experiments three cows calved late and the groups were then reduced evenly to eliminate the late calvers. Before setting up the three experimental groups, every animal was weighed and they were distributed at random in the three groups, according to their weight, through tripling animals of similar weight and condition.

Rations and Method of Feeding.

All three groups received approximately 20 lbs. of hay and 20 lbs. of babala silage per head per day. The latter was later replaced with maize silage. Water was always available in the paddocks, which consisted of about half an acre of short Eragrostis grassland.

The differential treatments were then as follows:—

Group I The hay fed each day to this group was sprinkled with 78 ozs. of urea dissolved in water with about 2 gallons of molasses. This provided 6 ozs. of urea per animal daily. A bone meal and salt lick was also available throughout the trial.

Group II In addition to untreated hay and silage, a proprietary urea phosphate block containing 40 per cent urea, 10 per cent molasses as well as some monosodium phosphate (3.8 per cent P) and traces of copper and cobalt was offered for licking free choice.

*[1] C/o Department of Botany, University of Witwatersrand.
[2] C/o Cooper & Nephews, S.Af. (Pty.) Ltd., P.O. Box 2963, Johannesburg.

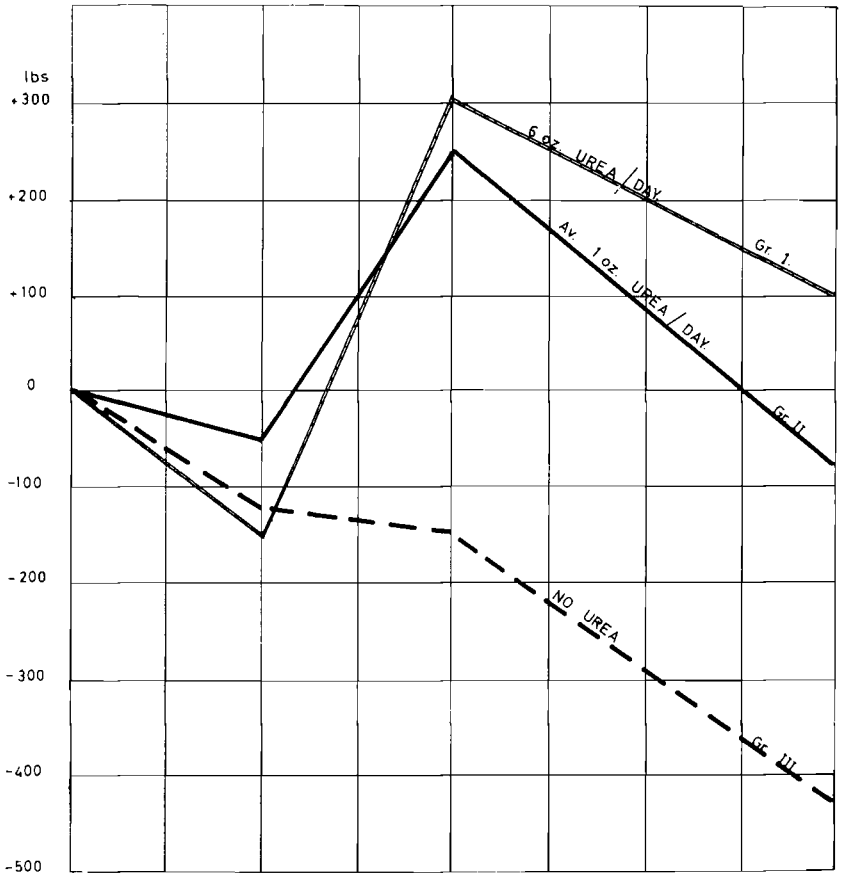
Group III This was the control group which received only untreated hay and silage. Bone meal and salt were provided as a lick throughout the course of the trial.

The animals kept fit until September, when, during the hot, wet weather a heavy worm burden developed.

Weighing.

All animals were weighed on three consecutive days at the beginning and end of the trial. The average of these three weighings was accepted as the weights of the animals at the beginning and end of the trial. During the trial the animals were weighed twice in July and August on two consecutive days, the average of the two consecutive daily weighings being recorded. Unfortunately, it was not possible to carry out weighings on two consecutive days during September due to rain; hence, no September data are provided.

GRAPH I: TOTAL WEIGHT CHANGES—ALL ANIMALS.



GRAPH I

Weight Changes

The method used in presenting the results is that of treating only the loss or gain in weight of the animals above or below their weights at the beginning of this trial.

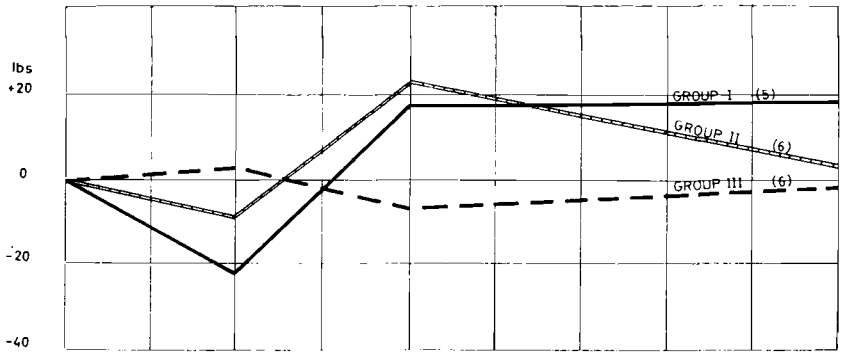
Graph I illustrates the net changes in the total weights of the three groups, including the three late calvers, one of which was in Group III and two in Group II. It will be seen that, at the end of the experiment, Group I had gained a total of over 100 lbs., while Group II had lost a little less than 100 lbs. On the other hand, Group III had lost more than 400 lbs. liveweight.

After removing two cows from each group, there is no significant change in the relative weight differences of the three groups.

	June Total Weight	*July*	*August*	*September*	*October*
		lbs.	*lbs.*	*lbs.*	*lbs.*
Group I . . .	10,895 lbs.	Loss 133	Gain 258	—	Gain 104
Group II. . .	10,489 lbs.	Loss 22	Gain 218	—	Loss 41
Group III. . .	10,356 lbs.	Loss 81	Loss 143	—	Loss 238

It is very interesting to study the response of not only the three groups as a whole but also of the dry cows, nursing cows and the calves in these groups separately.

GRAPH II: DRY COWS—AVERAGE WEIGHT DIFFERENCES.



GRAPH II

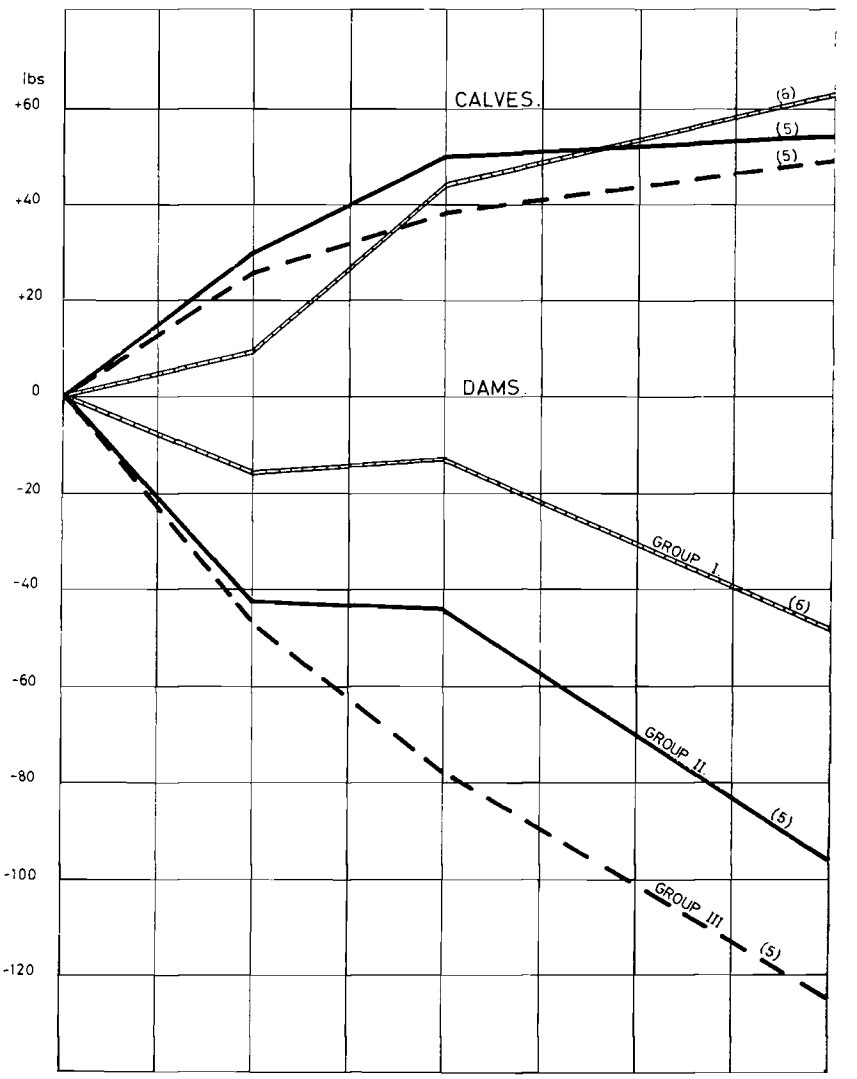
Graph II represents the weight changes of the dry cows in the three groups. It will be seen that there was no significant change during the experimental period in the weight of Group III (Controls), confirming that the nutritional status was sufficient for maintenance.

If now we consider the calves, it will be seen in Graph III that there is no noteworthy difference between the three groups. However, when studying the data of the dams of these calves, it is evident that the cows in Group III have vicariously sacrificed themselves to ensure that their offspring shall thrive.

Urea Consumption and Benefit therefrom

Now let us consider the amount of urea consumed by Groups I and II. Group I received 6 ozs. a day and is better than the control by 524 lbs.

GRAPH III: DAMS AND CALVES.



GRAPH III

Animals in Group II during the first week were taking 3.8 ozs. of urea per cow per day and during the second week this fell to 1.7 ozs. The fall continued until finally this group was only consuming 0.7 ozs. per day. The average intake of Group II over the whole period was 1 oz. of urea per cow per day. For this intake of urea Group II is better than the control by 329 lbs. and Group I on 6 ozs. of urea per cow per day was better than the controls by 524 lbs.

This can be expressed in another way. The response per 100 lbs. of urea in Group II is 392 lbs. and only 87 lbs. in Group I. There are two possible explanations for this result. It may be due to either the better utilisation of the urea resulting from the trace minerals in the urea/phosphate block or to a diminishing response with higher intake of urea in Group I.

Although those animals offered the urea/phosphate blocks were also being fed silage and hay, nevertheless they took readily to this method of urea supplementation at the beginning, but later the intake fell. A possible explanation is that the salt/phosphate hunger had been satisfied early in the trial and thereafter there was insufficient inducement to continue taking more of the block. These trials also indicate the benefits of offering bovines, under the conditions described, a urea/phosphate block because the labour entailed by this method of urea/phosphate supplementation is much less than by spraying the dissolved urea on to the hay daily.

ACKNOWLEDGEMENT

These trials were carried out at the Frankenwald Field Research Station of the University of the Witwatersrand, and the supplements were made available by Cooper & Nephews. S. Af. (Pty.) Ltd.

THE EFFECT OF TRACE ELEMENTS IN CALVES RECEIVING STERILIZED HAY.

J. H. Kellerman and H. Prinsloo.*

(*Received for publication 7th Feb.*, 1961)

INTRODUCTION

The bulk of the feed fed to the animals in experiments at Onderstepoort has to be bought and the source of the feed is usually not known. There may be deficiencies in the soil from which these feeds are derived which would affect their quality and mineral content.

If young animals are maintained on forage from the low or borderline areas [5,6], under conditions of zero grazing and restricted motion, the feeding of extra trace elements may be called for. As a matter of fact, the existing stock at this Institute is kept under such conditions and a large number of cattle are even continuously housed on concrete floors and fed sterilized hay from which essential food elements may have been leached out in the sterilization process. Consequently, with the view to ascertain whether trace element supplementation would be of any benefit to calves, some of the conditions prevailing at this Institute were simulated as nearly as possible in this experiment.

EXPERIMENTAL.

Sixteen three to five-day-old dam-nursed calves (mainly Grade Frieslands) were divided into two comparable groups with four males and four females in each group. A well ventilated asbestos building provided with a ceiling, sheltered the animals in individual stalls measuring 7 ft. by 3½ ft., each with a built-in hay rack and feed manger. Each day, excluding Sundays, the two groups were driven out into separate concrete-floored camps measuring 36 ft. by 18 ft., where the animals were exposed to the elements of nature from 8 a.m. to 11 a.m., with free access to water but not to feed.

Each calf received a maximum of eight pints of whole milk per day, half of which was given in the morning and the remainder in the afternoon. From the seventh day a calf starter and chopped sterilized lucerne hay were supplied *ad libitum*. Feed intake was recorded individually. On Sundays, and from 3 p.m. during the rest of the week, water was offered to appetite in the stalls.

At six months of age the calves were weaned and the males castrated. Furthermore, the animals were simultaneously weighed and bled at monthly intervals over a period of 300 days. The blood was analysed for haemoglobin, non-protein nitrogen, sugar, calcium and inorganic phosphorus. The haemoglobin was determined according to

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the method of Sanford *et al.*[4], the sugar and non-protein nitrogen according to the Folin-Wu system of blood analysis as modified by Graf[1] whereas the method of Malan and van der Lingen[3] was used for the determination of calcium and inorganic phosphorus.

The hay and starter meals were analysed for their protein (Kjeldahl), calcium and phosphorus (Malan and van der Lingen) as well as certain trace element contents. For the determination of the latter, existing methods were modified in order to comply with the routine procedures used in this laboratory. The essential reagents applied in these determinations were sodium diethyl-dithiocarbamate for copper, nitroso-R-salt for cobalt and periodic acid for manganese.

Results.

Except for the mineral mixture, the composition of the calf starter meals fed to the control and experimental groups was the same (Table I). The mineral mixture used in the control ration consisted of 67 lb. of bonemeal and 33 lb. of salt whereas the composition of the mixture used in the experimental ration is shown in Table II.

TABLE I.

CALF STARTER MEAL.

Yellow maize meal	28 per cent.
Kaffircorn meal	20 ,, ,,
Crushed oats	15 ,, ,,
Groundnut cakemeal	32 ,, ,,
Skimmed milk powder	1 ,, ,,
Food yeast	1 ,, ,,
Mineral mixture	3 ,, ,,
	100

TABLE II.

TRACE ELEMENT MINERAL MIXTURE

Bonemeal	66 lb. 10 oz.
Salt	33 ,,
$MnSO_4.5H_2O$	112 g. (4 oz.)
$Cu\ SO_4.5H_2O$	56 g. (2 oz.)
$Co\ SO_4.7H_2O$	5 g.
KI	2 g.

In Table III are presented the amounts of protein and some mineral elements in the sterilized hay and calf starter meals fed to the control and experimental groups. These data seem to be in accord with the normal requirements of calves. It will be seen that the hay contained 0.15 p.p.m. of cobalt and 6.2 p.p.m. of copper, whereas the calf starter with the unsupplemented mineral mixture contained 0.29 p.p.m. and 7.5 p.p.m. of cobalt and copper respectively. Thus, considering the fact that 0.1 p.p.m. of cobalt and 7.5 p.p.m. of copper in the dry matter are regarded as optimum for cattle,[2] one is therefore justified, theoretically, to expect as good a performance from the control calves as from those whose ration has been supplemented with the abovementioned trace elements.

TABLE III.

RELEVANT COMPOSITION OF THE HAY AND CALF STARTER MEALS. (ON DRY MATTER BASIS).

Feeds	Crude Protein	Calcium	Phosphorus	Copper	Cobalt	Manganese
	%	%	%	p.p.m.	p.p.m.	p.p.m.
Calf Starter (control)	28.4	0.54	0.53	7.5	0.29	33
Calf starter (experimental)	29.2	0.54	0.53	14.0	0.69	47
Sterilized hay (Average of 8 samples).	19.69	1.02	0.18	6.2	0.15	50

This supposition has been fully borne out by the results given in Tables IV and V as their perusal will disclose no differences in the growth, efficiency of food utilization or blood picture of the two groups of calves.

TABLE IV.

CORRELATION BETWEEN GROWTH AND FEED CONSUMPTION OF CALVES OVER A PERIOD OF 300 DAYS.

	Control Group.	Experimental Group.
Growth		
Initial weight (lb.)	83.5	82
Final weight ,,	665	612
Total gain ,,	582	530
Daily gain ,,	1.94	1.77
Feed Consumption		
Milk (dry basis lb.)	220.8	211.4
Starter ,, ,, ,,	1644	1521
Autoclaved hay (dry basis lb.)	641.6	566.3
Total feed ,, ,, ,,	2506.4	2299.1
Feed efficiency (lb. feed/lb. gain)	4.34	4.41

TABLE V.

TRACE ELEMENT FEEDING IN RELATION TO SOME BLOOD CONSTITUENTS. (AVERAGES FOR NINE MONTHLY BLEEDINGS.)

Group	Haemoglobin g. %	Non-Protein Nitrogen. mg. %	Sugar mg. %	Calcium mg. %	Inorganic Phosphorus mg. %
Control ..	10.5	27.9	78.4	8.9	7.1
Experimental	10.3	27.9	76.8	9.0	7.1

SUMMARY AND CONCLUSION.

1. Data pertaining to growth, feed utilization and blood composition are given for calves fed for 300 days on a sterilized hay and meal mixture with and without the addition of four essential trace elements.

2. In no respect do the results obtained with the control animals differ from those of the experimental group.

3. For normal growth, calves, and probably all waxing ruminants at Onderstepoort, continuously housed on concrete floors and regularly fed lucerne hay and a concentrate ration equal to that used in this experiment, would not need a trace element supplement in their ration.

ACKNOWLEDGEMENTS.

The writers wish to thank Messrs. J.R. Malan, G.J. Truter and J. de V. du Toit for the blood, micro- and macro-element analyses, respectively. Moreover, the guidance of Dr. G.D. Sutton in the preparation of the article and the kind assistance and useful advice of Dr.C.J. Muller are highly appreciated.

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A NOTE ON THE EFFECT OF VITAMIN B_{12} ON THE HAEMATOLOGICAL PICTURE OF THE RACE HORSE

L. A. Simpson.*

((*Received for publication* 8 *March*, 1961)

Over the past three years I have been interested in the correlation between the fitness of the race horse and its haematological picture. During this period I have taken blood samples from 169 race horses from the fittest to the unfit in various stages of training and also at different altitudes. At this stage I am unable to go into the subject too deeply through lack of data, but hope to produce a paper in the near future in fuller detail. The following report is merely a practical example emphasizing the importance of the blood picture in the race horse.

In November, 1959, I was approached by a race horse owner and trainer in Durban (sea level) who was sending up a three year old colt for one of our premier races on the Rand (altitude 6,000 feet). As we all know, there has always been the bugbear of the "altitude bogey" in all spheres of sport and it was this factor that worried him. The usual practice is to send up a horse two or three months before a race, in which time it would acclimatize itself. In this particular instance, however, there was not sufficient time, so he wondered if something could be done before the horse left the coast. At this period, I had little experience of the effect of Vitamin B_{12} on the red cell count, but suggested a course of Vitamin B_{12} injections and iron supplement in the feed

A blood sample was taken on the 18th November, 1959, and the first injection given on the 19th November. On the 21st November the colt won a Third Division race in Durban, with a weight of 8.13 over 9 furlongs. Treatment continued and the colt was taken by horse trailer on Monday, 7th December, staying over at Mooi River and arriving in Johannesburg on the 8th. On the 10th December, the horse was given a final sprint over 4 furlongs at Newmarket and that afternoon another blood sample was taken and sent by air to Durban for analysis.

The race was run at Turffontein on the 12th December (the following day) over a mile and the colt carried 7.0. He duly won in the record time of 1 min. 40.68 sec. These performances must be compared to the findings set out in the following table:—

* "Sonning", 355 Innes Road, DURBAN.

BLOOD TESTS.

Vit. B_{12} Administered	*Date of Test.*	*Haematocrit % (or Packed Cell Volume)*	*Hb (Gm%)*	*Red Cell Count (million/ cmm)*
19th November	18th Nov.	49	18.0	10.8
22nd November	23rd Nov.	51	18.8	11.1
24th November	26 th Nov.	52	18.9	11.9
28th November 4th December	3rd Dec.	59	19.4	13.7
7th December 10 th December	10 Dec.	61	21.3	14.1

The average figures which I have obtained from race horses in various degrees of training are:—

	Haemat. %	*Hb* (gm %)
Johannesburg	47.7	17.3
Durban.	43.8	15.4

Since then I have treated 3 horses travelling to the same high altitude with similar results.

ACKNOWLEDGEMENT.

I wish to express my thanks to Dr. G. Drummond for undertaking the blood analyses.

THE USE OF TRIFLUPROMAZINE: CASE REPORTS

R. R. van der Veen*.

(*Received for publication* 22 *March*, 1961)

Trifluprom azine ("Siquil" — Squibb) is 10-(3-dimethylaminopropyl)-(2-trifluormethyl) phenothiazine hydrochloride, and is classified as a "behaviour modifier". In the author's experience this is correct, as it causes tranquillisation without narcosis with correct dosage. The drug is issued in 1c.c. ampules, each containing 20 mgm. of the active ingredient.

Some case histories entailing the use of the drug are described.

No. 1. Dog; Bull terrier. Weight ± 25 lbs.

Emaciated and extremely vicious and uncontrollable. Given 20 mgm. subcutaneously; within 30 minutes the animal was comatose and exhibited hypothermia and depression of heart and respiration rates. Uneventful and full recovery after 5 hours. Owing to inexperience with the drug this was an overdose.

No. 2. Dog; Fox Terrier. Weight ± 20 lbs.

Presented for amputation of the tail. Given 0.4cc. Trifluprom azine subcutaneously followed by local anaesthesia. Animal stood quietly throughout the operation.

No. 3. Dog; Fox Terrier. Weight ± 20 lbs.

Animal showed severe post anaesthetic excitability. Given 0.4cc. Trifluprom azine subcutaneously. Within 5 minutes excitment passed off and animal recovered quietly.

No. 4. Bitch, ridgeback. Weight ± 35 lbs.

Presented for spaying. Given 0.5cc. Trifluprom azine followed 10 minutes later by 6.5cc. "Sagatal" intravenously. Anaesthesia perfect without excitement during induction or recovery.

No. 5. Bitch, Boxer. Weight 35 lbs.

Presented for removal of fish hook in lower lip. Given 0.5cc. Trifluprom azine subcutaneously; 10 minutes later the hook was removed without resentment.

No. 6. Bitch; alsatian. Weight ± 45 lbs.

Excitable after whelping and refused to suckle litter. Given 0.7cc. Trifluprom azine subcutaneously without effect.

No. 7. Heifer; Friesland. Weight ± 180 lbs.

Presented for fractured tibia. Given 40 mg. Trifluprom azine intravenously. Animal went down and fracture set with little manifestation of pain. Animal rose after about two hours.

* 40 Burger Ave., Lyttelton, Tvl.

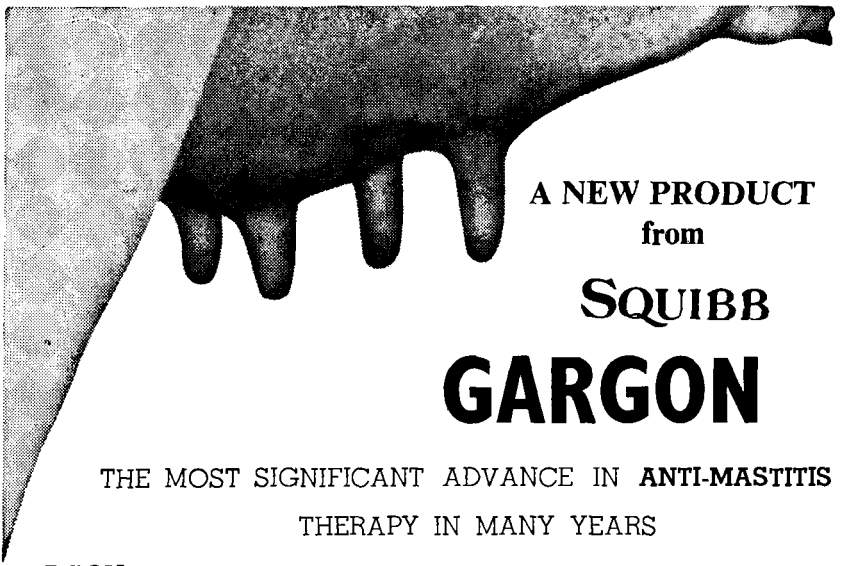
Conclusion.

The drug appears to have a definite place in veterinary practice. The dose of 0.4 to 0.7 mgm. per Kilogram live weight is appreciably less than for chlorpromazine and the effects appear to be more predictable. The safety margin is wide.

The use of Triflupromazine for preanaesthetic medication in dogs has been adopted as a routine measure. There is no appreciable reduction in dose of anaesthetic required but induction and recovery are extremely smooth and satisfactory.

ACKNOWLEDGEMENT.

Thanks are due to the firm of Squibb & Sons for supplies of the drug for clinical trials.



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Triple Sulfas									
Penicillin									
Streptomycin									
Neomycin									
Brand A BROAD SPECTRUM ANTIBIOTIC									
Brand B BROAD SPECTRUM ANTIBIOTIC									
Brand C BROAD SPECTRUM ANTIBIOTIC									
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NEW PRODUCTS

This section of the Journal was instituted for the convenience of practitioners and in co-operation with the various drug houses or their representatives and with suppliers of veterinary instruments and appliances.

The information has been compiled from press releases by the firms concerned and does not imply approval or recommendation by the Council of the S.A.V.M.A.

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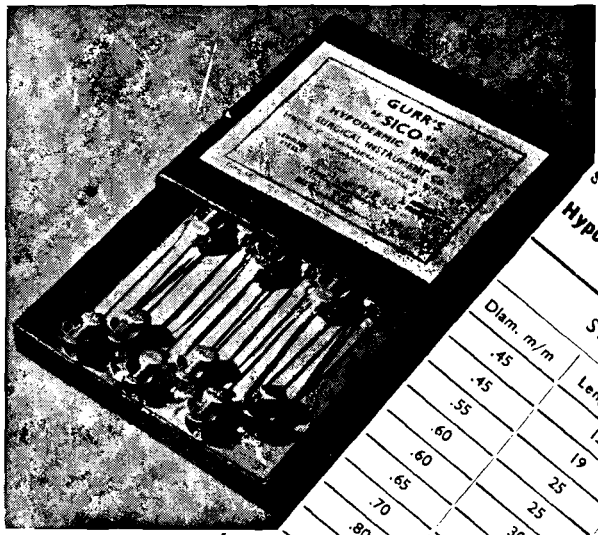

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BOOK REVIEW.

BERGE, E. & WESTHUES, M. (1961) TIERÄRTZLICHE OPERATIONSLEHRE. 28th ed. 282 Figs pp. XV—399. Verlag Paul Parey, Berlin und Hamburg, D. M. 39.60.

The 27th edition of this book was reviewed in this Journal (June 1959). Many chapters have been amended and enlarged and new chapters have been added. Intramedullary pinning, operations on the intervertebral discs, treatment of prostate abscesses and teat amputation in the cow are fully described.

In the latter group tranquillizers, paravertebral anaesthesia, percutaneous osteosynthesis and the operative treatment of dislocation of the patella and the tearing of the crucial ligaments may be cited.

This book is certainly one of the leading works of its kind today and has been translated into Spanish and Italian. It is recommended to every veterinarian who is interested in surgery.

C.F.B.H.

WAMBERG, K. (1960). HANDLEXIKON FÜR TIERÄRTZLICHTEN PRAXIS, VOLS. I & II.

Numerous illustrations, more than 1,000 pages. Medical Book Company, Copenhagen. Price not stated.

These two volumes are devoted to the whole field of clinical practice—surgical, medical and genesiological, as well as diseases of poultry, and fees. All subjects are arranged alphabetically. As the volumes are of the loose-leaf type and most subjects are dealt with on separate pages, it is possible to insert amended pages in the place of those outdated. The numbering of the pages is arranged so as to accommodate new pages, as letters of the alphabet are placed behind the numeral in case of new insertions. For instance, the pages inserted after page 804 are numbered 804a, 804b, etc. up to the end of the subject under discussion. Numerous authors have contributed to these volumes with the result that they are authoritative, comprehensive and up-to-date. The style is very compact, almost telegram form. This novel contribution to veterinary literature is to be welcomed and should command a great deal of support from veterinarians.

C.F.B.H.

VERSLAG VAN UITBREKINGS VAN GEPROKLAMEERDE VEE-SIEKTES.

REPORT OF OUTBREAKS OF NOTIFIABLE STOCK DISEASES

JANUARIE—MAART 1961.
JANUARY—MARCH 1961.

SIEKTE DISEASE	DISTRIK DISTRICT	GETAL UITBREKE. NO. OF OUTBREAKS
BEK- EN KLOUSEER FOOT & MOUTH DISEASE	Barberton T.	2
	Potgietersrus T.	3
	Waterberg T.	7
GONDERIOSE/GONDERIOSIS MILDE BEES (TZANEEN) (BENIGN BOVINE)	Umzumkulu K.	2
	Dundee N.	2
	Nelspruit	9
	Carolina T.	1
	Piet Retief T.	6
	Mt. Frere K.	1
	Kentani K.	1
	Umlazi N.	2
	Mtunzini N.	1
	Bergville N.	1
	Nongoma N.	1
	Hlabisa N.	1
	Port Shepstone N.	2
	Umzinto N.	6
	Umtata K.	1
	Nqutu N.	2
	Utrecht N.	1
	Nkandhla N.	2
	Carolina T.	2
	Lower Umfolozi N.	5
	Entonjaneni N.	1
	Lower Tugela N.	1
	New Hanover N.	5
	Umvoti N.	3
	Ixopo N.	1
	Ermelo T.	1
	Msinga N.	4
	Mapumulo N.	1
	Tabankulu K.	1
	Elliotdale K.	1
GONDERIOSE/GONDERIOSIS KWAADAARDIG BEES (Malignant bovine)	Sibasa T.	4
	Hlabisa N.	3
	Hlabisa.	8
KWAADAARDIG BUFFEL. (MALIGNANT SYNCERINE)	Mkuze	1
HONDSDOLHEID RABIES	Winburg O.	1 (Meerkat
	Kuruman K.	3 (Muskeljaat kat, Meerkat)
	Boshof O.	2 bees 1 meerkat
	Bultfontein O.	1 bees.
	Sibasa T.	1 Hond
	Hoopstad O.	1 Meerkat
	Kimberley K.	1 Meerkat
	Letaba T.	1 Kat
	Schweizer Reneke T.	3 (bees & Meerkat)
	Fort Beaufort K.	1 Kat

Siekte Disease	Distrik District	Getal Uitbreke No. of outbreaks
Hoendertifus Fowl typhoid	Albany K.	1
	KingWilliams Town K.	1
	Cradock K.	1
	Delareyville T.	1
Johne se Siekte Johnes Disease	Cradock K.	1
	Bedford K.	1
Knopvelsiekte Lumpy Skin Disease	Dundee N.	2
	Kroonstad O.	1
	Hoopstad O.	1
	Port Shepstone N.	1
	Carolina T.	1
	Riversdal K.	1
	Eshowe N.	6
	Marico T	2
	Pinetown N.	4
	Johannesburg T.	1
	Potchefstroom T.	2
	Mtunzini N.	1
	Ermelo T.	1
	BarkleyWest K.	1
	Inanda N.	1
	Christiana K.	1
	Schweizer Reneke T.	2
	Bloemhof O.	1
	Piet Retief T.	2
	Kimberley K.	1
	Umvoti N.	2
	Leydenburg T.	2
	Heidelberg T.	1
	ThabaNchu	1
	Vryheid	1
Miltsiekte Antrhrax	Mahlabatini N.	9
	Ventersburg O.	3
	Amersfoort T.	1
	Potchefstroom T.	2
	Klerksdorp T.	2
	Mafeking K.	1
	Stutterheim K.	1
	Utrecht N.	3
	Lindley O.	1
	Winburg O.	2
	Zastron O.	1
	Malmesbury K.	1
	Ermelo T.	1
	Rustenburg T.	1
	Babanango N.	1
	Boshof O.	3
	Odendaalsrus O.	2
	Brandfort O.	2
	Delareyville T.	1 Skaap
	Taungs K.	1
	Port Shepstone N.	1
	Bergville N.	2
	Koppies O.	1
	Vryburg K.	1
	Johannesburg T.	1
	Pretoria T.	1
Slapsiekte Dourine Skurfte Mange	Barkly Wes.	1
	Middeldrift K.	2 (bok)
	Umtata K.	1 (Perd)
	Ingwavuma N.	2 (bok)

Warmbad T.	1 Hoender
George K.	2 (Bees)
Potchefstroom T.	1 (Hoender)
Tulbagh K.	1 (Bees)
Piketberg K.	3 bees
Winburg O.	1 Bees
Middelberg K.	2 bees
Worcester K.	1 bees
Bellville K.	1 bees
Malmesbury K.	1 bees
Klerksdorp T.	1 bees
Krugersdorp T.	1 bees
Dewetsdorp O.	1 hoender
Stellenbosch K.	1 bees
Durbanville K.	1 bees
Vryheid N	1 bees
Ventersburg T.	1 bees

THE SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION

CONGRESS PAPERS

To be read before

THE FIFTY-SIXTH ANNUAL CONGRESS

SEPTEMBER 25th — 28th, 1961

DURBAN

KONGRESREFERATE

Gelewer te word voor

DIE SES-EN-VYFTIGSTE JAARKONGRES

25 — 28 SEPTEMBER 1961

DIE SUID-AFRIKAANSE VETERINÊR-MEDIESE VERENIGING

In this issue appear all the papers to be read before the fifty-sixth Annual Congress, except the paper by H. H. Kleeberg on "The Tuberculin Test in Cattle", which appeared in this Journal, Vol. XXXI, No. 2, pp. 213–215.

PROGRAMME

MONDAY, SEPTEMBER 25TH, 1961

8.00 a.m.	Registration.	
9.00 a.m.	Convocation of Meeting.	
9.05 a.m.	WELCOME TO GUESTS, DELEGATES AND MEMBERS ATTENDING CONGRESS BY HIS WORSHIP THE MAYOR OF DURBAN.	
9.10 a.m.	OFFICIAL OPENING OF CONGRESS BY HIS HONOUR THE ADMINISTRATOR OF NATAL.	
	REPLY ON BEHALF OF THE ASSOCIATION BY THE CHAIRMAN, NATAL BRANCH.	
10.00 a.m.	THE PRESIDENTIAL ADDRESS.	
11.00 a.m.	"Systemic Mycotic Diseases".....	J. D. Smit.
11.45 a.m.	"A Disease of Calves resembling Sporadic Bovine Encephalo-myelitis"	R. C. Tustin. John Maré. A. van Heerden.
12.30 p.m.	Slide projection: "Foot and Mouth Disease"	M. C. Lambrechts.
2.00 p.m.	Symposium: "THE USE OF MILKING MACHINES".	
	(i) "The Management of the Dairy Cow on a Physiological Basis"	I. S. McFarlane. R. Clark.
	(ii) "Mechanical Milking and Types of Milking Plant"	I. S. McFarlane.
	(iii) "The Hygiene and Care of Milking Machines"	L. W. van den Heever.
3.30 p.m.	GROUP MEETINGS.	
	(i) Public Health Group.	
	(ii) Animal Production Group.	
	(iii) Any other Branches desirous of meeting.	

TUESDAY, SEPTEMBER 26TH, 1961

8.00 a.m.	Registration.	
8.30 a.m.	Opening of the Trade Exhibits by the Vice-President and visits by Members to the Exhibition Stands.	
9.15 a.m.	Symposium: "HELMINTH RESEARCH IN SOUTH AFRICA".	
	(i) "Seasonal Incidence of Nematode Parasites in Cattle in the Natal Coastal Area"	W. B. Hobbs.
	(ii) "Seasonal Incidence of Nematode Parasites of Small Stock in the Grahamstown Area"	L. W. Rossiter.
	(iii) "The Diagnosis of Nematode Parasites in Ruminants for Worm Survey Purposes"	R. K. Reinecke.
	Film: "Faeces examination for worm infestation in Ruminants" (compiled by R. K. Reinecke and I. G. Horak)	

	(iv) "Field Trials on Thiabendazole (M.K. 360) as an Anthelmintic for Sheep; with a note on the Assessment of Diagnostic Methods"	G. L. Muller.
	(v) "Echinococcus in South Africa"	Anna Verster.
	Film: "Coenurus Cerebralis in Sheep" (compiled by Anna Verster, R. Tustin and K. van der Walt).	
12.30 p.m.	"Enzootic Pneumonia of Calves in South Africa"	S. J. van Rensburg. R. Every.
2.00 p.m.	"The Tuberculin Test in Cattle"	H. H. Kleeberg.
3.00 p.m.	"The isolation of Viruses associated with Infertility in Cattle: A preliminary Report"	J. Maré. S. J. van Rensburg.
3.30 p.m.	"Investigation into the Causes of Abortion in Angora Goats in South Africa"	K. M. van Heerden.

WEDNESDAY, SEPTEMBER 27TH, 1961

8.00 a.m.	Fifty-Sixth Annual General Meeting.	
2.00 p.m.	Informal visits by members to exhibition stands.	
2.30 p.m.	"The Chemotherapy of Nematode Parasites of Sheep and Cattle"	W. T. Harrow.
3.15 p.m.	"Investigation into and the Development of Hexachlorophene as an Anthelmintic"	C. J. Bosman. P. W. Thorold. H. S. Purchase.

THURSDAY, SEPTEMBER 28TH, 1961

8.00 a.m.	Simposium: "TRANSPORTATION OF ANIMALS BY RAIL."	
	(i) "The Behaviour of Cattle during Transportation by Rail"	J. H. R. Bisschop.
	(ii) "Transport of Animals by Rail"	G. D. Sutton.
	(iii) "Animal Transport and Meat Inspection"	L. W. v.d. Heever.
	(iv) "Diseases of Ruminants in Transit"	K. van der Walt.
9.30 a.m.	"Cobalt in Relation to Ruminant Nutrition in South Africa" Film: "Phalaris Staggers."	C. C. Wessels.
11.00 a.m.	"Respiratory Diseases of Fowls"	L. Abrams.
12.30 p.m.	Adjournment.	

SYSTEMIC MYCOTIC DISEASES

J. D. Smit*

Mycotic infections are usually associated with skin diseases. This is to be expected, because some of the best known fungus infections cause skin lesions, e.g. ring worm. Fungi are usually soil contaminants and the skin is therefore more readily exposed to infection. Without trying to minimize the importance of these skin diseases, the most serious, often fatal, and therefore the most important group of fungi is that responsible for systemic diseases.

They are conveniently classified as infectious granulomas, because these diseases are characterized by the formation of epithelioid granulomatous tissue. The diagnosis of these infections is usually difficult, as it is not always possible to demonstrate the causal organism without special techniques. Up to the present only a few of the known important mycotic diseases have been diagnosed in South Africa. These include nocardiosis, aspergillosis, mucormycosis and histoplasmosis. Some of the other diseases from this group may not occur in the country but I would not be surprised if we have missed some of them through a lack of knowledge or experience.

To familiarize you with the most important infections caused by fungi, I will attempt to give a very brief description of each.

COCCIDIOIDOMYCOSIS

Coccidioidomycosis has been recognized as a human disease since 1892. It is most prevalent in the arid regions of Southwestern United States, but its distribution is generally world wide. In man, the disease may occur as an acute, febrile, upper respiratory infection with a short, favourable course or as a progressive intractable disease with disseminated lesions and fatal outcome. In animals, the disease usually assumes the chronic progressive form. The causal organism *Coccidioides immitis* occurs in the soil and inhalation of spores will initiate the disease in either man or animals. Direct transmission from one animal to another apparently does not occur. In cultures the organism produces aerial mycelia which form a small, fluffy, white, spherical colony. In tissues, however, mycelial structures are not observed, the fungus taking the form of spherules 5–50 microns in diameter, with double contoured walls. Endospores may be found in the larger spherules. The gross lesions appear as discrete or confluent granulomas, with or without suppuration or calcification. In the disseminated form of the disease, as in the dog, greyish nodules of various sizes may be found in the lungs, lymph nodes, liver, spleen, meninges, bone marrow, and other organs. The microscopic

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appearance is characteristic. The largest spherules, often filled by endospores, are usually surrounded by a wide zone of epithelioid cells, and mixed with a few neutrophiles, some lymphocytes and Langhans' giant cells. The diagnosis is based on the characteristic cell reaction and the demonstration of the organisms. The Gridley fungus stain is the most reliable stain for the demonstration of the organisms.

Cryptococcosis

Cryptococcosis has been diagnosed in many animal species and is well known in man. *Cryptococcus neoformans* is a yeast-like fungus found in soil, manure and dust. Direct transmission from animal to animal has not been demonstrated. The manifestations of cryptococcosis depend upon the organs or systems involved. Therefore no clinical syndrome can be described. In cats, nasal obstructions resembling neoplasms have been associated with pulmonary infection and subsequently the meninges have been involved. Otitis media with a spread to the meninges is another common feature of the disease, especially in dogs. The gross lesions are not diagnostic. They appear as granulomatous nodules. Affected lymph nodes are enlarged and usually show a severe oedema. The involved meninges are thickened and oedematous. The diagnosis is based on the presence of ovoid or spherical, thick-walled, yeast-like bodies, which occasionally show single budding and are surrounded by a wide, gelatinous capsule. The cell inside the capsule is usually 5 to 20 microns in diameter, the capsule increases the overall diameter to a maximum of 30 microns. In sections stained with haematoxylin and eosin, the cell wall and sometimes its contents are visible, but the capsule remains unstained. The best stain to demonstrate the capsule is the periodic acid-schiff (PAS) method.

Blastomycosis

Blastomycosis is a serious disease described primarily in the Missouri Valley of the United States. The incidence and the distribution of the disease are not accurately known. In animals, principally dogs, the pulmonary form of the disease is observed more commonly. Fatal dissemination may follow. In the lungs of affected dogs, circumscribed grey nodules of solidification may be seen in some cases, and diffuse consolidation of the lung, with the cut surfaces yielding purulent exudate, in others. The histological picture is characterized by intensive infiltration by reticuloendothelial cells in which foci of neutrophiles and diffusely distributed lymphocytes may be found. Caseation and necrosis may occur; there is little tendency towards encapsulation. Giant cells of the foreign body type may be present. The causative organisms are found in the lesions, free or in macrophages, as spherical, yeast-like cells, 8 to 20 microns in diameter, with double contoured walls. The organisms usually appear as a central mass surrounded by a refractile, double-contoured, unstained zone which is bounded by a thin outer wall. Budding may occasionally be seen. Gridley fungus stain and P.A.S. are suitable stains for the demonstration and diagnosis of the organisms.

Histoplasmosis

Another, often fatal mycotic disease in man and animals is histoplasmosis.

It has been reported from many parts of the world. *Histoplasma capsulatum* is a mould which bears spores of two types: spherical, minutely spiny microconidia, 3 to 4 microns in diameter, and spherical, or rarely clavate, macroconidia, 8 to 12 microns in diameter. The parasitic phase in the mammalian host develops from either of these conidia into a yeast-like form. The disease may either assume a benign form, which usually remains unrecognized, or it may assume a fatal, disseminated form, especially in dogs. It usually runs a prolonged course with progressive loss of weight, lymphadenopathy, diarrhoea, weakness, anaemia, hepatomegaly and ascites. The diagnosis is seldom made in the living animal. The dominant feature of the tissue changes is the extensive proliferation of reticulo-endothelial cells, many of which contain yeast forms of histoplasma, either a few, or so many that the cytoplasm is distended and tremendously enlarged. In the dog the benign form may show only a few discrete, well-encapsulated nodules of epithelioid cells, some of which may contain organisms. The yeast-like bodies, which are always located in the cytoplasm, are irregularly egg-shaped and measure from 2 to 4 microns. In sections stained with haematoxylin and eosin, a central, spherical, usually basophilic body is surrounded by an unstained zone, which, in turn, is encircled by a thin cell wall. The wall can be stained selectively with the PAS or Gridley fungus method. These stains are particularly useful in recognizing only a few organisms and to differentiate them from other phagocytosed particles, especially tissue debris. The lymph nodes in the disseminated form of the disease are tremendously enlarged and grossly resemble those of malignant lymphoma. The iliocaecal junction of the gut and the adjacent lymph nodes are often severely affected, especially in cats, and this may lead to obstruction of the gut.

Nocardiosis

Nocardia is an aerobic, Gram positive, filamentous organism, which under some conditions has acid-fast staining properties. The disease occurs in man and animals, particularly in dogs and cats. In dogs, infection of the lungs and pleura is most common, although generalization may occur or it may localize itself in various other systems. The lesions are seen microscopically as tangled, indistinct colonies of organisms surrounded by necrotic cellular debris, purulent exudate and granulation tissue. The colonies are not surrounded by radiating clubs. The organism could be confused with actinomycosis and actinobacillosis. It occurs in most species of domesticated animals and has a world-wide distribution.

Aspergillosis

Infection with *Aspergillus*, particularly *A. fumigatus*, is most prevalent in birds but may occur in mammals. The bovine seems to be most commonly affected. The organisms are extremely common in nature, occurring on foodstuffs and plants as a white, fluffy mould. In birds, the lungs are

most often affected. This has also been our experience in cattle. In man, the external ears are more frequently involved. The lesions usually consists of a nodular consolidation with a marked reaction zone surrounding it. The nodular lesion consists of a central core of caseation and necrosis, in which the organisms are found, surrounded by a wide zone of epithelioid granulation tissue. The organisms in these granulomas appear as short, slender, septate, branching filaments, 3 or 4 microns wide and about 8 microns long. The Gridley fungus stain shows them up to the best advantage.

Haplomycosis

Haplosporangium parvum is another fungus that may affect our domesticated animals but it usually does not produce a progressive disease. The lesions are usually limited to the lungs, which suggests inhalation of the organisms. They are large, spherical structures, up to 270 microns in diameter and have thick double-contoured walls.

Mucormycosis

Mucormycosis is one of the less frequent forms of granulomas. The lesions are rather non-specific, but ulcers with raised edges are a frequent manifestation of the disease. The stomach and various other portions of the gut may be involved. Ruminants are most often affected but cases have also been described in dogs. The organism appears in giant cells or necrotic zones as irregular, coarse hyphae, which are often branched but rarely septate.

This is a brief summary of the salient features of the most important pathogenic fungi occurring in our domesticated animals. The talk will be illustrated further by case reports and colour slides demonstrating the main histopathological features of the diseases as well as the appearance of the organisms reponsible.

ACKNOWLEDGEMENT

The author wishes to make use of the opportunity to acknowledge his indebtedness to Angell Memorial Hospital, Boston, for most of the material used in the preparation of the slides and in particular to Dr. T. Carl Jones for his help and all the information obtained from him either from protocols of cases or from his book "Veterinary Pathology." The Director of Veterinary Services in thanked for permission to publish this paper.

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A DISEASE OF CALVES RESEMBLING SPORADIC BOVINE ENCEPHALOMYELITIS

R. C. Tustin,* John Maré** and A. van Heerden.***

INTRODUCTION

Sporadic bovine encephalomyelitis (S.B.E.) is an acute infectious disease of cattle caused by a virus of the psittacosis lymphogranuloma venereum group of viruses. It is characterized by a sudden onset with fever, anorexia, listlessness, nasal discharge, cough, excessive salivation, occasionally diarrhoea and nervous symptoms, viz. depression, a progressive paralysis and in some cases opisthotonus and blindness. The mesenchymal tissues, particularly endothelial and serous lining membranes, show the greatest pathological changes[1]. These are manifested in the majority of fatal cases by the development of a serofibrinous peritonitis, pleuritis, pericarditis and a non-purulent meningo-encephalomyelitis. Calves under the age of six months are more susceptible than adult cattle[2]. It usually occurs enzootically in affected herds. The natural mode of transmission is not known.

The disease was first recognized to be a specific entity by McNutt[3] in 1940, when he described four outbreaks in Iowa, U.S.A. It has subsequently been reported from eleven states of the mid-western and western regions of the United States of America[4], and a similar, if not identical, disease has been described in Japan[5]. It has been suggested that the disease is probably more widespread in the U.S.A. than is realized.[4]

Sporadic bovine encephalomyelitis, or a similar disease, was suspected to be present in South Africa for some months before suitable material could be obtained for transmission experiments. The opportunity arose when one of us (A. v. H.) investigated an outbreak of a disease in calves. Material for histopathological examination revealed the presence of a lymphocytic meningo-encephalitis. A sick calf was subsequently donated by the owner to Onderstepoort Laboratory for examination.

HISTORY OF THE OUTBREAK

A farmer in the Christiana district of the Western Transvaal purchased twelve pregnant heifers in May, 1960, from another farmer in the Schweizer-Reneke district. They were allowed to mingle with other cattle on his farm, and eventually calved. The first case of the disease occurred, according to the farmer, during October, 1960. Thereafter, new cases developed at approximately eight day intervals. The disease was at first considered by the farmer to be some hereditary defect, as the heifers

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had been covered by their own sire. The first specimens received, originated from the eighth case, which was the first to receive veterinary attention; the ninth case was submitted to Onderstepoort Laboratory while still alive, and was slaughtered soon after arrival.

Of the first nine cases, three were calves born of cows that were originally on the farm; the rest of the calves was the progeny of the newly introduced heifers. The first case occurred in a calf of one of the heifers that had been purchased.

Neither the seller nor the purchaser had previously encountered the disease in their herds.

Symptomatology observed in natural cases

Listlessness, mild lachrymation and a mucopurulent nasal discharge were the first symptoms seen in sick calves. After approximately three days, a paresis of the hindquarters developed, the animals walking with a swaying gait. The paresis progressed until they were unable to stand. During the first few days the sick calves ate and drank, but subsequently were unable to do so as they appeared to suffer from trismus. The nasal discharge interfered with respiration. When they had developed complete paralysis, most of the sick calves were slaughtered by the owner on humanitarian grounds. One six months old calf (the tenth case) recovered completely, except for a mild kyphosis, a slight stiffness of the hindlimbs and enlarged prescapular lymph nodes.

The possibility exists that the disease occurred in two adult cows in a very mild form. One developed a severe stiffness of the forelimbs during October and November, but continued to milk well and did not go off her feed. A stiff gait and scoliosis, not present previously according to the owner's assurances, were still in evidence some months later. The other cow, whose calf developed the disease, showed a slightly swaying gait of the hindlimbs, with incomplete flexion of the joints when walking.

The animal submitted for examination—a four months old Jersey calf—showed a mild ataxia, and appeared dull and depressed, but continued to eat. On the second day after arrival, it went down and was unable to rise when prodded. The temperature was within normal limits. The animal was slaughtered and autopsied, and material was collected for experimental purposes.

Pathology

Two calves were autopsied (the eighth and ninth cases).

1. *Macroscopic Pathology*

Except for a hyperaemia of the nasal mucous membranes, no abnormal changes were observed in one of the cases. The other showed a fibrinous peritonitis, especially of the peritoneum covering the spleen, omentum and diaphragm. Hyperaemia of the entire length of the small intestine, and of the brain, was present.

2. *Microscopic Pathology*

The brain of one calf, and the brain and various organs of the other, were examined microscopically. The brain lesions of both were similar.

The following histopathological changes were observed:

Brain: A lymphocytic meningo-encephalitis was present. The meningitis was manifested by a congestion and severe infiltration of mononuclear leucocytes and a few neutrophils into the pia-arachnoid membranes.

Oedema and a marked lymphocytic cell cuffing of the congested blood vessels were present in all regions of the brain. Rare petechial haemorrhages and small areas of colliquative necrosis of the brain substance had occurred in some regions. Small foci of microglial cell proliferation were scattered throughout the brain.

The spinal cord was not examined.

Spleen: A perisplenitis was observed, which was manifested by hyperaemia and lymphocytic cell infiltration in the sub-peritoneal zone of the capsule. An exudate containing fibrin and a few mononuclear leucocytes—some of which showed necrosis—was adherent to the peritoneum.

Liver: A mild round cell infiltration into some portal tracts, and a mild congestion and lymphocytic cell infiltration in the capsule of the liver were present.

Omentum: The omentum was hyperaemic and infiltrated with mononuclear leucocytes. Attached to the peritoneum was an exudate consisting of fibrin and a relatively large number of round cells and a small number of neutrophils. Some of these cells showed necrotic changes.

Smears: Impression smears of the exudate showed a small number of free elementary bodies.

Experimental Work

1. *Guinea Pig Inoculation*

One ml. of a 10% suspension in saline of pooled spleen, brain and peritoneal exudate from the Jersey calf was injected intraperitoneally into each of two guinea pigs. One of these showed a febrile response (104°F) on the sixth day after inoculation, reaching a maximum of 104.8°F the following day. It was slaughtered on the ninth day after inoculation, its temperature still being 104°F. Post mortem examination revealed a mild fibrinous peritonitis, pronounced ascites, and patchy consolidation of the lungs. Specimens of liver, spleen and heart were taken for further guinea pig inoculation. Liver surface impression smears were made, and stained with Giemsa and with Machiavello's staining technique. No bacteria were observed, but a large number of free elementary bodies was present in the exudate.

Intraperitoneal inoculation of guinea pigs with an organ suspension from the above case, resulted in a very marked febrile response, reaching a maximum of 106.8°F. on the sixth day after inoculation. These guinea pigs were sacrificed; autopsy once more revealed a fibrinous peritonitis and ascites. In smears large numbers of free elementary bodies were present. Liver, spleen and heart were taken for further guinea pig passage, as also for egg inoculation.

2. *Egg Inoculation*

A suspension of infected guinea pig tissues was inoculated into the yolk sac of seven-day-old embryonated hens' eggs. Each egg received 0.2 ml. of a 10% organ suspension containing 200 units of streptomycin per ml. After three serial passages in eggs, 100% mortality was observed, embryo deaths occurring between the third and seventh days. Impression smears, prepared from washed yolk sacs, revealed the presence of intracytoplasmic and free-lying elementary bodies. To date nine serial yolk sac passages in eggs have been performed, using infected yolk as the inoculum. Titration of yolk from the eighth serial egg passage gave a titre of $10^{-4 \cdot 8}$

3. *The Experimental Disease in a Calf*

One experimental case has been produced. A six months old calf was inoculated subcutaneously with 1 ml. of a 1:10 dilution of infected yolk from the ninth serial egg passage.

(*a*) *Symptoms:* On the tenth day after inoculation the animal looked listless, and on the following day marked ataxia was observed. During the next seven days the calf became progressively weaker, and seemed to have some difficulty in getting to its food. Marked stiffness, first of the hock joints and later the knees, was observed. The animal appeared very depressed; its sight became impaired, and when examined on the seventeenth day after inoculation, it appeared to be blind. At this stage the animal was unable to walk, and was seen to stand pushing against the wall. It died the following day. The maximum temperature recorded was 102.8°F. on the seventh and eleventh days.

(*b*) *Pathology.* The following pathological changes were observed in this calf:

(i) *Macroscopic Pathology*

General: The calf was in a debilitated condition, and showed a serous infiltration in the intermuscular septa, especially of the larger muscle groups.

Abdominal Cavity: An ascites consisting of approximately 20 ml. of clear straw-coloured fluid was present. The peritoneum had a roughened appearance in many parts. A fibrinous exudate, which could be removed by scraping and consisted in parts of thick yellow caseous material, was adherent to the peritoneum. This was particularly apparent over the rumen, omentum, diaphragm and urinary bladder and its lateral ligaments. The peritoneum covering the liver, spleen and fatty capsule of the kidney also showed a similar fibrinous exudate with varying amounts of adherent caseous material.

Lymph Nodes: Generalized enlargement of lymph nodes, some of them congested, was present. Many lymph nodes which are not usually

very apparent, for example, the ruminal, omasal, cervical and smaller mesenteric nodes situated adjacent to the large and small intestines, were prominent.

Pericardium and Epicardium: The pericardium was thickened and hyperaemic, and had to be peeled from the heart, leaving roughened surfaces with short strands of fibrin attached. Small pieces of yellow caseous exudate were adherent to both the pericardium and epicardium.

Articulations: Both hock joints and the right stifle joint appeared to contain more synovial fluid than is normally encountered.

Nervous System: The pia mater of the brain showed congestion. Cross sections of the spinal cord, especially in the thoracic region, revealed the grey matter to be softer than normal and surrounded by a hyperaemic zone.

(ii) *Microscopic Pathology*

Peritoneum and Pericardium: The inflammatory reaction of the peritoneum and pericardium consisted of hyperaemia and a fibrinous exudate containing few mononuclear leucocytes, some of which showed necrotic changes. The microscopic appearance of the caseous exudate was similar, except that more cells were present.

Kidney: Cloudy swelling and pigment granules were present in some epithelial cells of the ascending and descending loops of Henle.

Urinary Bladder: Beneath the peritoneal surface, hyperaemia, a fibrinous exudate and a severe infiltration of mononuclear leucocytes, some showing necrosis, were present.

Adrenal: On examination of the adrenal, hyperaemia and the presence of single or multiple round acidophilic intracytoplasmic inclusions in some medullary cells were observed. The inclusions varied in size from approximately half that of an erythrocyte to larger than the cell nucleus. They are not regarded as being specific, as they have been noticed in other diseases.

Liver: The liver was congested and showed a mild leucostasis with a very mild round cell infiltration into some portal tracts. One small focus of coagulative necrosis of liver cells was noticed. In the subperitoneal layer of the capsule of the liver, a mild, focal infiltration of lymphocytes occurred. The hepatic peritoneum showed the typical fibrinous exudate.

Lymph Nodes: A reactive hyperplasia was noticed in the majority of lymph nodes examined.

Brain: The lesions in the cerebrum, cerebellum, hippocampus, thalamus, midbrain and medulla resembled those seen in the natural cases.

Spinal Cord: The spinal cord showed a meningo-myelitis similar to the inflammatory reaction seen in the brain. The meningitis, however, was not prominent. A small number of neurones revealed varying degrees of necrosis. The inflammatory process extended from the cervical to the lumbar region.

Lung: A pulmonary congestion was present.

Heart: A leucocytic cell infiltration, consisting of approximately a 70:30 ratio of lymphocytes to neutrophils, was present in the sub-epicardial layer. A typical fibrinous exudate was attached to the epicardium. Mild, focal, degenerative changes were seen in some muscle fibres. A small number of cocci and bacilli was present in the pericardial exudate. These are regarded as secondary invaders.

Smears: Impression smears prepared from exudate on the surface of the abdominal organs revealed the presence of numberous free-lying elementary bodies.

No specific abnormal changes were observed in the thyroid, pituitary gland, pancreas, dura mater, intestine and synovial membranes of the right and left hock joints and the right stifle joint.

4. *Re-isolation of the Causal Organism*

From liver and spleen taken from the calf at autopsy, the agent was re-isolated by the intra-peritoneal inoculation of guinea pigs.

Discussion

While it has not, as yet, been proved that the condition described here is sporadic bovine encephalomyelitis, there appears to be a remarkable similarity between the two diseases. The pathological picture and symptoms seen were identical to those described for sporadic bovine encephalomyelitis by Menges *et al.*[2] in both the natural and experimental cases. The agent isolated is morphologically and tinctorially indistinguishable from the viruses of the psittacosis lymphogranuloma venereum group. In its behaviour in guinea pigs and embryonated hens' eggs this virus closely resembles the S.B.E. virus.

The serological relationship between the virus isolated and the S.B.E. virus has yet to be investigated.

Menges *et al.*[4] state that in the U.S.A. sporadic bovine encephalomyelitis has undoubtedly a greater prevalence than is generally recognized. That this will also hold true for the disease under discussion here, there is very little doubt. In recent years a non-purulent encephalitis in cattle has been encountered at infrequent intervals during routine histopathological examination of material received for the diagnosis of rabies, and which subsequently proved to be both biologically and histologically negative for that disease. The similarity in the symptomatology of the disease under discussion, and of rabies and three day stiff-sickness in cattle, could be the reason why the disease has not previously been recognized as a distinct entity.

Summary

1. An outbreak of a disease in calves not previously diagnosed in South Africa, and closely resembling sporadic bovine encephalomyelitis, is described.

2. The main symptoms and lesions manifested were: mucopurulent nasal discharge; lachrymation; progressive paralysis; a fibrinous peritonitis, pleuritis and pericarditis; and a non-purulent meningo-encephalomyelitis.

3. The causative organism was isolated and propagated in guinea pigs and embryonated hens' eggs. Impression smears of exudates revealed the presence of elementary bodies indistinguishable from those of the psittacosis lymphogranuloma venereum groups of viruses.

4. The disease was reproduced in a calf by the subcutaneous inoculation of a 1:10 dilution of yolk from the ninth serial egg passage.

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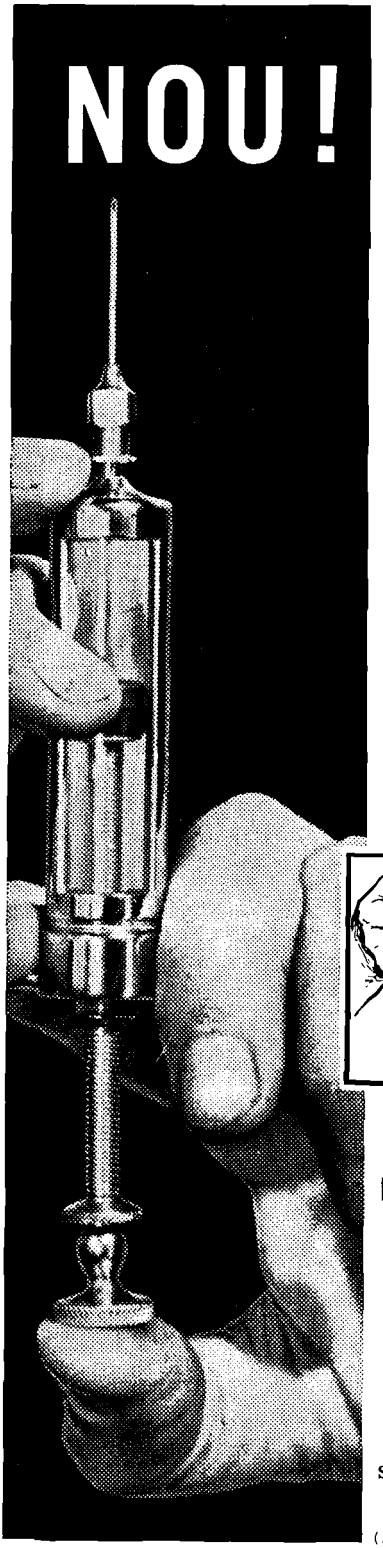

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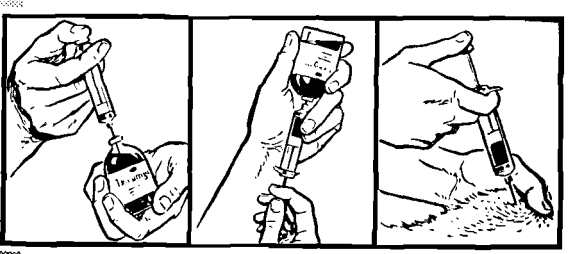

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THE USE OF MILKING MACHINES

I. THE MANAGEMENT OF THE DAIRY COW ON A PHYSIOLOGICAL BASIS

I. S. McFarlane* and R. Clark**

Introduction

The modern dairy cow can only achieve her full genetic potential production if all her body systems are functioning to maximum efficiency. Although obvious, the dependence of mammary function on general body function is not always fully realized. For instance, it has been calculated that from 150 to 200 volumes of blood must pass through the udder for every unit of milk secreted. In a cow producing only four gallons of milk per 24 hours this means a mammary blood flow of up to 800 gallons per 24 hours. At the same time the metabolic rate may be doubled due to lactation. The daily losses in a four gallon cow are approximately as follows:—protein, 700 gm.; fat, 700 gm.; sugar, 1,000 gm.; Ca, 25 gm.; P, 20 gm. and NaCl, 100 gm. The calorific value of the milk itself, apart from energy required for production, is 13,000 K.cal. Even under optimal nutritional conditions such outputs are only possible when all the organ systems of the body are acting at full capacity and in perfect correlation. This demands optimal development of the total genetic potential from birth to the end of productive life. This can only occur under optimal environmental conditions, both physical and psychological. The object of this paper is to stress the importance of good management and stockmanship in obtaining maximum production from a dairy herd. The obviously essential aspects of nutrition, hygiene and specific prophylaxis against disease will not be dealt with, but emphasis will be laid on the often less well appreciated importance of the relationship between milker and milked and the creation of an environment which will ensure the full co-operation of the cow by making the best use of natural and acquired reflexes. Just as the scientific advance of medicine has resulted in a decline in the valuable human relationship between doctor and patient, so has the advent of balanced rations, machine milking and the general commercialisation of the dairy industry tended to overshadow the importance of "stockmanship." The modern dairy cow has been described, and often approached, as a "milk manufacturing machine." This is nonsense. She is a highly specialized and sensitive animal with a highly developed capacity of responding to her environment.

As all good stockmanship must be based on a sound knowledge of the physiology, and psychology, of the animal, a short survey of our present knowledge of the physiology of the mammary gland will now be given.

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Part I

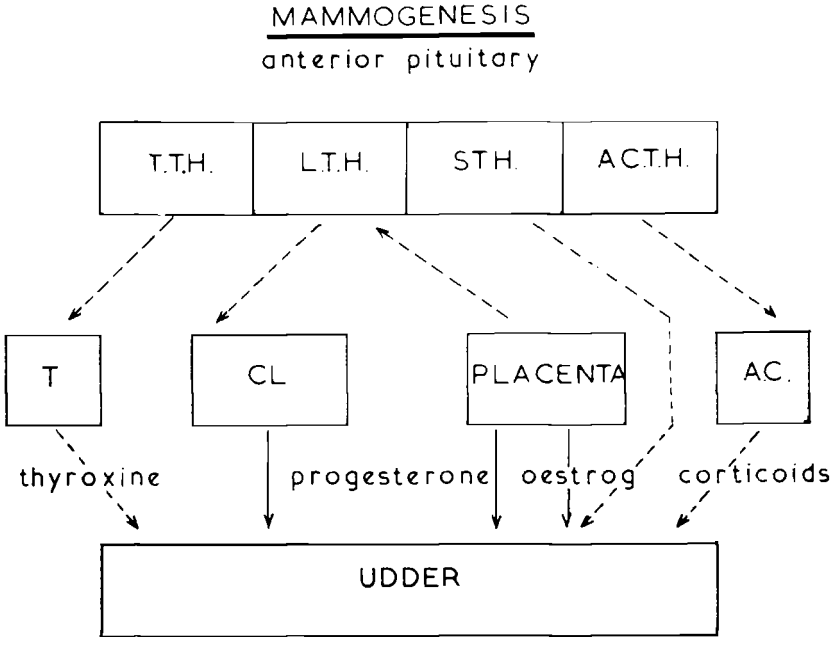
The Physiology of the Mammary Gland

R. Clark

(i) *Mammogenesis*

The specific development of the mammae is dependent on the presence of a series of hormones, finely balanced both as regards proportions and sequence. In the spayed heifer functional development can be produced by oestrogens alone, but the glands are abnormal and production usually low. Optimal development takes place in the presence of oestrogen and progesterone in the proportions of approximately 1: 1,000. Other hormones, however, are essential. These are somatotrophin and prolactin (= luteotrophin) from the anterior pituitary as well as thyroxin and adrenocorticoids. The action of the former two hormones is probably direct, while that of the latter two is probably indirect through their influence on metabolism. When it is remembered that the ovaries, adrenal cortex and thyroid are governed by the anterior pituitary, the key position of this organ in mammogenesis becomes apparent.

During puberty, a slight amount of udder development takes place at each oestrous cycle, due to ovarian oestrogens and progesterones, but real functional development only starts in the fifth month of pregnancy, when placental hormones presumably play the major rôle. The key position of the anterior pituitary, however, still holds, the cycle now being: placental hormones maintaining the output of luteotrophin, which maintains the corpus luteum, which maintains the endometrium on which the placenta depends. At the same time placental oestrogens and progesterones cause mammogenesis. These hormonal relationships are shown diagramatically in Figure 1.



(ii) *Lactogenesis*

Although the udder develops steadily from mid-term to reach full structural development just before parturition, no true milk secretion occurs during this period. It is accepted that prolactin (supported by somatotrophin) is responsible for milk secretion by the conditioned udder, yet this hormone, in the guise of luteotrophin, has been present throughout pregnancy. The following questions therefore arise: What inhibits lactogenesis during pregnancy and how is this inhibition released at parturition? The most generally accepted theory is as follows:—

(*a*) Prolactin can only act in the presence of a certain range of oestrogen. This explains the facts that lactogenesis can be initiated in the virgin heifer by moderate doses of oestrogen and inhibited in the lactating animal by high doses.

(*b*) High levels of progesterone also inhibit the lactogenic action of prolactin. During pregnancy the high levels of placental oestrogen and progesterone then inhibit lactogenesis and this inhibition is released at parturition by the drop in placental hormones.

(iii) *The Maintenance of Lactation*

Once lactation has been initiated, it is maintained by the continued output of lactogen from the anterior pituitary. This is closely associated with withdrawal of the milk. Pleasant tactile stimuli to the udder and teats cause nervous impulses to pass up to the hypothalamus and oxytocin is secreted via the posterior pituitary. This oxytocin not only causes milk expulsion in the udder (see later) but also reacts on the anterior pituitary, stimulating prolactin production. This prolactin then maintains milk production, later at a decreasing tempo, until the next milking. The increase in milk production obtained with more frequent milking is largely due to the maintenance of a high prolactin level by this mechanism.

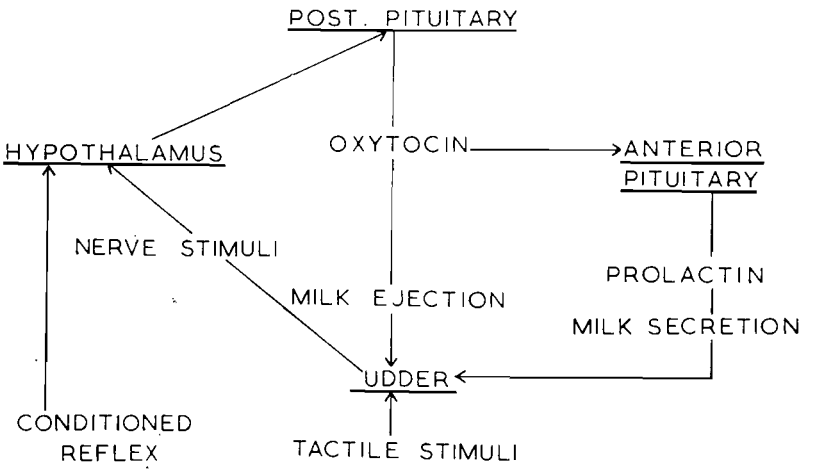
(iv) *The Milk Expulsion Reflex*

The milk in the udder is held up by capillary attraction in the alveoli and fine ducts. To be withdrawn it must be expelled into the larger ducts and cisterns by active contraction of the myo-epithelium of the udder tissue which occurs in response to the presence of oxytocin in the blood. This is the socalled "let down" reflex. The term "let down" is not really acceptable, as it indicates the relaxation of a withholding mechanism, whereas the reaction is, in fact, one of active expulsion. The term "milk ejection" reflex will therefore be used. As stated above, the oxytocin responsible for the reaction may be released in response to pleasant tactile stimuli to the teat and udder. Three very important facts in respect of this reflex must be emphasized. The first is, that it is inhibited by adrenalin and therefore by fright, anger or any external stimuli leading to emotional upset or apprehension. Secondly, the reflex is of short duration, lasting about ten minutes. Once it has been invoked and allowed to pass off without withdrawal of the milk, it is very difficult to reproduce for a considerable time. The third important fact is that the reflex can easily become conditioned, i.e. it can be invoked by a variety of pleasant stimuli associated, by the animal, with being milked. When properly carried out,

being milked is itself a pleasant experience to the cow. As Rabbi Akiba (in Roman captivity) said to his favourite pupil: "My son, more than the calf wishes to suck, does the cow yearn to suckle." But this yearning can only be fully satisfied in an atmosphere of security and contentment, created by full understanding between stockman and stock.

The maintenance of lactation and the milk ejection reflex are illustrated in Figure 2.

MAINTENANCE OF LACTATION



(v) *Difference in Composition of First and Last Drawn Milk*

It has long been known that the percentage of butter fat in the milk increases during milking. The following figures are taken from Smith[1] as an illustration of this fact. Samples of milk from a single quarter were taken during milking.

Sample	*Butter Fat %*
First	1.45
Second	4.85
Third	9.70
Stripping	11.10
Total Milk	4.35

The explanation for this phenomenon is not fully known. The old "creaming" theory, i.e. that the fat rises to the dorsal part of the udder and is therefore drawn last, has been abandoned for many reasons. Pavlov and Breslau[2] give the following explanation: prior to milking, the milk in the collecting systems contains a small percentage of fat consisting of small globules. In the secretory epithelium large fat globules are concentrated in the apices with smaller globules in the basal portions of the cells. When milking is started, residual milk from the previous milking is drawn first. Tactile stimuli from the udder stimulate the rapid secretion of fat droplets into the alveoli. The larger fat droplets are secreted first,

followed by a massive secretion of finer droplets which raise the fat content of the milk sharply. The authors do not indicate whether this reflex secretion of fat following tactile stimuli to the udder is mediated through oxytocin or not. It would be an inviting hypothesis. The above theory does not quite explain the fact quoted by Smith,[1] viz., that if the four quarters are milked in rotation the milk from the glands milked first almost invariably contains more fat than that from the glands milked last.

On the above theory it could be argued that the longer the tactile stimuli had to act, the greater should be the butter fat content, i.e., the glands milked last should contain more fat. The explanation quoted by Smith is that in the glands milked last "the muscular tone (sic) of the udder decreases before all the fat globules have been forced from the secretory cells of the alveoli." The first theory appears to lay emphasis on the secretion of fat during milking and the second on the expulsion of preformed fat.

Whatever the explanation may be, the fact that the last drawn milk contains the highest percentage of butter fat is of obvious practical consequence to the dairyman and emphasizes the importance of complete milking.

(vi) *Residual Milk*

Even after complete milking the udder still contains a quantity of "residual milk." This usually amounts to some 20% of the milk drawn. A proportion of the residual milk can be obtained by the injection of oxytocin (about 10 units to the average cow). The milk so obtained is very high in butter fat, i.e. 15% as against 3.6% for the milk previously withdrawn by normal milking.

PART 2

PRACTICAL ASPECTS OF THE PHYSIOLOGY OF MILKING

I. S. McFarlane

To the good stockman lactation can be broken down into three phases:—

(1) Preparation.

(2) Milking.

(3) Drying off and dry period.

1. PREPARATION.

(*a*) *The Maiden Heifer*

The whole future lactation potential of the animal is directly correlated with the management and feeding of the non-lactating female. From birth onwards the whole rationale is one of treating the animal as a future milk-producing biological entity. This paper does not intend to

deal with calfhood. Provided that the nutritional plane is maintained, no great difficulty is experienced these days in raising good calves. One point, however, must be stressed, and that is: that the calf should have pleasant association with the buildings and surroundings and in particular with the human factor. Correct handling leading to full confidence in the human with no associations of pain or fear is essential.

The maiden heifer is usually the most neglected animal on the majority of farms, and this during a very important period of development. The common attitude is that once a calf has been weaned, she can take care of herself until she starts to make udder. The opposite is self-evident, but unfortunately rarely applied.

The management of the maiden heifer should be aimed at judicious feeding coupled with a conditioning to handling. Although stable routine cannot be initiated, the animal should be aware of byre activity and any fears associated with these buildings should be allayed. It is as well to remember that sounds and smells play an important rôle in dairy cows and pleasant associations of these factors with byre activity can be of importance later when lactating.

At the onset of puberty there is usually a primary udder development which regresses to a greater or lesser extent up to three months later, depending on the breed. Usually this development is exaggerated when heifers are being over-fed for shows, etc. Feeding at this stage is usually neglected however, the animals being considered as non-earning passengers. The folly of this policy cannot be over-emphasized.

(b) The Pregnant Heifer

The care and management of this group is orientated towards the developing of conditioning to byre conditions. Handling and feeding at routine intervals establishes a pattern within which milking efficiency can be maintained. The change-over from dry heifer to milking cow should be effected in such a way as to make the calving or partus almost incidental.

The initial alveolar and duct tissue growth occurs early in pregnancy but remains static until the secondary development occurs. During this period "heifer-honey" appears and there are indications that its free flow may be correlated with later high production. Supernumerary teats and quarters develop rapidly and may upset the whole shape and balance of the udder. Feeding on a rising scale must be judicious and a good supply of clean water is essential. This is sometimes neglected or skimped: the water requirements of a pregnant cow or heifer are usually higher than the owner thinks.

It is well to remember that bovines are gregarious and usually well-established relationships and cliques develop within a herd. A good stockman will always remember this and train "mates" together. A common mistake is to put two antagonistic cows or even groups together: this always has a drepressing effect and upsets byre management. Aggressive animals are never an asset.

Partus should be concluded with as little interference as possible and "calving boxes" should be avoided. A clean, quiet camp is much to be

preferred, particularly in South Africa. It is customary to allow non-milking staff to handle calving animals, as they sometimes associate individuals with calving and the removal of the calf. There is no sound reason why water should be withdrawn from a parturient cow or heifer. This is a fairly common practice and has no scientific basis at all. Normally, she will limit herself and will become very thirsty; it is customary for her to drink copiously after calving.

2. MILKING

(*a*) *Hand-milking*

From the milker's point of view the main functional components of the udder are:—

(1) the teat orifice, which is closed by a sphincter muscle;

(2) the teat sinus or cavity;

(3) an annular ring of mucous membrane between teat sinus and udder, which, under certain circumstances, may interfere with the passage of milk from udder to teat;

(4) the udder cistern immediately above the teat;

(5) large ducts leading into the cistern;

(6) the secretory portion.

In hand milking the method of milking is to close off the teat sinus from the udder cistern and increase the internal pressure by squeezing and overcoming the resistance of the sphincter muscle at the orifice. It is a common but erroneous belief that the sphincter relaxes completely during so-called "let-down." As has been explained, this term implies a conscious effort on the part of the animal to "hold-up" the milk and the unacceptable suggestion that the egress of milk is actively prevented.

The whole aim of the good stockman should be to bring about a series of pleasant associations for, and stimuli to, the cow in order to encourage the expulsion reflex. The action of oxytocin is limited and for all practical purposes its period of activity is assumed to be ten minutes. The hand milker has, therefore, to stimulate one cow at a time and see that she is milked within ten minutes. This implies rapid milking. Most milkers become aware of this phenomenon and the tendency, therefore, is to increase force to attain the object. In South Africa the Bantu milks mainly by pulling and stripping, which is unpleasant for the cow and may even be painful. When "full hand" milking has been taught, a marked difference in production is automatically produced.

An important factor, which is often forgotten, is the painful sensitization of the teat due to the handling which occurs three to four days after milking commences. This may even have a serious inhibitory effect on milk production. "Full hand" milking reduces this possibility. As production increases individually and collectively in a herd, so hand milking becomes inefficient, mainly due to the fact that the cow cannot be milked out fast enough and fatigue in the milker becomes a real problem.

Any unpleasant association must be avoided and leg chains, ropes and hind-leg ties should be avoided as they are not conducive to good

reflex stimulation. A cow likes to stand comfortably during milking and does not take kindly to restraint. It is common knowledge that kicking is "infectious" and one excitable animal may set up such an epidemic of kicking. There is only one answer to such animals: they should be got rid of as soon as possible.

(*b*) *Machine milking*

It is important to remember that a milking machine acts by reduction of external pressure on the teat. In order to assist this suction and to stimulate expulsion reflex, a pulsating mechanism is also incorporated. It must be well understood that this pulsating action does not squeeze the milk from the teat, but merely acts as a mechanical stimulus for milk expulsion as well as maintaining blood circulation in the teat wall. The technique of milking is basically the same, no matter what type of milking machine is used.

The two main principles on which efficient milking is based are:—

(1) a machine mechanically sound and clean;

(2) the building up of a standard routine which will give maximum stimulus for milk expulsion.

The second of these principles will be dealt with in this paper.

It has been found that as the machine milking rate is higher than hand milking, the ideal time in which the majority of cows should be milked is about six minutes. This will depend entirely on whether oxytocin stimulation is optimal. This stimulation can be best provided by an orderly and efficient method in routine.

Pleasant associations with milking should always be maintained. One of these is the anticipation of the short feed which is usually provided during milking. The advantages and disadvantages of feeding hay or "long feed" before or after milking are still a matter of opinion, but it is generally accepted amongst experienced machine milkers that there are more advantages to feeding the long feed before milking. Most milking parlour designs are based on this principle. This means that a contented animal will be milked.

The building up of the reflex stimulation of expulsion should be associated with the actual milking plant:

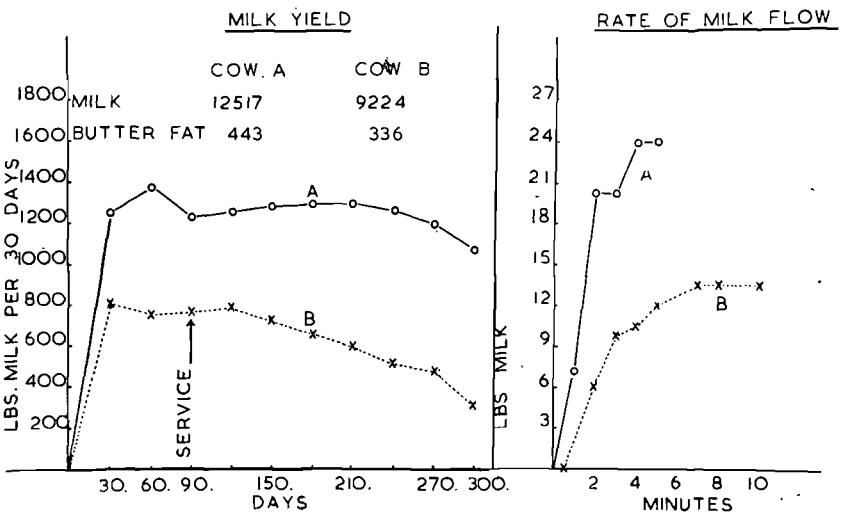
(1) Handling of the udder can be a powerful stimulus and should be avoided until as near to putting on of the teat cups as possible. As it is essential to clean the udder before milking, this is made use of by washing down with warm disinfectant just before milking. In parlour milking this has one disadvantage in that it is also usual to strip the teats into a stripping cup before milking to eliminate mastitis carriers and it will be only when the cow is already in the machine that signs of abnormal milk is detected. This means that she will have to be turned out and hand milked, thus upsetting her and the machine routine.

For all practical purposes it has been found that teat cup stripping and udder cleaning can be done before milking, as long as the cow can get into the parlour and be milked as soon as possible without losing any of the effect of the stimulus set up by handling of the udder.

(2) Feeding production meal just before and concurrently with milking can also be a strong stimulus, but it must be remembered that milking time should be limited to six minutes and in the case of high producers this does not allow sufficient time for the cow to consume her proportion of meal. Hence some workers prefer not to feed the short feed during milking. Another disadvantage to this meal feeding is that a cow may complete her allocation of meal before she is completely milked out and will expect more meal or become upset and disturbed. This happens only towards the end of lactation, when production has fallen and the allocation of concentrates is cut accordingly. Cases can be cited where premature drying off could be attributed to such an aberrant stimulus.

(3) The most powerful stimulus is naturally the application of the teat cup and the pulsating action and downward pull of the claw piece. Milk flow should be immediate and any indication that this does not take place should be investigated. It has been shown that immediate release and rate of flow of milk can be correlated almost directly with total production.

FIGURE 3.



It will be noted that cow A released her milk almost immediately, whereas B has a lag period before the milk actually flows after the teat cups have been applied.

If the cow has been correctly handled this milk flow should be looked upon as the climax to a psychological build-up, which is aimed at inducing a sustained flow of milk for as long as possible. In her natural state the cow is only expected to release her milk at intervals on demand from the calf.

(4) Association with sounds, such as clicking of the pulsators, opening of parlour gates, etc., can also be a stimulus. It has been the experience of one of the authors that, where an electrical bell was used for a signal to stable helpers, this sound became a stimulus for the "expulsion reflex" and had to be discontinued.

The rate of flow has a definite effect on production and the faster the animal can be milked the better. It is possible to train cows to milk fast in machine milking by making maximum use of the expulsion reflex. In one milking parlour the average milking time per cow decreased from 8 minutes to 4 minutes 32 seconds over a period of five years.

The faster the milking, the easier it becomes to strip the animal thoroughly, as use is then made of residual oxytocin effect, whereas with longer periods stripping becomes more difficult. Machine stripping can be just as effective as hand stripping, if done within the period of oxytocin stimulation.

In fig. 3 it will be seen that cow A showed a sudden cessation of milk flow after two minutes when she had yielded 19 lbs. of milk and another lesser flow of milk up to four minutes. This secondary flow or stripping is obtained in a number of ways; the most important are:—

(1) Increased stimulus to the teats by applying a downward pressure on the teat claw-piece.

(2) Massage of upper portion of the udder.

(3) Slowing of the pulsation rate and increasing the vacuum, if the machine is so designed as to allow these adjustments.

(4) Hand stripping. This method is still being used although machine stripping is rapidly replacing it. The danger in this method lies in the cow giving proportionately more to the hand milker and becoming virtually useless in a machine as time goes by.

One common fault is to over-stimulate by stripping, in other words, to use too much force on the teat cups or by too robust massage.

3. *Drying Off.*

The essential procedures in drying a cow off are:—

(1) to reduce feed proportionately;

(2) to reduce water intake;

(3) to break milking sequence and thus destroy reflex stimulation.

The first two are self-evident.

The third procedure is the most important and it can be, and is usually, overdone. Possibly the most important factor is irregularity in routine, in other words, the cow is taken out of her normal routine and milked at odd times, as well as in an unusual stanchion, or byre. The feed may be changed in the byre or hand milking may be instituted instead of machine milking. Usually three to four days suffices to break up the routine without undue stress developing and, if judiciously coupled with reduced feed and water intake, it works well.

Summary

The modern concepts of the physiological control of mammogenesis, lactogenesis, maintenance of lactation and milk ejection reflex are summarized and an outline is given of how this knowledge may be applied to the stockmanship of milking.

ACKNOWLEDGMENT.

The Director of Veterinary Services is thanked for his assistance and for permission to publish this paper.

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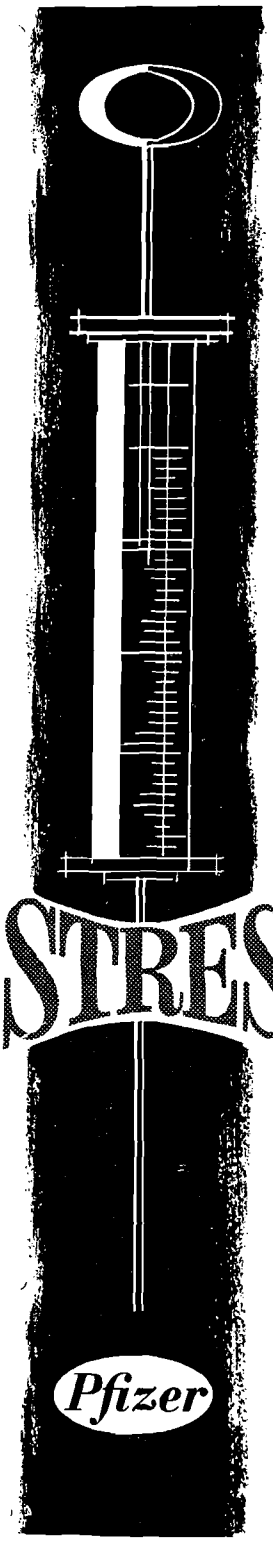

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THE USE OF MILKING MACHINES

II. MECHANICAL MILKING AND TYPES OF MILKING PLANT

I. S. McFarlane*

Introduction

The science of mechanical milking has advanced so rapidly that many practitioners have lost touch with the modern techniques and types of machines. The object of this paper is to summarize present knowledge and practices.

The Milking Machine

Basic principles

In contrast to hand milking, where the milk is squeezed out, machine milking operates by suction, i.e. by vacuum, sometimes inaptly termed "negative pressure." If applied continuously, the suction would cause oedema of the teats and pain, thus inhibiting the milk ejection reflex. Consequently, the double-action principle of milking, with few exceptions, is universally applied today. Broadly speaking, this action consists of applying a vacuum to the end of the teat to "suck out" the milk and convey it to a suitable container and alternating this with a rhythmical squeezing action on the teat to maintain proper blood circulation and to promote the "milk ejection" reflex.

The frequency of this action varies between 40 and 60 pulsations per minute, and is referred to as "pulsation rate." The massage applied to the teat is accomplished by a pulsation, which consists of a "release" or "shut" and a "squeeze" or "open" phase. Although milk flow is continuous, withdrawal increases in the former phase. The ratio of the time occupied by the two phases is called "pulsation ratio" and may vary from 1:1 to 3:1.

To attain this action it is thus necessary to have (*a*) a vacuum pump, (*b*) a pulsator, to produce the pulsations; and (*c*) an assembly—the teat cup and liner—to mediate this action onto the teat itself.

Teat cup and liner.

The teat cup and liner assembly is illustrated in figure I. It consists of:

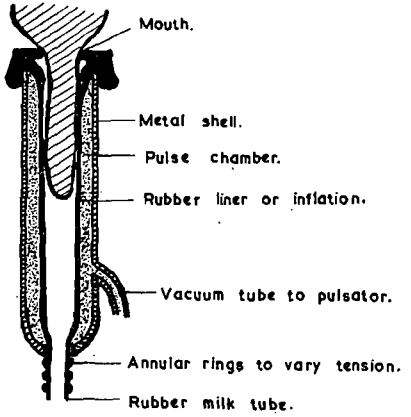
1. A metal shell, the teat cup, usually made of stainless steel or aluminium, and so shaped that it suits the particular type of liner.

2. A rubber liner or "inflation," fitting into the teat cup and over the teat.

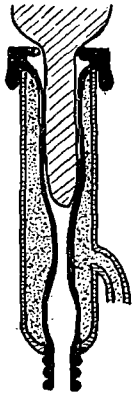
3. The annular space between the liner and teat cup, known as the pulse chamber.

* Section of Reproduction and A.I., Onderstepoort.

FIG. I

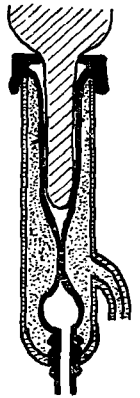


A. SHUT OR RELEASE:– NORMAL TENSION.



B. OPEN OR SQUEEZE:– NORMAL TENSION.

FIG. II



C. OPEN OR SQUEEZE:– WHERE LINER COLLAPSE IS COMPLETE, STOPPING MILK-FLOW, CAUSED BY TENSION BEING TOO SLACK.

4. The mouth of the liner, fitting around the base of the cow's teat.

5. The milk tube, attached at the neck of the liner, distal to the cow's teat.

6. A vacuum tube connected to the teat cup and leading from the pulse chamber to the pulsator.

7. Annular rings on the milk tube to vary the tension on the liner. (Compare figs. I and II).

Through the milk tube suction is applied to the teat. The milk is carried off to a container through this tube. A tight seal at both mouth and neck of the liner ensures proper maintenance of the vacuum. The tension on the liner, and thus the tightness of the air seal, can be varied by moving the annular rings to different positions relative to the neckpiece of the teat cup through which the milk tube extends.

In figure IA the teat cup assembly is shown in the "release" or "shut" phase. There is a vacuum in the pulse chamber as the pulsation is in the "shut" phase, i.e. the "pulsator" has now shut off the atmosphere and allowed connection to the vacuum pump.

In figure IB the "squeeze" phase is illustrated, in which the pulsator is in the "open" position, i.e. open to the atmosphere. Therefore the pressure in the pulse chamber is higher than that within the liner, and pressure ("squeeze") is thus effected on the teat.

Liners are made of natural rubber with a soft resilient consistency to obtain the physical properties necessary for efficient milking. They should have the following characteristics:

1. They should provide a shaped upper opening designed in such a way as to give a comfortable fit over the base of the teat and also prevent the liner "riding up" the teat onto the teat base, which would close off the milk cistern from the teat canal. (A slight leak at the mouth is necessary to allow a flow of air to carry off the milk.)

2. They should respond rapidly to pulsation.

3. They should be easy to clean.

There are three main types of liner:

1. *Fully moulded*, or universal type, in which mouthpiece, barrel and milk tube are moulded in one piece. Tension can be varied to a limited extent by having rings moulded into the milk tube so that the neckpiece of the teat cup holds it in varying states of tension. Most machines use this type.

2. *Semi-moulded*, in which the mouth-piece and barrel are moulded in one and the milk tube is sealed to them in a variety of ways. Their only advantage is that the tension can be varied more easily.

3. *Extruded*, in which the liner is simply a tube. The mouth-piece can be varied by inserting a metal ring of various diameters. The connection to the milk tube is similar to that of the semi-moulded type.

Figure II illustrates one of the main disadvantages of a liner which is too soft or on which the tension is too slack: there is a tendency for it to collapse and completely shut off the milk flow.

Connection of teat cup assembly to rest of plant.

The four teat-cups are joined to the pulsator and vacuum lines by means of the "claw-piece." Although varying in construction, it is basically a four-way distribution casting provided with a safety shut-off valve. The purpose of the valve is to cut off the vacuum when the teat-cluster becomes detached or is removed from the teat. If the vacuum is not shut off, there is the danger of dirt being sucked into the container or vacuum line, as well as an unwanted drop in vacuum pressure throughout the whole line.

The vacuum to the cluster and therefore to the teats is controlled by a master tap. In the case of the simplest machines the tap may be of a spigot type, but in the case of more advanced plants it is a multiple casting, although still simple to operate.

The pulsator mechanism is usually between the master tap and the teat-cluster.

Pulsator.

Pulsators can be divided into two groups:—

1. Mechanical types, which produce a pneumatic pulsation applied directly to the teat cup, or transmitted through a pipeline to pneumatic relays which then apply the pulse to the teat cups.

2. Electrical types, which produce an electrical pulse transmitted by a conductor to electro-magnetic relays. These relays produce a pneumatic pulse which is applied directly or through pneumatic relays.

If the pulsator operates relays, either mechanical or electrical, it is usually known as a master pulsator. This is usually the type in a milking parlour. On the other hand, milking buckets have individual pulsators as a rule. By varying the connections to the pulsators, it is possible to have the teat cups acting all together, or in pairs, or simply in rotation.

It is important that the change in phase, i.e. from atmospheric to vacuum pressure, should be sharp and clear-cut, so as to get rapid and positive change in the pulse chamber. A slurred or drawn-out change does not collapse or inflate the teat cup liner rapidly enough and thus reduces the stimulus to the teat.

The speed of the pulsator, and thus the pulsation rate, may be controlled simply by a swinging pendulum, which is adjustable only to a limited extent. By introducing springloading, the range of adjustments is increased, but the mechanism becomes less reliable.

The Vacuum Pump.

The vacuum is obtained by means of a vacuum pump, which is in reality an air compressor in reverse. Most milking plants work with vacuum pressures of 15 inches of mercury and this can easily be obtained with a rotary positive displacement pump. It is the type most commonly used; it is robust, compact and requires very little maintenance.

The vacuum level is maintained by regulators which are either spring or weight-loaded, the latter being slightly more reliable and accurate. These regulators are usually placed at the opposite end of the vacuum

line to the pump, thus regulating the pressure over the whole distance of the line. In this line there is a guage which accurately registers the pressure.

All machines are based on the above principles with minor alterations: even the most elaborate and complicated looking types have this same basic design.

Types of Plants

There are two main categories of plant:

1. The individual bucket type.
2. The multiple milker, whether parlour or bail.

The individual bucket milkers are classified into static and suspended types. The static type consists of a receptacle or bucket which stands on the floor of the stable next to the cow to be milked. It has a vacuum-proofed lid which is fitted with a length of vacuum tubing to connect the unit to a convenient spigot on the main vacuum line. Also on the lid is a pulsator unit, usually spring-loaded, for speed control. The open to shut ratio is fixed. The pulsator and bucket in turn are connected to the teat-cluster by means of a sufficient length of piping to enable the milker to work efficiently.

The second type of bucket is essentially the same as the static type, except that it is slung under the cow from a surcingle or spring-loaded suspensory point on the stanchion. The action is slightly different in that there is not only suction on the teat but also traction forwards and downwards, which can be varied in force and direction. The pulsations add a rhythmical backward and forward motion to the suspended pail, thus giving an intermittent pull to the teats. All four teats are milked at once, i.e. the open and shut phases coincide on all four teats, whereas in the static pail it is customary to milk two teats in bi-lateral alteration, i.e. "side by side" milking.

The relative merits of these two types are mainly matters of opinion amongst farmers: there is very little actual difference in milking efficiency between the two. In the hands of an expertly trained operator, who has a sound knowledge of his cattle, the slung type gives slightly better results, but in the hands of unskilled labour it may have no advantage over the static pail.

The Multiple-Milker: the Parlour and Bail

The Parlour.

There are many variations in lay-out of these units. The major technical difference between the various types lies in the fact whether the vacuum is used for milking only or also for conveying the milk from teat cup to the milk room. In the latter case a detachable milk line (or transporter pipe) which can be of plastic, stainless steel, aluminium or even glazed porcelain, is connected through a vacuum releaser mechanism

to the vacuum pump. The releaser is necessary, as the milk in the transporter pipe is under vacuum and must be allowed to flow out without dropping the vacuum in the rest of the machine. There are many ingenious designs on the market; they are fairly efficient to excellent in operation.

In the more advanced types, weighing or measuring devices are incorporated, so that the milk from individual cows may be recorded before being transported to the milk-room through the releaser; these are known as Recorder Units and have now reached a very high standard of efficiency.

Most plants also cater for concentrate feeding in the milking stalls by fully mechanical or semi-mechanical feed hoppers, thus keeping the cow contented during milking as well as allowing controlled feeding.

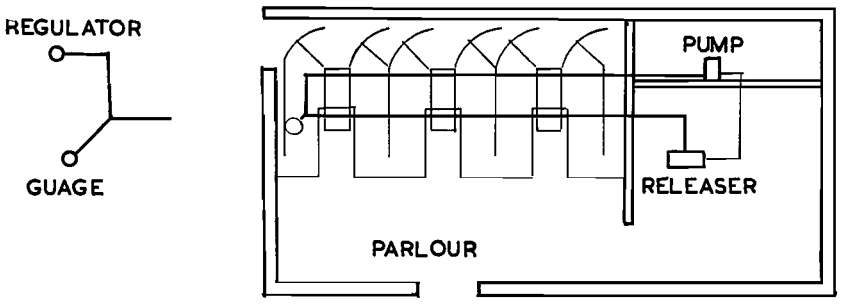
Lay-outs.

The two main types of lay-out are:

1. the abreast system, and
2. the tandem system.

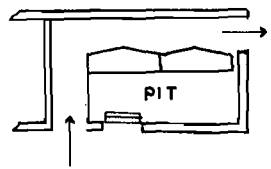
In the former the cows are tied up in milking stalls which are abreast at right-angles to the general flow of animals through the parlour. In the latter, the cows are tied one behind the other, and "in line" with the general flow. Both systems may have the milking stalls raised, so that the operator is virtually standing in a pit to facilitate the manipulation of clusters and udder. Their construction is relatively easy and much cheaper to apply to the "in line" or tandem system than to the abreast parlour. Another variation which is very popular is the tandem "herring-bone" system which "staggers" the animals obliquely, thus allowing more animals to be accommodated per unit length of parlour.

FIG. III



TYPICAL ABREAST PARLOUR

FIG. IV



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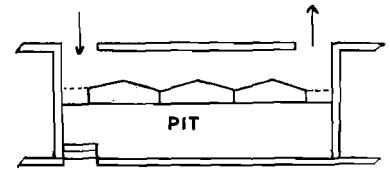

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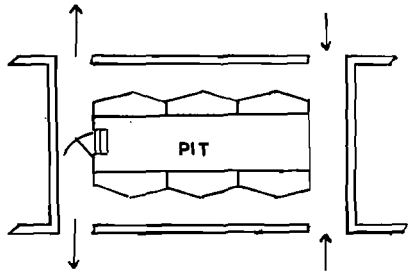

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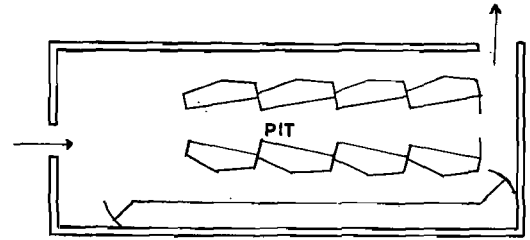
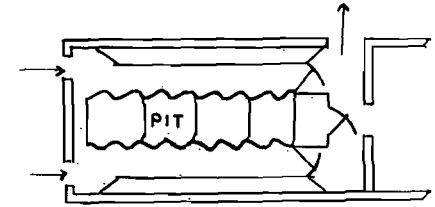


J.



K.

EXAMPLES OF TANDEM STALL LAY OUTS.

Each and every farm, and each and every farmer, presents a different problem in deciding which type of plant should be installed. It is very seldom possible to design a lay-out which will meet all the needs; it may be that a combination of design factors is the ideal. The basic tenet, which must be adhered to, is that fast milking is efficient milking.

The further mechanization of milking plants is proceeding apace and the number of cows per unit milker and per unit time is being increased rapidly. One of the advances is the "merry-go-round," in which a circular parlour is rotated slowly past the milkers so that production-line techniques may be applied.

The Bail.

The bail is essentially a mobile milking unit, whereby the milking plant is taken to the cow instead of having the cows coming to the parlour. It is adapted to particular circumstances, such as obtain on small holdings supplying milk to a single centre. As the principles are the same, the details need not be dealt with in this brief reviews.

ACKNOWLEDGEMENT

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THE USE OF MILKING MACHINES

II. THE HYGIENE AND CARE OF MILKING MACHINES

L. W. van den Heever*

The efficiency of the milking machine must be measured by its ability to remove the milk completely from the udder in the optimum time with no damage to the tissues of the teat or udder, and to deliver milk which is clean, safe, of good keeping quality, low cell content and free from off taints or flavours. Most modern milking machine units available today are reasonably efficient and are in addition labour saving, but without proper care and maintenance the very opposite results are obtained. For this reason regular and routine attention to the milking unit is not only essential for the production of bacteriologically and physically satisfactory milk but also to ensure healthy udders and economical production.

Hygiene of Milking

Attention must first of all be given to the condition of the udder. Long hairs hamper proper cleansing and should therefore be clipped or singed regularly. Cows with abnormal or damaged teats are not suitable for machine milking, and teats with cracks, ulcers, large papillomata, etc., should receive the necessary attention prior to commencing with machine milking. Quarters should be free of mastitis and in herds where mastitis is rife, rigid culling and even laboratory examination of milk from apparently healthy quarters may be advantageous in avoiding the "flare-ups" of clinical mastitis which so often occur when converting from hand to machine milking methods.

Before milking is started, all loose dirt such as mud, dung, grass and hair particles should be removed, either by the use of a running water spray or with clean cloths dipped into a detergent solution or warm soapy water. The udder and teats should then be dried rapidly with a clean towel or disposable paper towels. Teat disinfection by immersion in a suitable antiseptic solution or wiping with a clean cloth soaked in such a solution may then take place. Various antiseptic solutions are suitable, those containing chlorine being amongst the most efficient and inexpensive. Such solutions should contain 100–150 p.p.m. of available chlorine and should be freshly made up and renewed when visibly dirty. Removal of all fat and dirt is essential when using chlorine solutions. Other preparations such as the quaternary ammonium compounds are also effective, though somewhat more expensive. They have simultaneous

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detergent and bactericidal effects in the recommended concentrations of about 0.02%, although the pseudomonas organisms, which may also cause mastitis, are not so readily killed by this type of bactericide[2]. It should also not be used in conjunction with soap, due to incompatability on the grounds of anionic and cationic antagonism. Use of high concentrations of quaternary compounds or those having excessive detergent properties, leads to cracking and drying of the skin of teats and milkers' hands. Hexachlorophene (G. 11) solutions are excellent for the purpose of disinfecting the skin of teats[4] and, though fairly expensive, may be used economically by using small amounts of freshly made solutions for teat "sterilization" only and not for the whole udder.

For reasons outlined in other contributions, the whole process of cleaning, drying and disinfecting the udder and teats should be completed efficiently and expeditiously, if interference with "let down" of milk is to be avoided. Before finally applying the teat cups, a strip cup should be used to test at least the first stream of milk from each teat for visible abnormalities such as clots, strings, flakes, and blood. This is essential in order that mastitis may be controlled and to ensure only good quality milk to the consumer.

Assuming that the milking machine has been cleansed and sterilized, milking may now proceed. Care should of course be taken that in applying the teat cups they do not come into contact with the floor or any other surface which may introduce contamination, and aspiration of foreign material into the cup should be avoided.

After milking each cow, the cluster of cups should be dipped frequently into luke warm water which is bacteriologically clean. Tepid water is to be preferred to cold[3], as the latter is inclined to solidify fat particles. This water rinse is simply to disperse milk from the cups mechanically, and afterwards immersion into a sterilizing solution at about 110°F is used to "sterilize" the cups. Solutions of 100–200 p.p.m. of available chlorine are excellent. Quaternary ammonium compounds and hexachlorophene may also be used. Chlorine solutions should be renewed as soon as they show evidence of cloudiness. A ten second "sterilizing" dip is the minimum which may be accepted as reasonably effective, immaterial of the nature of the disinfectant used, and this should be followed by a ten second drip period before use on the next cow. Whilst this procedure is reasonably effective, it will not sterilize in the true sense of the word. The only known method in which this may be achieved is by teat cluster "pasteurization". Wilson[1] maintains that mechanical brushing of teat cups in bacteriologically clean, warm water is as effective as any efforts at chemical sterilization.

Where teat cup rubbers and liners are not in good physical condition, rinsing and efforts at sterilization are correspondingly less efficient.

Releaser plant and other types of plant using extended pipelines.

The complexity and variation of these different plants make it essential that the detailed procedure be appropriate to the specific plant. However, the following broad outline of procedure[1] should be followed in addition to any cleaning directions provided by the manufacturer.

After every milking: Residual milk and external dirt should be removed by brushing in cold or luke warm water; not less than 2 gallons of fresh water should be drawn up through each teat cup assembly so that a turbulent water flow through the plant is brought about. In circulation systems the water should be renewed until it remains clear.

In place cleaning may then be effected by circulating a detergent sterilizer solution at 160°F. for at least 10 minutes. Where there are parts of the plant that do not become adequately exposed, they should be dismantled and brushed in hot detergent sterilizer solution.

After cleaning or before the next milking, rinse the system with cold water to which may be added 50 p.p.m. of available chlorine. Quaternary ammonium compounds and hexachlorophene residues may thus be removed to eliminate their gaining access to the final milk.

At least every 10 to 14 days such pipelines should be dismantled so as to permit a hot brush rinse in detergent sterilizer. Glass and metal parts may then be boiled or steamed, whilst rubber parts may be boiled in a 2–5% NaOH solution, which ensures a longer useful life. Especially where rubber "sleeves" are used to join glass or steel pipe sections, there is ample opportunity for accumulation of milk residues. Rubber parts should be renewed when they show cracks in the inner surfaces, and alkaline treatment such as described for milking machine rubbers may well be used to prolong their life.

Care of Milking Machine Rubbers

The rubber teat cup liners, claw tubes, milk lines, etc. of a milking machine unit are made of hard, soft, natural, synthetic or mixed rubber compounds. All are more or less susceptible to the three most important factors which cause rubber to deteriorate viz. fats, light and stress. Ozone, heat, bacteria and chemicals effect the rubber to a lesser degree.

The care of milking machine rubbers is secondary only to the basic design of the unit when the efficiency and durability of the machine is considered. Neglect of rubbers leads to decreased useful life, poor milking hygiene, contaminated milk, udder trauma, increased cellular content of milk and even to mastitis[6].

To operate efficiently, rubbers must retain their original shape and size, remain resilient and elastic to maintain the correct positive and negative pressures, retain the smooth gloss on the surface to facilitate cleaning and sterilizing, and remain air-tight. Fat causes rubber to swell, become porous, lose its elasticity and original shape and size. It leads the way to roughness and cracks in which milk residues accumulate and in which bacterial development not only adds to the bacterial count of the milk but which encourages the bacterial decomposition of rubber and the deposition of milk stone or detergent stone on the otherwise smooth "milk" surfaces.

For proper care of rubbers the following procedure is recommended:[3 6]

1. Have two sets of rubber which are used alternately and changed and checked weekly.

2. Rinse out all rubbers immediately after use with warm water. Cold water solidifies the fat particles, whilst hot water coagulates the milk protein.

3. Clean out the tubes with a detergent recommended by the manufacturer of the machine and use, if necessary, only a *soft* brush. Hard and wire brushes score the surfaces and promote further deterioration.

4. Boil the rubbers in 5% NaOH solution for 15–20 minutes, re-boil in clean water, drain dry and store in the dark in an extended position to prevent "kinking" or other deformities developing—*or* "wet" store in a 1–2% solution of NaOH and boil in clean water immediately before re-use.

5. Where hard waters are in use, lime deposits may result, and the addition of calcium binding chemicals such as the polyphosphates may be indicated. Otherwise, periodic soaking in weak acetic acid solution is indicated.

6. Do not steam rubbers in the stretched condition and do not dry them in heat or in the sun.

7. Do not use greasy or fatty milking salves. Salves containing lanolin, especially, are to be avoided.

8. Check rubbers periodically and discard those showing deterioration. Do not wait until rubbers leak before renewal.

9. Do not stretch rubbers during dismantling or assembly of the unit. The use of glycerine facilitates assembly.

It is important to institute proper care of rubbers when they are new. Absorbed fat cannot be removed from rubber using chemicals in the ordinary way, although prolonged soaking in NaOH solutions will help to some extent provided calcium binding chemicals are added to prevent deposition of lime salts on the surfaces.[3]

Finally, it should be stressed that a milking machine is only as good as its rubber parts, and these should be regularly examined for signs of wear, cuts, hardness, cracks, swelling, water, or milk stone, etc. Faulty parts must be replaced immediately.

Summary

The efficiency of a milking machine as regards the production of good quality milk, the maintenance of udder health and economy of milk production depends largely on cleaning. The principles of hygienic milking and cleaning of the machine, with special reference to the rubber parts, are outlined.

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HELMINTH RESEARCH IN SOUTH AFRICA

I. SEASONAL INCIDENCE OF NEMATODE PARASITES IN CATTLE IN THE NATAL COASTAL AREA

W. B. Hobbs*

Introduction

The survey on the seasonal incidence of nematode parasites was conducted on cattle, as dairy farming is an important industry, whereas sheep are scarce and relatively unimportant in the Natal Coastal area.

Materials and Methods

(1) *Dairy Herds.*

The three herds selected were, (*a*) at Irvington in the Pinetown District; (*b*) at Saxony and (*c*) at Ukulinga both in the Pietermaritzburg District. Unfortunately there were not 25 calves under three months of age on any of the farms so that older calves up to the age of 7 months had to be included in the survey herds.

(2) *Parasitological Examination.*

Diagnostic procedures, with references to methods used are fully described elsewhere.[1]

(3) *Climatic data.*

This was recorded daily, either on the farms themselves or in the immediate vicinity.

Results

The period covered by the survey was as follows:

(*a*) Irvington: August, 1959 to February, 1961.

(*b*) Saxony: September, 1959 to October, 1960.

(*c*) Ukulinga: October, 1959 to February, 1961.

The results of the egg counts are illustrated in the histogram in figure 1. The highest mean egg per gram (e.p.g. count) of each respective

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species is taken as 100%; the other counts are converted to percentages of this maximum. Climatic data are also included in figure 1.

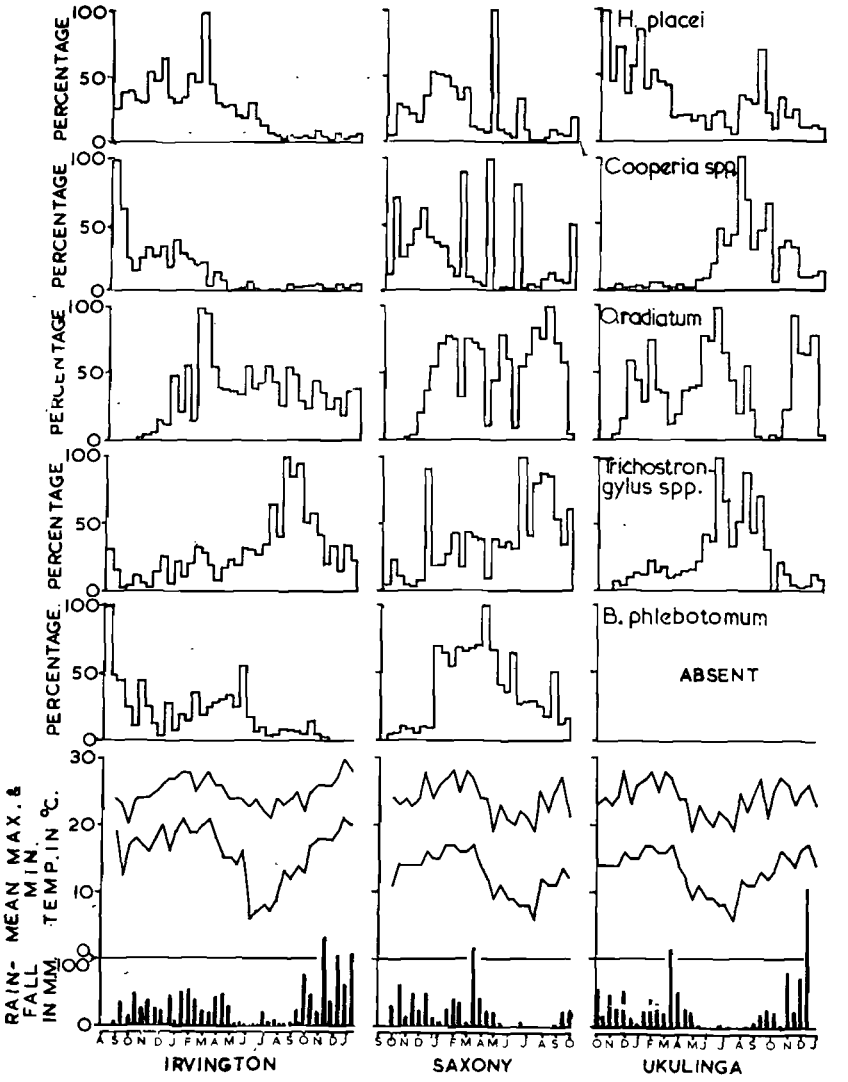

Fig. No. 1. Fortnightly mean egg per gram counts expressed as percentages of the highest fortnightly mean egg count for each species.

Mean egg counts were considerably higher at Irvington than at Saxony or Ukulinga. At Ukulinga egg counts were so low, that some doubt exists of their value for survey purposes; they are merely included for purposes of comparison.

Seasonal incidence of species was as follows:

Haemonchus placei.

A. *Irvington*: Egg counts rose steadily to reach 60% of the maximum in November, only to fall again with a sudden rise to their highest level of 2,987 e.p.g. in February. Thereafter counts fell steadily until the end of the survey period. As calves approached 17 months of age, some of them became negative and were discharged.

B. *Saxony*: Although egg counts were lower on this farm, similar tendencies were observed. Counts rose in December and January only to fall in February and March, followed by a sudden rise to their maximum of 248 e.p.g in April. An equally sharp fall was observed at the next sampling and counts remained low thereafter.

C. *Ukulinga*: From a mean maximum of 35 e.p.g. in October, counts fell to half this level at the next sampling, only to rise again 2 weeks later, followed by a further fall and then they rose until January. From this time until the following August egg counts fell steadily, only to rise gradually until October and then fell until the end of the survey period.

Cooperia spp. (*C. pectinata* and *C. punctata*).

A. *Irvington*: From a mean maximum 337 e.p.g., in August, counts fell to a low level in October, rose again in February and fell steadily thereafter throughout the rest of the survey. As calves reached an average age of 8 months *Cooperia* spp., although still present, were of very little significance.

B. *Saxony*: Marked fluctuations in egg counts were noted. After an initial rise followed by a marked fall in October, egg counts rose steadily until December only to fall gradually until February, when an isolated peak of 90% of the maximum was recorded. In April the highest count of 183 e.p.g. was reached and after falling almost to zero for six weeks, counts shot up again to 80% to fall as dramatically thereafter and remain at a low level. At the last sampling they rose again to 50% of the maximum.

C. *Ukulinga*: After remaining at a low level until May counts rose gradually to a peak of 132 e.p.g. in August. The general trend was a gradual decrease until the end of the survey, although this fluctuated somewhat with minor peaks in October and November respectively.

Oesophagostomum radiatum.

This species was absent on all the farms until November when the following trends were noted:

A. *Irvington*: There was a fairly steady rise to a peak of 208 e.p.g. in February and a fall to about half this level in March. Thereafter it gradually fell until the end of the survey.

B. *Saxony*: Counts rose steadily to about 75% of the maximum in January, falling to half this level in February and rising to the same

level again at the next examination. In the autumn and winter, apart from two marked troughs in April and June, egg counts remained fairly constant, rising to a peak of 25 e.p.g. in August. From that time onwards counts fell.

C. *Ukulinga*: After rising to 80% of the maximum in January egg counts fell steadily throughout the autumn, rising sharply in May to reach a mean maximum of 26 e.p.g. in June. After falling to almost nil in September a sudden rise to the 90% level was recorded in November; the counts thereafter fell to reach a very low level in January.

Trichostrongylus spp.

A. *Irvington*: The counts rose very slowly and steadily to reach a peak of 102 e.p.g. in August, eleven months after the survey started; followed by a gradual fall until the end of January.

B. *Saxony*: With the exception of an isolated peak in February, similar trends were noted to those at Irvington, egg counts reaching a peak of 28 e.p.g. in July. Thereafter counts fell until the end of the survey.

C. *Ukulinga*: The rise and fall in egg counts were very similar to Irvington; a peak of 26 e.p.g. occurring in July.

Bunostomum phlebotomum.

A. *Irvington*: From a mean maximum of 17 e.p.g. in August, the level of infestation fell throughout the summer to rise steadily to half the maximum in May. Thereafter counts fell steadily to disappear entirely from November onwards.

B. *Saxony*: Egg counts were recorded for the first time in October, rising suddenly in December and steadily increasing to a mean maximum of 14 e.p.g. in March; thereafter egg counts fell until the end of the survey.

C. *Ukulinga*: This species was absent.

Prevailing Climatic Conditions.

Climatic data were recorded and are included in figure 1. It will be noted that the mean maximum temperatures exceeded 20°C. Mean minimum temperatures only fell below 10°C. in winter, which coincided with the period when little or no rain fell.

Discussion

The discussion must be limited to statements of a general nature. The survey period was not more than 17 months on any farm, nor, with the exception of Irvington, were worm burdens heavy enough to warrant the drawing of conclusions. None-the-less certain patterns in the seasonal incidence of the various parasites were noted.

Haemonchus placei was the most prevalent summer parasite, but as calves reached an average age of 17 months, it assumed a very minor

rôle. At Irvington *Cooperia* spp. were at their highest levels in calves 3 months of age. On the other two farms, this was not the case, nor could any seasonal trends be noted. On the other hand *O. radiatum* was only really important in calves older than 9 months of age and remained at fairly constant levels thereafter. *Trichostrongylus* spp. were winter parasites. The level of infestation of *B. phlebotomum* was too low to be of any significance.

In many ways the results of these trials confirm the observations of Roberts[2] and Roberts, O'Sullivan and Riek[3]. In Queensland, Australia, where these workers carried out their trials, climatic conditions and animal husbandry methods are similar to those in Natal. It is therefore reasonable to assume that somewhat similar seasonal incidence trends in the worm burdens may occur.

Before this hypothesis can be substantiated, considerably more work will have to be done on stock with heavier worm burdens.

An interesting observation not mentioned in the results was noted at Irvington. The calf rearing methods were poor but the standard of feeding was high. No calf was treated with anthelmintics unless the egg count exceeded 6,000 e.p.g. This was found necessary in only a few calves on the farm. It appears that where worm burdens are not excessive, good feeding can control the effects of normal worm burdens.

SUMMARY

1. *Haemonchus* is the most important worm in the Pinetown and Pietermaritzburg areas and is prevalent in Spring and Summer.

2. *Cooperia* is common in calves up to the age of 10 months, but of little consequence thereafter; it is an early summer parasite.

3. *Oesophagostomum* is only of consequence in calves over the age of 9 months.

4. *Trichostrongylus* is a parasite of calves during the late winter.

5. Calves over the age of 20 months, that have been exposed to prior infestation have a strong acquired immunity to all species, with the possible exception of *Oesophagostomum.*

6. Where egg counts remained below 6,000 e.p.g., good feeding provided sufficient control of the nematode parasites encountered.

ACKNOWLEDGEMENTS.

The author records his thanks to the Director of Veterinary Services to publish this article and to Dr. R. K. Reinecke for his assistance and guidance.

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HELMINTH RESEARCH IN SOUTH AFRICA

II. SEASONAL INCIDENCE OF NEMATODE PARASITES OF SMALL STOCK IN THE GRAHAMSTOWN AREA

L. W. Rossiter*

INTRODUCTION

The work done here during the past year is part of a Union-wide survey which is being conducted to determine:

(*a*) the species of internal parasites affecting small stock in the area, and

(*b*) the seasonal incidence of the main species involved.

It was felt that our knowledge of these fundamental facts was inadequate for the intelligent application of control measures.

This area is one of considerably diversified relief and topographically may be divided into three regions, (i) the Fish River Valley to the north, (ii) a tract of ridges and valleys in the centre, and (iii) a coastal peneplain. It is also peculiar in that it lies in the zone of approximately equal summer and winter rainfall. In some years the winter rainfall is slightly higher than the summer rainfall but, in general, there is a balance in favour of the summer rainfall. The average annual rainfall varies from 25 in. to 15 in. and is in the nature of soft steady rains. Storms are uncommon but mists are fairly frequent along the hills, especially in summer, when they blow inland from the sea. It is further peculiar in that it is also the meeting ground of three very distinct Floras, viz., the South-Western Cape Flora, a subtropical Flora from Natal, and the Karoo Flora[1]. It may also be mentioned in passing that this area has been experiencing an unprecedented drought for the last seven years.

Three farms were chosen, one in each of the three regions, viz.:

(*a*) "Steynsrust" in the Bathurst district, some four miles inland from Port Alfred. The veld consists of mixed to sweet grass. Here 25 Merino ewes and 10 Boer goats were kept but the latter were withdrawn from the experiment.

(*b*) "Rockhurst" in the Albany district, some 26 miles to the North of Grahamstown towards the dry Fish River Valley. The veld consists of Semi-Karoo and Karoid Scrub. Here 25 Merino ewes were kept.

(*c*) "Kudu Estates", also in the Albany District, some 45 miles due west of Grahamstown below the northern slopes of the Zuurberg Range. The veld consists of mixed to sweet grass to semi-Karoo with Karoid scrub. Here 25 Angora goat ewes and later 10 kids were kept, but the observations on the latter are incomplete.

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Material and Methods

The survey was commenced at the end of 1959 (March, 1960 on Steynsrust). The sheep or goats were kept separately in small dry camps, where the stocking rate was lower than on the farm concerned; faeces were collected from each animal at fortnightly intervals. Egg counts were made.

The techniques used are described elsewhere[3].

Results

The results are depicted histographically in figure 1 for Steynsrust, Rockhurst and Kudu Estates. The highest mean egg per gram (e.p.g.) count is expressed as 100% for each species, and the fortnightly incidence as a percentage thereof.

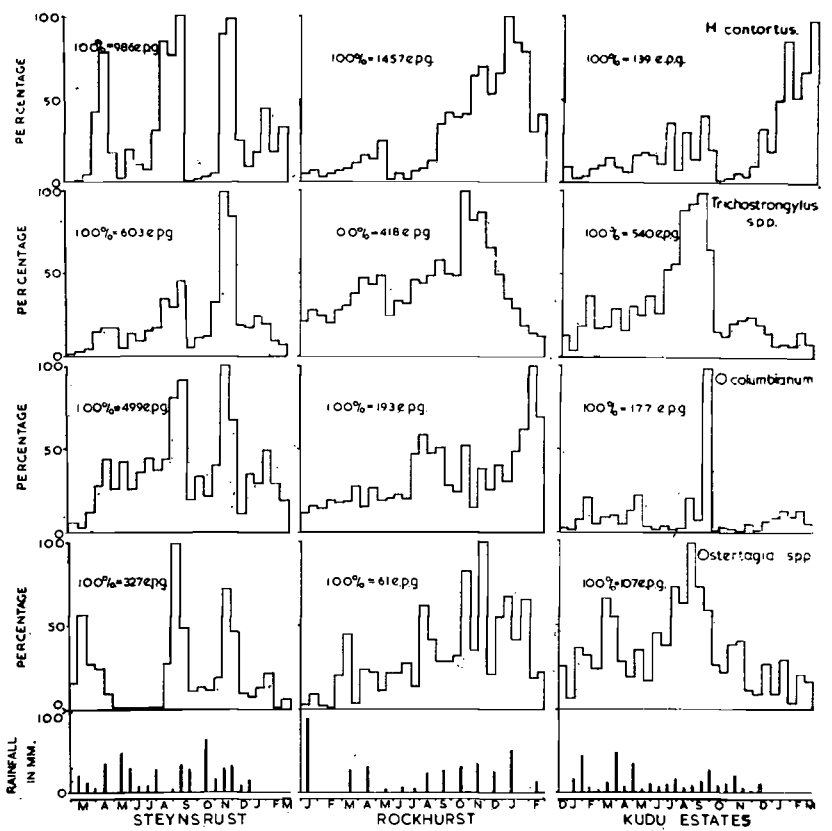

Fig. 1 Fortnightly mean egg per gram counts expressed as percentages of the highest fortnightly mean egg count for each species.

The four main species are *Haemonchus contortus*, *Trichostrongylus* spp., *Oesophagostomum columbianum* and last but by no means least, *Ostertagia* spp. In spite of the great diversity of climate, topography and

veld in respect of these three farms, a pattern more or less common to all three for both sheep and goats is seen to emerge from a study of the histographs.

(*a*) *Haemonchus contortus*: There is a summer to autumn rise in both sheep groups and a distinct fall during the winter, followed by a rapid rise in early spring reaching its peak in September and October, when it was found necessary to control it by drenching with Neguvon A* on no less than two occasions on Steynsrust. In goats, however, there is an insignificant summer to autumn rise, with no marked fall in winter but with a rapid spring rise as in the case of the sheep.

(*b*) *Trichostrongylus* spp.: In sheep there is a small rise in autumn, followed by a bigger rise in spring, reaching its peak in October and November. In goats, however, there is an insignificant rise in summer with a rapid rise in winter and spring, reaching its peak in August and September, followed by a rapid fall in late spring, presumably after dosing.

(*c*) *Oesophagostomum columbianum*: There is a slight difference evident between the two sheep flocks. On Steynsrust, apart from an insignificant rise in autumn and winter, there is a rapid rise in spring which reaches its peak in November and December. On Rockhurst, apart from a slight rise in autumn, there is a steady rise in winter, which, with minor ups and downs, reaches a peak in summer, i.e. January and February, a month or two later than the other flock. In goats there is no significant rise except when it shoots up rapidly in spring (September) and just as rapidly falls, presumably after dosing.

(*d*) *Ostertagia* spp. In both sheep flocks there is a distinct rise in autumn (February, March and April) followed by a sharp drop in winter but with a very rapid rise in early spring. In goats there is also an autumn rise, with a fall in winter, followed, as in the sheep flocks, by a rapid rise in spring.

Nematodirus spp., as reflected in the e.p.g. counts, are always present in the adult sheep and goats, but more especially in the lambs and kids: this agrees with the observations of Tetley[4] and Thomas[5]. They reach their peak during January and February.

Discussion

It will be observed that in general the e.p.g. counts are low; this however does not detract from the information so obtained as to the seasonal cycle of these nematodes. As has already been mentioned, the stocking rate in the camps was low and the rainfall below normal, associated with periodic heat waves. The combination of these factors severely limited the number of free living stages and hence the level of infestation. It was found on other properties during the course of this survey that where sheep are kept at higher stocking rates than in our paddocks, where artificial pastures are grazed and especially so when irrigated, the balance

* Neguvon A: A proprietary preparation consisting of "Neguvon" 10 parts and "Asuntol" 1 part which is used as an anthelmintic in S. Africa.

is grossly disturbed and the e.p.g. counts may soar to dangerous levels. As Gordon[2] so succinctly puts it: "Haemonchosis is a disease of the warmer months depending basically on the effects of temperature on the free living stages" and to this one may add: "also depending on rainfall."

The temperature at Steynsrust, which incidentally is a frostfree area, varies from a mean maximum of 23.3°C. to a mean minimum of 12.7°C., with an average of 18.0°C. The monthly average is only below 18.3°C. (65°F.), which is the lowest mean temperature for the development of the free living stage of this species, for the months of May to July, (Dinaberg as quoted by Gordon[2]).

At Rockhurst and Kudu Estates frosts are not unknown and the average of the first and last frosts occur on 16 June and 5 August respectively, but the mean maximum temperature is considerably higher (25.3°C.) which leads to a certain amount of desiccation of the dung and hence a marked mortality of the free living stages.

Rain, especially in excess of 18 mm., gives an impetus, particularly to *Haemonchus*, and this is clearly shown in fig. 1 where such rains fell on 4 January, 7 March and 20 November. The figure of 18 mm. is mentioned because it is rain of 18 mm. or more that releases the larvae from the dung pellets and allows their subsequent migration in the soil and hence to the vegetation.[2]

Gordon[2] states that the cooler months are more favourable for *Trichostrongylus* spp. This was so in goats at Kudu Estates, but both sheep flocks showed their peak during summer, i.e. October to December; this is perhaps owing to the fact that the nutritional level of the sheep was at its lowest during these months due to the summer decline of pastures.

Oesophagostomum columbianum is normally a cold weather parasite in spite of the fact that infection probably occurs during the warmer months. In goats it did reach its peak of infestation in winter but in the two sheep flocks the peak infestation appeared in spring and summer. It is difficult to speculate on the cause of this phenomenon but it is possible that the severe drought in winter had an adverse effect on the free living stages, as they are more susceptible to the adverse effects of temperature and moisture than the others already dealt with. The result is that the parasite is carried over to the spring and summer months.[2]

Ostertagia, whilst low under the conditions in which the experimental sheep and goats were kept, has shown itself on other properties to be one of the most important nematodes affecting small stock in this area. It causes a very rapid decline in the general health of its host. Both in sheep and goats it reaches its two peaks (in summer and early spring) a month or two at least before the peaks of *Haemonchus* infestation.

Strategic Drenching

This survey has provided fundamental knowledge which hitherto was sadly lacking. In spite of the fact that this knowledge is by no means complete and the experiments will have to be repeated, it does provide

sufficient data on which to base a dosing programme. As Gordon[2] states: "Sheep should be well fed at all times and drenched with the right drench at the right time and in the right way."

It is obvious that early spring, summer and autumn are particularly dangerous periods of the year and strategic drenching, i.e., treatments based on the seasonal fluctuations in worm burdens in sheep, should be applied as follows:—

Drench no. 1 in July to control the early spring rise of *Ostertagia* spp.

Drench no. 2 in August to forestall the spring rise of *H. contortus*.

Drench no. 3 in September to prevent the late spring rise of *Trichostrongylus* spp. and *O. columbianum*.

Drench no. 4 in December aimed especially at forestalling *Ostertagia* spp. and also *O. columbianum*.

Drench no. 5 in March to control the autumn rise of all four species.

In goats it would appear as if only three strategic drenchings are necessary, viz.:—

Drench no. 1 in July aimed essentially against the early spring rise of *H. contortus* and *Trichostrongylus* spp.

Drench no. 2 in August to prevent the spring rise of *O. columbianum* and *Ostertagia* spp.

Drench no. 3 in January to forestall the summer rise of *Ostertagia* spp.

In sheep, drenches nos. 3 and 4 should most definitely be microfine phenothiazine, whilst Neguvon A is indicated in the others. In goats Neguvon A is not safe and phenothiazine should be used. Many of the older remedies should find no place in the armoury of the modern sheep or goat farmer for adult stock. Some of the older remedies are, however, still useful for the treatment of tapeworm in lambs and kids.

Apart from these strategic dosings, there are the socalled tactical drenchings, i.e. three weeks after a rainfall of 18 mm. or more has been recorded. It may even be possible to combine some of the tactical drenchings with one or more of the strategic drenches and thus minimize handling of the flock.

Summary

1. The seasonal cycles of the four main nematode parasites in the Grahamstown area have been determined.

2. The four species are *Haemonchus contortus*, *Oesphagostomum columbianum*, *Trichostrongylus* spp. and *Ostertagia*, spp.

3. A dosing programme for both sheep and goats is given.

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The author expresses his thanks, too, to the Director of Veterinary Services for his assistance and for permission to publish this paper.

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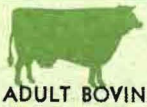 ADULT BOVINE		75 - 125 mg.	100 - 150 mg.
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HELMINTH RESEARCH IN SOUTH AFRICA

III. THE DIAGNOSIS OF NEMATODE PARASITES IN RUMINANTS FOR WORM SURVEY PURPOSES

R. K. Reinecke*

Introduction

Taxonomically the helminths of domestic ruminants are fairly well known, but very little is known of their geographical distribution, seasonal incidence, host-parasite relationships, the effects of climatic factors or husbandry methods on their incidence and so forth. In attempts to clarify the situation, a survey of the nematode parasites of domestic ruminants was started in 1958 in various centres in South Africa. Preliminary reports on the results of this survey have been published[7 5 12] with brief references to the methods used. This paper deals with the diagnostic procedures in more detail.

Examination in the Live Animal: Faeces Examination

At present faecal examination for worm eggs is the method of choice. In time serological and allergic tests will undoubtedly be of value in determining worm burdens, but these techniques have not yet been perfected sufficiently to replace faeces examination.

Equipment Required

(*a*) *For sampling*:

1. A twenty ml. test tube with a window cut into the blind end, or a copper tube of similar dimensions (as illustrated).
2. Collecting bottles.

(*b*) *For preparation of the faeces emulsion*:

1. A balance to weigh accurately in grammes, e.g. triple beam balance.
2. Forty per cent sugar solution.
3. An electrically operated blender.
4. Hundred ml. stout glass jars—one-quarter-pint milk bottles may be used—with rubber cork.
5. Ball bearings of about 5 mm. diameter.
6. Amyl alcohol.

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(*c*) *For making egg counts*:

1. Wide-mouthed pipettes of 5 mm. diameter.
2. McMaster slides (as illustrated).
3. Microscope with low power magnification (20–25 diameters).

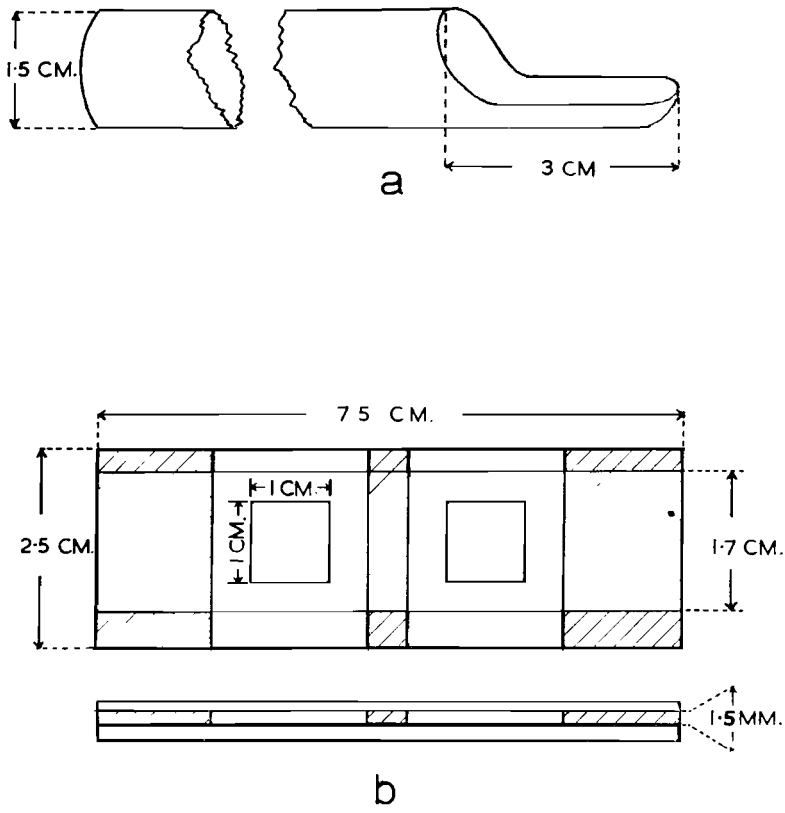

Fig. 1—(*a*) Sampling tube. (*b*) McMaster slide—top and side views. The square centimetres are engraved on the lower surface of the cover slide.

(*d*) *For preparing larval cultures*:

1. Heavy glass jars, ± 3 cm. diameter and 2 cm. high, e.g. rouge jar, which fit fairly snugly into

2. larger glass vessels, 5 cm. diameter and 4–5 cm. high, with screw caps.

3. Plastic wash bottle.

4. Vermiculite.

5. Incubator.

(*e*) *For identifying larvae*:

1. Forceps.
2. Labelled test tubes.
3. Pipette.
4. Lugol's iodine.
5. Microscope as above.

TECHNIQUE

(*a*) *Egg Counts*

The method used is a slight modification of the McMaster egg counting technique of Gordon and Whitlock.[3]

1. In sheep and goats, faeces are collected by inserting the sampling tube into the rectum. The faecal pellets fall through the tube into the collecting bottle. A 10 to 15 gm. sample is adequate. Defaecation may be stimulated in sheep and goats by inserting the finger into the rectum and rapidly rotating the finger for about 15 to 30 seconds. In calves it can be brought about by inserting two fingers into the rectum, spreading the fingers and slowly withdrawing them through the anus. In cattle 30 gm. faeces should be collected.

2. After mixing, the faeces are weighed off: 2 gm. in the case of sheep and goat faeces and 4 gm. in the case of calf faeces. The 40% sugar solution is added: 58 ml. to the sheep or goat faeces and 56 ml. to the calf faeces. The faeces are emulsified in the blender and placed in the 100 ml. glass jar or quarter pint milk bottle with six to ten ball bearings. The bottle is corked and shaken for 2 minutes.

3. Four to five drops of amyl alcohol are added to break air bubbles in the emulsion. The bottle is corked, shaken for a few seconds and the requisite amount of the emulsion transferred to a counting chamber of the McMaster slide by means of the wide-mouthed pipette. The vessel is again corked and the procedure repeated, each chamber of the McMaster slide being filled separately until six chambers have been filled for each specimen.

4. The slide is allowed to stand for 2 minutes to allow the eggs to rise to the surface, and then examined microscopically with maximum light under low power. All the eggs in the 10 mm. square on the lower surface of the coverslip are counted: these represent the eggs in 0.15 ml. of the emulsion. *Strongyloides* and *Nematodirus* eggs are counted separately. After counting the total number of eggs in six chambers the number of eggs per gram of faeces is calculated as follows:

Sheep and goats: Total No. of eggs $\times \frac{200}{6}$ = eggs per gram of faeces.

Cattle: Total No. of eggs $\times \frac{100}{6}$ = eggs per gram of faeces.

Since eggs are difficult, if not impossible, to identify with certainty, cultures are made and the larvae identified.

(*b*) *Larval Culture*

Whitlock's culture technique[13] is used, which is briefly as follows:—

1. The culture is made in the small glass jar. About 10 gm. faeces are broken up manually and the jar filled. If very dry, a little water is added from a plastic wash bottle. As cattle faeces are usually very moist, a little vermiculite is mixed with the faeces, until the consistency approaches that of moist sheep faeces. Furthermore, two cultures are made, as cattle are frequently lightly infested.

2. The jar is placed in the slightly larger vessel. Water is added to the outer vessel until it reaches the brim of the inner one. The lid of the larger vessel is screwed on, the jar labelled, and incubated for eight to nine days at 27°C.

3. The inner container is removed with the forceps, and the water remaining in the outer jar, which contains the larvae, is transferred to a labelled test tube. The larvae are allowed to settle for 20 minutes, a drop of the sediment is transferred to a glass slide, the larvae are killed with a drop of Lugol's Iodine or by heating the slide and identified microscopically under low power.

(*c*) *Larval Identification*

The keys drawn up by various authors are used to assist in larval identification.[8 2 6 9] At least 100, but preferably 200 larvae are counted and the different species noted on a percentage basis. Hand tally counters are of great assistance in carrying out these counts. *Strongyloides* and *Nematodirus larvae*, if present, are ignored.

(*e*) *Differential Egg Counts*

After carrying out total egg counts and identifying the larvae on a percentage basis, conversion to egg counts is a relatively simple matter, as shown in the example in Table 1.

TABLE 1

An Example of Differential Egg Counts on Sheep Faeces

Species	Original egg per gram counts
Nematodirus spp.	33*
Strongyloides spp.	366*
All other nematode eggs	10,000

Larval culture results expressed in percentages		Conversion to eggs per gram
Haemonchus contortus	67%	6,700*
Ostertagia spp.	12%	1,200*
Trichostrongylus spp.	15%	1,500*
Oesophagostomum columbianum	6%	600*
	100%	10,000

*Final result of the differential egg count.

(e) *Differential Egg Counts on a Flock or Herd Basis*

At present there are six centres where the worm survey is being carried out. The procedures followed, are shortly as follows:—

1. Flocks or herds are selected on three farms in the district, with conditions of animal husbandry that vary but are none the less representative of the district.

2. Climatic data are collected throughout the survey and attempts made to correlate this information with worm burdens, e.g., the sudden rise in egg counts after well distributed rains.

3. Twenty-five animals are regarded as representative of a flock or herd. This figure was arrived at after conducting a trial on 150 animals, which were divided at random into 6 groups of 25 sheep each. The mean egg count in each group was very similar to the average egg count for the whole flock. In fact, in only one group did the mean egg count vary by as much as 20% from the flock average.

4. On sheep farms 25 ewes and 25 lambs are selected for the survey flocks. In cattle herds 25 calves between 3 and 24 months of age are used. Most animals lose their worm burdens at 2 years of age and are replaced by calves under 3 months of age.

5. Every two weeks each individual animal in the survey flock or herd is sampled. Mean differential egg counts for the respective groups are estimated from the collected data and these are regarded as representative of the flock or herd.

COMMENT

Muller[10] has quoted other workers to confirm his observations that egg counts vary from day to day. Roberts[11] has shown that although high egg counts indicate heavy worm burdens in young susceptible animals, low egg counts do not necessarily indicate the reverse. However, egg counts are not entirely without value, particularly when taken regularly over a period of years. Trends can certainly be observed and differences between age groups noted. With all their shortcomings, they are certainly more reliable than any other technique for assessing worm burdens in live animals.

POST-MORTEM EXAMINATION

TECHNIQUE

The procedure at autopsy is shortly as follows:

1. The gastro-intentinal tract throughout its length is examined for worms. A macroscopic examination of the oesophagus and fore-stomachs is carried out and the rest of the gastro-intestinal tract divided into 3 parts:—

(i) the abomasum;

(ii) the small intestine;

(iii) the caecum, colon and rectum.

The advantage of separating this part of the gastro-intestinal tract into three sections, is to assist in the identification of the worms, which are for the most part specific for their localities.

2. The ingesta of each part is sieved separately and in the case of the abomasum and small intestine, passed through two sieves of 44 meshes to the linear inch and 100 meshes to the linear inch respectively. The sieves are fairly large and a strong stream of water is used to wash out the fine ingesta. The sievings are placed in separate labelled jars to which 10 ml. of 10% formalin are added.

3. Herlich's[4] technique is used for the digestion of the gut. The three parts of the gut are placed separately in a freshly prepared solution consisting of 10 gm. pepsin, 30 ml. concentrated HCl in a litre of water. The pH is adjusted to below 2 by the addition of more HCl if necessary; 200 ml. of this solution are added to each 100 gm. of gut and incubated at 37°C. overnight.

4. The material is sieved through a 200 mesh sieve; the sievings containing immature and adult worms are collected in glass jars to which 4 or 5 ml. of 10% formalin are added.

5. Total worm counts of each genus are made by examining aliquots of the ingesta and digested gut under a dissecting microscope. Generic identification of the third and fourth stage worms is carried out with the assistance of Douvre's Key[1]. If many worms of the same genus are present, 60 to 100 adult males are examined microscopically and the number of each species present expressed as a percentage of the total.

6. The abdominal cavity, lungs and liver are examined for worms. Where *Coenurus cerebralis* is suspected the brain is also examined.

Post Mortem Examination for Survey Purposes

Regular autopsies throughout the year are of great value for survey purposes. The ideal is regular slaughtering under controlled conditions with thorough examination of the worms collected. An example is quoted below:

The object of the experiment was to determine the worm burdens in sheep from the age of eight weeks to two years, at the Outeniqua Experimental Farm, in the George District. Lambing takes place in the spring and the experiment commenced in September, 1960. Two eight week old lambs and two yearlings were slaughtered; every fortnight thereafter a further 2 lambs and 2 yearlings were slaughtered and the experiment will continue for a year. Complete autopsies, using the techniques already described, are carried out. Egg counts on two flocks of lambs and yearlings on the same farm are being carried out for comparative purposes.

COMMENT

Critical slaughter trials confirm the presence and severity of adult worm burdens and are the only accurate indication of the immature worm burdens. The data of more than 50 analyses per age group over a 12 months' period will provide critical evidence of the seasonal worm burdens. This will also indicate how much reliance may be placed on regular differential egg counts.

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IV. FIELD TRIALS ON THIABENDAZOLE* (M.K. 360) AS AN ANTHELMINTIC FOR SHEEP; WITH A NOTE ON THE ASSESSMENT OF DIAGNOSTIC METHODS

G. L. Muller†

INTRODUCTION

Recently Brown *et al.*[1] reported the discovery of a new class of anthelmintic agents possessing a broad spectrum of activity for gastro-intestinal helminths of domestic animals. The most outstanding anthelmintic was 2—(4'–Thiazolyl)—benzimidazole (generic name: thiabendazole). The structural formula and other relevant data of a chemical nature are reported by these authors. It was decided to test this anthelmintic under field conditions at the Outeniqua Experimental Farm, George, Cape Province. This paper describes the results of these trials.

METHOD

Seventy-eight (78) sheep of varying ages (yearlings and mature animals) were divided into three groups of 25, 25 and 28 respectively. Using the modified McMaster technique, faecal egg counts of all three groups were determined every day for five days prior to dosing day (D-day).

TABLE I

Average e.p.g. Count for Sheep—Prior to treatment

Date	Group 1 25 sheep			Group 2 25 sheep			Group 3 28 sheep		
	Nem.	Strong.	Other	Nem.	Strong.	Other	Nem.	Strong.	Other
15.11.60	—	3	1,390	—	27	2,290	—	—	610
16.11.60	3	30	1,781	1	9	1,827	—	—	675
17.11.60	—	33	1,709	—	9	2,045	—	—	1,623
18.11.60	—	38	2,227	6	18	2,501	3	—	1,822
19.11.60	4	4	576	—	9	1,068	3	3	579
Mean....	1	21	1,536	1	14	1,946	1	1	1,062

Key: Nem.—*Nematodirus.*
Strong.—*Strongyloides.*
Other—All other nematode strongyles.

* This drug was kindly supplied by Merck, Sharpe and Dohme under their Code Number M.K. 360.

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Not only were faecal egg counts made, but after incubation of faecal samples, a larval determination of the nematode strongyles present in the gastro-intestinal tract was carried out.

TABLE II

Average e.p.g. Counts and Larval Differentiation Eleven days before Treatment.

	e.p.g. Counts			Larval Differentiation on a percentage basis						
	Nem.	Strong.	Other	Haem.	Oes.	Bun.	Trich.	Ost.	Chab.	Coop.
Group 1	—	33	1,709	22	—	11	61	1	5	—
Group 2	—	9	2,045	23	1	5	60	1	10	—
Group 3	—	—	1,623	13	1	29	54	1	2	—

Key: Haem. — *H. contortus*
Oes. — *Oesophagostomum* spp.
Bun. — *B. trigonocephalum.*
Trich. — *Trichostrongylus* spp.
Ost. — *Ostertagia* spp.
Chab. — *C. ovina*
Coop. — *Cooperia* spp.

The preliminary counting of the number of eggs per gram of faeces (e.p.g. counts) was conducted from the 15th to the 19th November, 1960. On 28 November, 1960, the animals were weighed individually and treated as follows:

Group 1 (25 animals) was dosed per os with a suspension of thiabendazole at the rate of 50 mg. active ingredient per kilogram live weight.

Group 2 (25 animals) received 100 mg. active ingredient of thiabendazole in suspension per kilogram liveweight.

Group 3 (28 animals) remained as undosed control group.

Group 1 and 2 had received a predosing stimulant of 4 ml. of a 10% solution of copper sulphate.

Both prior and subsequent to dosing, all 78 animals were grouped together as a single flock and grazed with the rest of the sheep on the farm under the normal husbandy methods practised.

For three days subsequent to dosing, five animals out of each of the three groups were bagged and the faeces collected at 24-hour intervals. Every seven days after being dosed for a period of three weeks, faecal samples were collected from all the animals of each group and e.p.g. counts were made.

TABLE III.

Average e.p.g. Count per Sheep—Post-dosing.

Date	Group 1 50 mgm./kg.			Group 2 100 mgm./kg.			Group 3 Controls		
	Nem.	Strong.	Other	Nem.	Strong.	Other	Nem.	Strong.	Other
5.12.60.....		40	39		9	24		79	965
12.12.60.....			53			9		1	1,032
19.12.60.....			59			33			340
Mean.....		13	50		3	22		26	779

On 5.12.60, i.e. seven days after dosing, larval determination of the genera present was also carried out.

TABLE IV

E.p.g. Counts and Larval Differentiation — Post-dosing. 5.12.60

	e.p.g. Counts			Larval Differentiation						
	Nem.	Strong.	Other	Haem.	Oes.	Bun.	Trich.	Ost.	Chab.	Coop.
Group 1*		40	39			266	5			
Group 2*		9	24			188	4			
Group 3†		79	965	36		34	24		6	

* = Total larval count. † = Average percentage differentiation.

On 4.1.61 the animals were all weighed individually.

RESULTS

Table I shows a mean predosing e.p.g. count for Group 1 of 1,536, for Group 2 of 1,946, and 1,062 for Group 3.

Faecal examination after dosing at weekly intervals for 3 weeks showed a marked drop in the mean e.p.g. counts of the treated groups, viz. from 1,536 to 50 in Group 1; 1,946 to 22 in Group 2, while the undosed controls continued to show a relatively high mean of 779.

The examination of the faeces collected by bagging had to be abandoned as the result of staff problems and the results of the few specimens examined were inconclusive.

An assessment of the efficacy of the drug against the various genera present is obtained by comparing Tables II and IV.

In Table V the average weight per sheep and the weight gain per sheep are indicated.

TABLE V.

Weight gains of individual groups—Average per sheep.

	Group 1	Group 2	Group 3
Predosing weight.....	83.5 lb.	86.1 lb.	121.9 lb.
Post-dosing weight.....	91.5 lb.	91.7 lb.	127.5 lb.
Weight gain per sheep.....	+8.0 lb.	+5.6 lb.	+5.6 lb.

DISCUSSION

Despite the fact that the daily faeces collections were made at the same time (9 a.m.) each day, a considerable variation in the daily e.p.g. counts of each animal was encountered. This phenomenon has been commented on by Gordon[2].

Within 7 days after dosing the mean egg per gram counts dropped from the high levels of 1,536 and 1,946 for the test groups to 50 and 22

e.p.g. respectively. The undosed Group 3 (controls) showed considerable fluctuations in the daily mean e.p.g. counts, but not the spectacular drop common to Groups 1 and 2.

The larval determination (Table II) shows the presence of the majority of nematode strongyles with the exception of *Cooperia* spp., although *Oesophagostomum* spp., and *Ostertagia* spp. are poorly represented to the extent of 1% in both genera.

Post-dosing incubation of faeces samples on 5.12.60 produced mainly *Bunostomum* larvae with a very limited number of *Trichostrongylus* spp. (Table IV). It is therefore apparent that thiabendazole caused the complete disappearance of the eggs of *Haemonchus contortus*, *Oesophagostomum* spp., *Ostertagia* spp., and *Chabertia ovina*. Whereas *Trichostrongylus* spp., in the pre-dosing samples had been present in all three groups on an average of 58% or a mean conversion total of 1,005 larvae (Table II), the post-dosing examination of incubated faeces gave a total of only 9 *Trichostrongylus* spp. larvae from Groups 1 and 2, while Group 3 still showed that 24% (or 232 by conversion) of the larvae present were *Trichostrongylus* spp. It is apparent, therefore, that thiabendazole is very effective against all the nematode helminths of the gastro-intestinal tract with the exception of *Bunostomum trigonocephalum*.

The question whether the disappearance of eggs, as shown by the faecal counts (Table III) subsequent to dosing, is the direct result of an elimination of the affected nematodes, or whether it is the result of a suppression of the egg-laying capacity of the females, cannot be answered by the examination of faeces alone. The answer would have to be supplied by conducting fairly large scale critical slaughter tests when a minimum of 10 sheep per group should be slaughtered.

It is claimed by Brown *et al.*[1] that at dosage rates of 50 mg./Kg., 95% of worms of ten genera (*Trichostrongylus*, *Cooperia*, *Nematodirus*, *Ostertagia*, *Haemonchus*, *Oesophagostomum*, *Bunostomum*, *Strongyloides*, *Chabertia*, *Trichuris*) were removed in sheep. These trials did not support their claim for the efficacy against *Bunostomum*, within the limits of the egg counting technique.

An examination of the literature shows that, within recent years, a number of drugs have been tested for anthelminthic efficacy, e.g. by Gordon[3], Herlich and Porter[4], Meldal-Johnson *et al.*[5], Reinecke and Schutte[6], Riek[7], Riek and Keith[8], Stampa,[9] [10] Thorold *et al.*[11] The majority of these tests, with the exception of those carried out by Herlich and Porter[4], have been based on the examination of faecal egg counts. The trials conducted by Herlich and Porter have been based on critical slaughter tests.

As previously stated, Gordon[2] has commented on the variable faecal e.p.g. counts and this phenomenon has again been demonstrated by the e.p.g. counts of the 78 animals recorded on successive days in this experiment. The fluctuations of the e.p.g. counts detract considerably from the value of such methods of assessment. Further doubts as to the value of faecal e.p.g. counts as a criterion of the number of helminths present

were raised during the course of slaughter tests in an epizootiological project being conducted by the author. Whereas a number of animals had shown remarkably low faecal e.p.g. counts with corresponding low larval counts, such animals, on slaughter, had shown considerable numbers of nematodes to be present in the gastro-intestinal tract. To assess the value of any anthelminthic, it is essential that large scale critical slaughter tests should be carried out, as by this method the only logical evidence can be presented as to the efficacy of the anthelminthic.

No untoward reactions were observed in any of the animals dosed with thiabendazole, so that, at the indicated dosage range, the drug appears to be reasonably safe.

Conclusions

The results of the tests, described above, indicate that thiabendazole is an anthelminthic of very high efficacy against all the gastro-intestinal nematodes present with the exception of *B. phlebotomum*. These results warrant field trials and critical slaughter tests on a larger scale.

Summary

1. Two groups of sheep (25 each) were dosed with 50 mg./Kg. and 100 mg./Kg. of active ingredient of thiabendazole respectively, with a third group (28 animals) acting as undosed controls.

2. The results obtained by faecal e.p.g. counts and larval differentiation indicate a high value as an anthelminthic drug against most gastro-intestinal nematodes with the exception of *B. phlebotomum*.

3. The value of faecal e.p.g. counts as a criterion of anthelminthic efficacy is doubtful and critical slaughter tests are advocated as the only logical method of assessment.

ACKNOWLEDGEMENTS

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HELMINTH RESEARCH IN SOUTH AFRICA

V. ECHINOCOCCUS IN SOUTH AFRICA

Anna Verster*

Echinococcus is a genus of tapeworm which, in the adult or sexual stage, occurs in the intestine of predator carnivores; the asexual stage, in the form of hydatid cysts, occurs in the prey, e.g. perissodactyls, artiodactyls, rodents and primates. The classification of the genus is based mainly on characters of the adult, such as the number of segments, and the number and arrangement of the testes.[7] Previously the size of hooks was also used, but it has been shown that these continue growing after the adult is established in its carnivore host.[9]

Three species of *Echinococcus* have been described from South African carnivores, viz.:

(1) *E. granulosus* from dogs in the Pretoria vicinity[1] (Lopez-Neyra and Planas[2], however, consider this a new species, *E. ortleppi*).

(2) *E. lycaontis* Ortlepp, 1934[4], from the Cape hunting dog, *Lycaon pictus*.

(3) *E. felidis* Ortlepp, 1937[5], from the lion, *Panthera leo*.

Work is at present in progress on the incidence in the livestock, and on the identity of the parasites and that of their hosts. These investigations have not yet progressed to the stage where definite conclusions can be arrived at, but a number of interesting observations have been made.

(1) *Incidence*

In a preliminary survey, data on the incidence of hydatid cysts were obtained from the directors of five of the larger abattoirs, covering periods from 6 months to 15 years. These data showed the following average incidences:

Cattle: 0.7% (total number slaughtered: 4,886,441).

Sheep and goats: 1.8% (total number slaughtered: 12,936,963).

Pigs: 0.4% (total number slaughtered: 735,852).[10]

Despite the fact that the incidences shown by the preliminary survey were relatively low, it was decided to organize a further more detailed survey, covering both large and small centres; the large centres would reflect the incidence over the country as a whole, while the smaller centres, which obtain their slaughter stock locally, would give information on specific areas. This survey, covering 21 centres, has been in progress for

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nine months; only the data of the first six months, however, will be discussed (Table I).

TABLE I.

Average monthly incidence of hydatidosis from some South African centres.

Centre	Cattle	Sheep	Goats	Pigs
	%	%	%	%
Bloemfontein	3.1	3.7	—	0
Ermelo	4.7	4.0	—	0
Grahamstown	10.5	1.4	—	0
King William's Town	28.6	13.4	—	13.5
Pietersburg	10.6	3.5	1.3	1.7
Port Elizabeth	3.1	0.3	4.4	0.03
Queenstown	10.3	1.0	—	5.3
Umtata	10.8	0.3	—	5.7
Upington	0.6	0.8	4.9	0.2
Welkom	1.8	25.6	—	0
Worcester	8.2	10.1	—	32.1

This survey has shown that hydatid cysts occur in livestock in all parts of the country.

Incidence in Cattle

Only at one centre (Calvinia) could no hydatid cysts be found in cattle. Average incidences below 1% were recorded at five centres, while average incidences between 1 and 3% were recorded at five centres; average incidences above 3% were recorded at eleven centres, five of these being above 10%.

Incidence in Sheep

Only at one centre (Pretoria) could no hydatid cysts be found in sheep. Average incidences below 1% were recorded at nine centres, between 1 and 3% at six centres and average incidences above 3% at a further six centres.

Incidence in Goats

Figures regarding the incidence in goats have been submitted by six centres only. One centre showed an average incidence below 1%, two centres between 1 and 3% and three above 3%.

Incidence in Pigs

At seven centres no hydatid cysts in pigs were recorded; an average incidence below 1% was found at seven, while at one the incidence was between 1 and 3%; at six centres the recorded incidences were above 3%.

It is to be regretted that the incidence in human beings is not known. The only figures available are these kindly supplied to me by Dr. Hesselson: at Groote Schuur Hospital, Cape Town, an average of 17 cases

per year over 10 years and at Belville Hospital 2 cases per year over $2\frac{1}{2}$ years were encountered. Although the above figures for the Cape cannot be considered negligible, the incidence in this country as a whole does not appear to be as high as in other countries.

(2) *The identity of the species occurring in South Africa.*

During investigations on the biology of *Echinococcus*, altogether 828 hydatid cysts of bovine origin were dissected. These cysts were mainly fertile, i.e., contained scolices; only 2.8% were sterile. During the latter part of the investigation, calcified cysts, i.e. degenerate cysts which may or may not have contained scolices, were also included in the investigation. Of the 394 cysts so examined, six were sterile and 29 calcified, making a total of 8.1% sterile cysts.

The above findings show the fertility of these samples of South African cysts to be higher than any previously reported in the literature. The most recent data, incidentally those corresponding most closely with the above figures, are Pullar and Marshall's for hydatid cysts of bovine origin in Victoria, Australia.[6] They found that 63% of the cystic parasites were fertile, as against the South African figure of 97.2%, and that 22% of *all* parasites were fertile as against 91.9% in South Africa.

Since the species cannot be determined from the hydatid cysts alone, various carnivores were infested with equal amounts by volume of scolices of bovine and ovine origin; domestic cats received half the amount. Three Cape hunting dogs, *Lycaon pictus*, two domestic dogs, *Canis familiaris*, one dingo, *Canis dingo*, two silver foxes, *Vulpes chama*, and three domestic cats, *Felis domesticus*, were infested with scolices from each strain. The animals were slaughtered 48 days after infestation and the numbers of parasites recovered from the various hosts were compared (Table II).

TABLE II

Numbers of worms recovered from different hosts infested with the same number of scolices.

Strain	*L. pictus*			*C. familiaris*		*C. dingo*	*V. chama.*		*F. domesticus* a		
	No. 1	No. 2	No. 3	No. 1	No. 2	No. 1	No. 1	No. 2	No. 1	No. 2	No. 3
Bovine	—b	14,200	23,000	580	3,384	4,580	10	120	62c	—d	6
Ovine	6e	7,061	14,672	2	250	12	0f	0f	0f	0f	0f

a. Received half the dose given to the larger carnivores.
b. Due to an injury this dog died shortly after infestation.
c. Died three days after infestation.
d. No scolices given
e. Approximately 10 months older than No. 2 and 3.
f. No specimens recovered.

Bovine Material

The tapeworms resulting from the bovine cysts morphologically resemble *E. granulosus*, in the number of testes and number of segments, and in the size of the hooks, but differ in three aspects of their life cycle:

(1) The South African cysts of bovine origin are mainly fertile, whereas elsewhere *E. granulosus* cysts of bovine origin are not so fertile[6].

(2) The Cape hunting dog is apparently more susceptible to infestation than is the domestic dog which is considered one of the normal hosts of *E. granulosus*.[1 11]

(3) In the cat a small percentage of the worms took and matured, whereas *E. granulosus* has not been known to mature in the cat.[3 8]

Ovine Material

The worms resulting from the ovine hydatid cysts resemble *E. lycaontis* in the number of segments, but have only two rows of hooks, whereas *E. lycaontis* has four rows.[4] The Cape hunting dog is also apparently more susceptible to infestation than is the domestic dog or the dingo. These tapeworms do not establish themselves in the Silver fox or domestic cat. Unfortunately, it is impossible to trace the area of origin of the sheep which supplied this particular material. Since the Cape hunting dog does not occur in the major sheep-rearing areas, it is possible that other carnivores, with a less restricted distribution, may act as the definitive host of this strain or species.

It is thus clear that it is impossible to assign these parasites to any given species at the present stage of the investigations. It is hoped that further work will show whether one is dealing with *E. granulosus* itself and/or two or more other species, or whether all the forms found are but variants of one species.

SUMMARY

1. Average monthly incidences of hydatidosis from some South African centres are recorded.

2. Fertile cysts comprised 91.9% of all cysts, and 97.2% of all cystic parasites of bovine origin.

3. The numbers of parasites resulting from scolices of bovine and ovine origin in various carnivores are compared.

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ENZOOTIC PNEUMONIA OF CALVES IN SOUTH AFRICA

S. J. van Rensburg† and R. Every‡

Introduction

Pneumonias of the calf characterized by slight tissue destruction have been variously termed pneumoenteritis,[1] enzootic bronchopneumonia,[2] enzootic pneumonia,[3] cuffing or atypical pneumonia,[4] pneumonitis,[5] and virus pneumonia[6]; considerable variations in the pathology and other aspects of the disease have been recorded. Possible multiplicity of aetiological agents[7] and the influence of extrinsic factors may be responsible.[8] A satisfactory terminology still awaits conclusive elucidation of the causative factors.

In recent years the authors have noted the widespread occurrence in this country of a distinctive entity in bovines, in which pulmonary and, to a lesser extent, intestinal involvement are cardinal features. Proliferative cellular inflammatory phenomena of a chronic nature, rather than exudation and tissue destruction, predominate. The complex may easily be overlooked, as appreciable lesions are frequently lacking and clinical symptoms usually assume an insidious character.

Following several years' investigation, it is the authors' conviction that this disease has a pertinently detrimental effect on the growth rate of calves. It is also frequently intimately implicated in mortality resulting from multiple factors, and on occasions it is of primary significance in causing death.

Procedure

Observations on aspects of the natural disease have been made for some five years during the course of veterinary practice, mortality investigations, and meat inspection duties at abattoirs. Deductions as to the pathogenesis of the disease were made by examination at the abattoir of animals of different ages from known farms, necropsy of unprofitable individuals, and post mortem examination in cases of mortality. In addition, enzootic pneumonia was frequently observed in animals where death was attributed to other causes.

Formalin-fixed material was taken from 25 calves ranging in age from two weeks to one year, haematoxylin-eosin sections for histopathological examination being prepared from the lungs, intestine, lymph nodes, liver, kidney, myocardium and spleen. The lungs of 200 mature bovines were scrutinized at slaughter for evidence of unresolved pneumonia and

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sections for histological examination were prepared from five, the oldest animal being eight years of age.

The bulk of the observations were made in the Natal Midlands. The disease has, however, also been seen, and proved histopathologically similar, in the Western Cape and in the Transvaal.

General Observations

Epizootology

Seasonal variation in the incidence of the disease appears to occur, the condition being particularly prevalent during wet summer months in areas where highly variable weather conditions exist. Higher rainfall areas appear to favour severe outbreaks, while in semi-arid regions the entity appears to be self limiting. In recent years, however, the incidence of the disease appears to be increasing, and on farms where it has been prevalent for some time, cases are being recognized throughout the year.

As a clinical entity the disease is confined virtually exclusively to calves kept under intensive farming conditions. Typical cases in calves on extensive ranching enterprises have not been encountered. Where, however, the undesirable "dairy ranching" is practised and the calves congregate in a confined space, the disease frequently occurs. In large herds, with an indifferent standard of management and where crowding of many calves under unsanitary conditions takes place, its ravages can be particularly severe. Once established in such a herd, the condition appears to become progressively worse.

Pathogenicity

All breeds appear to be equally susceptible, but in practice it is confined mainly to dairy calves, as these are mostly kept under intensive conditions. Clinical cases have not been seen in calves under two weeks of age and a marked resistance to the condition appears to be present after the age of six months. Calves appear to be highly susceptible between the ages of three weeks to three months. In the presence of any debilitating factor, the insidious chronic form may be encountered from three months to one year of age. Examination of lungs of mature animals at slaughter revealed that small areas of consolidation may be detected in animals of any age.

The disease appears to be highly contagious when unfavourable conditions prevail and the morbidity can then be 100 per cent. The mortality rate is difficult to assess, owing to the fact that a secondary condition may frequently be the actual cause of death. On farms which had a history of severe calf mortality of up to 90 per cent for prolonged periods, however, the presence of faulty management and enzootic pneumonia have been consistent findings.

Predisposing factors

As with many diseases, but especially in enzootic pneumonia, any factor which is detrimental to the vitality of the calf may markedly aggravate the course of the disease. In practice, a combination of these factors usually appears to be operative, and only on rare occasions has an individual in excellent physical condition been observed to succumb to the condition.

Incorrect housing is a common fault. The disease appears to thrive when intimate contact occurs in communal unsanitary pens or poorly ventilated sheds. Lack of adequate shelter during rainy seasons leading to excessive contact with moisture and sudden variation in skin temperature is another predisposing factor.

Faulty nutrition is also frequently concerned. Inadequate or excessive amounts of milk, feeding inferior milk substitutes or skimmed milk without any vitamin supplementation, and unhygienic feeding utensils are common malpractices. With the current practice of weaning calves at an early age, satisfactory nutrition during the postweaning period has assumed increased importance. Good quality hay as roughage is particularly important. In one severe outbreak, calves had been put out to luxuriant clover pastures without any access to hay after weaning: the survivors at two years of age are still very stunted.

Further factors which may predispose to the condition are internal and external parasites. A heavy tick infestation, particularly with *R. appendiculatus*, lowers the resistance of the animals. Of the internal parasites, *Moniezia* spp. infestation is commonly encountered with severe forms of the disease.

Diseases frequently associated with severe pneumonia or an acute flare-up of a previously quiescent lesion, are anaplasmosis, paratyphoid, and babesiosis. It is not always clear if one of these diseases or pneumonia was primary; however, in combination each appears to have a synergistic action and if death does not intervene the disease may become most persistent, and the efficacy of therapy limited.

Clinical Aspects

Case History

This has been found to be most characteristic and useful in aiding diagnosis. Usually the calves are reported to have been thrifty up to approximately two weeks of age. Thereafter there is a progressive deterioration in condition, the appetite, however, remaining unimpaired. The calf suffers from moderate intermittent attacks of greenish or yellowish diarrhoea, which is never severe but sufficient to soil the tail. In older calves the diarrhoea is invariably green in colour.

As the condition progresses, the calf becomes listless and frequently stands for long periods in one position, refraining from the frolic of

healthy calves. If death supervenes, there is a sudden and generally unexpected collapse with death taking place within a few hours. By this time the animal is usually considerably emaciated.

Clinical Examination

The degree of symptoms vary widely, depending on the presence of predisposing factors. The clinical disease may be divided into the transient, subacute, and chronic forms.

The mild *transient form* occurs on farms where the standard of calf management is satisfactory, or during the dry months of the year. There is usually irregularly intermittent pyrexia varying between 102° to 104°F. The conjunctival mucosa is congested and a slight discharge is present. Coughing is not always evident, and percussion and auscultation of the thorax reveals nothing abnormal. The superficial lymph nodes are usually slightly enlarged. Appetite is unimpaired and little loss of condition occurs. Evidence of mild diarrhoea may be noted. Provided the calf does not receive a severe setback before the age of six months, these cases are benign and recover rapidly.

The *subacute form* is found particularly on farms where the standard of management is poor and a combination of predisposing factors exists. On clinical examination the calves show a temperature of 103° to 106°F. and variable degrees of tachycardia. Auscultation of the chest may reveal moist râles or areas where adventitious sounds are absent. The conjunctiva is usually congested and some serous to mucopurulent discharge is present. Invariably there is a moderate diarrhoea but the appetite remains unchanged. Hyperpnoea is distinct, and in the event of death, dyspnoea is present during the terminal stages. Evidence of associated diseases is frequently present and according to the availability of secondary bacterial opportunists, complications such as pleuritis or purulent bronchopneumonia may supervene.

The *chronic form* is most commonly encountered and is considered the most grave type economically. Symptoms are of a very protracted nature and are accompanied by progressive loss of condition, eventually leading to marked emaciation. Hyperpnoea and a non-productive cough, which may easily be induced, are invariably present. Auscultation frequently reveals tachycardia and moist râles. A generalized enlargement of the superficial lymph nodes takes place. Diarrhoea may be continuous or intermittent. As the condition progresses, anaemia develops, the coat becomes shaggy and lustreless in appearance, and the eyeballs become sunken.

The course of the chronic form varies considerably according to the degree of adversity of the environment. Death may take place after three weeks or it may take as long as three months to occur. Mortality after six months of age is generally due to some secondary condition. Usually, however, the animals survive, the recovery period being extremely prolonged and permanent underdevelopment a common outcome.

Treatment

No specific therapeutic treatment has been found to be effective for the primary condition. Affected calves should be isolated and suitably housed. The use of the tetracyclines in cases where secondary bacterial complications are present, reduces the mortality rate considerably. Intestinal antiseptics and symptomatic treatment of diarrhoea meets with limited success.

Supportive therapy has been found useful particularly in chronic cases. A course of intramuscular haematinics should be instituted. Large doses of vitamin A given orally or parenterally appear to be beneficial.

Control

Contrary to therapy, prophylactic measures are highly successful when applied rigorously. As enzootic pneumonia only appears in the severe form when predisposing factors exist, deficiences in respect of calf management must be rectified, and farmers encouraged to raise only limited numbers of calves in order to ensure best available attention. Undoubtedly, in the case of intensive dairy herds, the most important factors in controlling the disease are high standards of nutrition and housing combined with meticulous hygiene.

Satisfactory results have been attained by allowing newborn calves to run with their dams for 2–3 days and then resorting to bucket feeding twice or three times daily. If skimmed milk is used, it is supplemented with vitamin A preparations. Milk powders are suitable, but caution must be exercised with the choice of milk substitutes. Good quality hay and calf meal is fed from the age of two weeks. Weaning may take place at four months of age provided suitable feed is available, failing which, it is essential that weaning should not occur before six months.

It is imperative that calves be housed in individual pens for effective control. The calf pens should face approximately north, being open in this direction and the other three sides closed to avoid any contact with adjoining animals. It is desirable that calves be confined in these pens for six months, adequate dry bedding being provided daily.

Usual prophylactic measures against associated diseases, such as inoculation against paratyphoid, anaplasmosis, and babesioses assist in limiting the severity of pneumonia.

Prognosis

In subacute cases the mortality rate is high, while in the chronic form the prognosis is grave economically. The mild form usually encountered under favourable conditions is essentially benign.

In the Natal Midlands the condition appears to be on the increase and many dairy farmers have ceased attempting to raise calves. The entity reduces the resistance of calves to other diseases, the appearance of which in turn is followed by recrudescence of the pneumonia in the severe form.

Macroscopic changes

Lungs: Slaughtered calves less than two weeks of age, which originated from known affected farms, show patchy, reddened and slightly raised areas on the anterior lobes of the lungs. By two weeks of age light reddish-grey areas of consolidated lung parenchyma are evident, particularly at the tips of the apical lobes, the volume of the affected tissue being slightly increased. The right apical lobe is involved most constantly and the consolidated portions may be distributed along the course of the bronchial tree. The lesions appear to become confluent and progressive consolidation of the affected lobes with distinct lobular delineation follows.

In calves apparently suffering from the benign form, less than a quarter of the anterior lobes are involved. Marked lesions may involve all the anterior lobes and the ventral and anterior portions of the diaphragmatic lobes. Limited consolidation only is frequently present, however, in chronic cases and in some instances of mortality. The latter cases often show oedema and patchy consolidation throughout the lungs in addition to usual longstanding anterior lesions. In cases of some standing the consolidated tissue is slightly decreased in volume and deep reddish-purple in colour with mildly increased consistency. On incision the surface has a slightly moist, "meaty" appearance and the walls of small bronchi may be prominent. Changes, such as purulent bronchopneumonia and adhesive pleuritis due to secondary bacterial invasion, are not infrequent.

Animals which appeared to have recovered from the disease usually show an irregular shape particularly of the extremity of the right apical lobe. This appears to be due to contraction of fibrosed interlobular septa and is considered to be evidence of resolved pneumonia. This anomaly was observed in 90 per cent of 200 mature bovines examined. In addition, 33 per cent of these animals had evidence of adhesive pleuritis and in 14 per cent small areas of consolidation were detected.

Intestine: A constant feature in relatively acute cases is thickening of the wall of the small intestine, particularly that of the ileum. The mucosa is diffusely and lightly reddened and an excess of catarrhal mucus is present.

Lymph nodes: Initial stages of the disease are accompanied by marked enlargement of the mesenteric and bronchial nodes. When pressure is applied to incised mesenteric nodes, milky white fluid exudes and is considered a characteristic feature. A generalized enlargement of lymph nodes, which are irregularly hyperaemic and moist on section, is noted in the chronic disease.

Spleen: A moderate tumor splenis is invariably present. The cut surface is not unduly moist and the lymphoid tissue is prominent.

Liver: The liver is usually pale brown in colour and a mild increase in consistency may be detected. On close inspection of the cut surface

in chronic cases small alternating red and brown areas may result in a variegated appearance.

Kidneys: The surface may show patchy reddened and/or pale areas. On section, small pale areas may be seen in the cortex and the medulla is usually hyperaemic.

Circulatory system: Generalized cyanosis of a relatively emaciated carcass is common. In chronic cases anaemia may be advanced, but in many subacute cases it is absent. The consistency of the myocardium may be slightly increased and is usually pale in colour. Subepicardial and endocardial haemorrages are relatively common.

Microscopic appearances

Lungs: Principal features in uncomplicated cases are essentially proliferative in nature involving the alveolar walls and the terminal ramification system of the bronchi.

Early cases show thickening of the alveolar septa which is chiefly due to moderate congestion and proliferation of macrophages, some of which are present in the alveoli. The affected alveolar septa soon become variably infiltrated with lymphocytes and later plasma cells.

Masses of proliferating mononuclear cells frequently result in triangular projections from the alveolar walls, and occasionally may be particularly accentuated (Fig. 2). Epithelization of alveoli (Fig. 2) was seen in only two of the 25 cases. In ten cases multinucleate cells containing two to 48 generally peripherally arranged nuclei were seen (Fig. 3). The pleura and interlobular septa are thickened at an early stage and are lightly infiltrated with cells similar to those seen in alveolar walls.

Eventual elimination of aerated surface appears to be due to concomitant collapse and thickening of alveolar septa.

Exacerbation of pneumonia in the presence of other infectious diseases usually presents a different picture. Oedema and congestion may be marked, and frequently there is a massive infiltration of the alveoli with vacuolated macrophages, lymphocytes, and other leucocytes.

More characteristic changes are present in the bronchi, and though these were not usually the most prominent lesions in our cases, they constitute the main basis of diagnosis.

Excessive mucus secretion and moderate hyperplastic changes in the epithelium of secondary bronchi and large bronchioles are apparent at an early stage. In cases of some standing, accumulations of lymphocytes are frequently noted in the peribronchiolar area, and are usually focal in nature (Fig. 1). Several foci may arise around a single bronchus and greatly enlarge so as to form an irregular "cuff". Though most frequent around small bronchi and bronchioles, lymphocytic nodules are at times seen in the lamina propria of larger bronchi, adjacent to terminal and respiratory bronchioles, and infrequently in the alveolar and interlobular septa.

The structure of the hyperplastic bronchial epithelium is somewhat confused, the cytoplasm being vacuolated or assuming a lightly basophilic "ground glass" appearance. A tendency to multinucleate cell formation in the affected epithelium is clear in some instances, this change being most distinct in sections where many multinucleate cells are present in the alveoli.

Large vacuolated vesicular bodies with an inner reticular to granular basophilic structure are present in some activated bronchial epithelial cells distal to the nucleus. In young calves they are markedly vacuolated and have a delicate, pale, basophilic network between the vacuoles. The inner structure is, however, more prominent and strongly basophilic in older animals.

Distinct from the abovementioned structures and normal basal cilia granules, a few cases show the presence of small intracytoplasmic pleomorphic bodies which show some similarities of morphology and size to the PPLO group. These are particularly clear in Giemsa-stained impression smears, and occasional similar bodies are seen in the cytoplasm of alveolar macrophages and free in distended interlobular septa of early cases.

In sections of small consolidated areas in the anterior lobes of mature slaughtered cattle, all the essential features of the calf disease are noted.

Intestine: The lamina propria is densely infiltrated with lymphocytes, plasma cells, macrophages and eosinophil leucocytes. Many lymphocytes and eosinophils are present between the layers of the muscularis mucosae.

Diffuse hyperplasia of the lymphoid tissue in the submucosa is constant and may be marked in the ileum of fairly early cases (Fig. 4). This change, and to a lesser extent the cellular infiltration of the mucosa, may result in considerable increase of the dimensions of the intestinal wall, oedema not being a feature.

Lymph nodes: Cellular hyperplasia is marked in the mesenteric and bronchial nodes. In recently infected cases, where milky fluid exuded from the cut surface of mesenteric nodes, numerous small free lymphocytes are packed in the medullary sinuses. Eosinophils are relatively frequent in mesenteric nodes. Macrophages are seen particularly in the medullary sinuses of bronchial nodes. Hyperaemia, and less frequently oedema, are evident

Liver: Cellular accumulations, comprising chiefly lymphocytes and mononuclears, are seen in the majority of cases, particularly around the periphery of interlobular veins and bile ducts (Fig. 5). Proliferation of endothelial and Kupffer cells and a diffuse light infiltration of lymphocytes in the hepatic sinusoids are frequently present.

Kidney: A moderate periglomerular infiltration of lymphocytes was not infrequently observed, and cells may be seen to infiltrate surrounding intertubular tissue. Perivascular "cuffing" was sometimes observed, particularly in the region of the arciform vessels.

Spleen: Hyperplasia of the lymphoid tissue, some proliferation of reticular cells, and mild congestion are seen rather regularly.

Myocardium: In all instances of mortality and in unthrifty animals suffering from the chronic type of pneumonia, evidence of myocarditis exists. Accumulations of mononuclears, lymphocytes and plasma cells

may be prominent in the connective tissue septa and frequently infiltrate the muscular tissue (Fig. 6). Particularly in cases of mortality, focal areas of degeneration—swelling, loss of striation, vacuolation, and peripherally displaced nuclei—are usual.

Blood: Differential leucocytic counts performed on nine affected calves revealed a mean of 54.4 per cent lymphocytes and 41.4 per cent neutrophils. In six normal calves of similar origin the values were 43.7 and 53.7 respectively, indicating a state of lymphocytosis in affected calves.

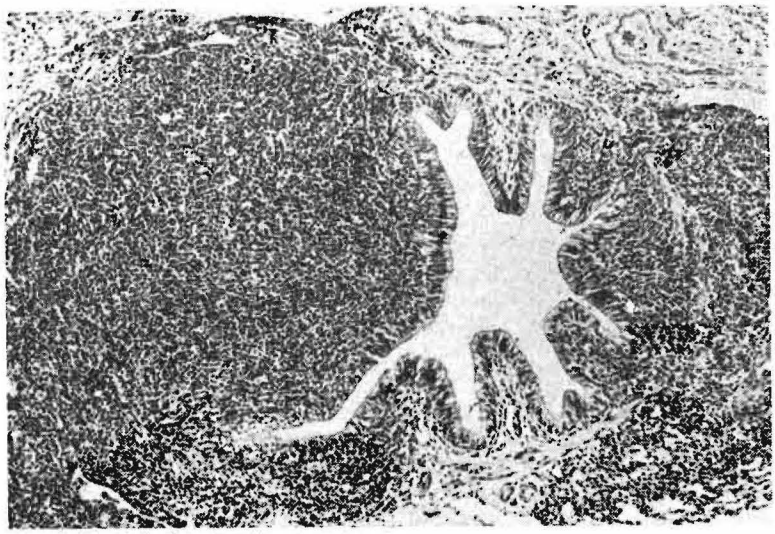

FIG. 1.—Lung. Peribronchiolar lymphoid hyperplasia. x75.

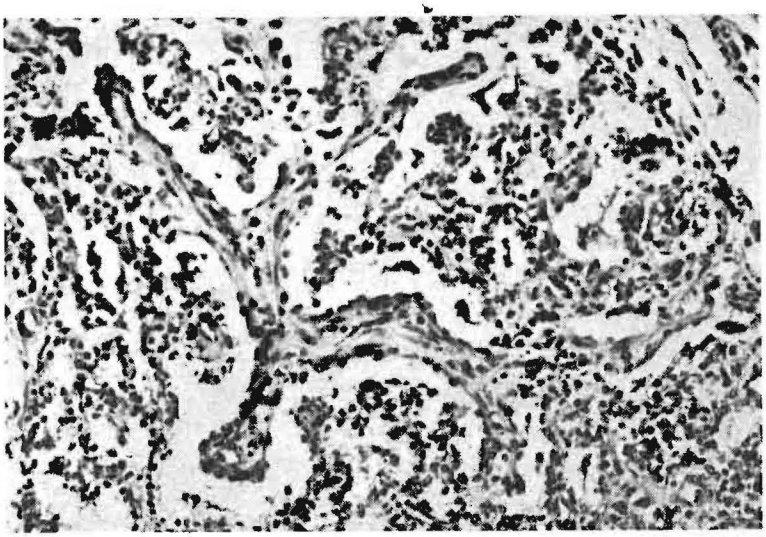

FIG. 2.—Lung. Proliferative changes in alveolar septa with epithelization. x200.

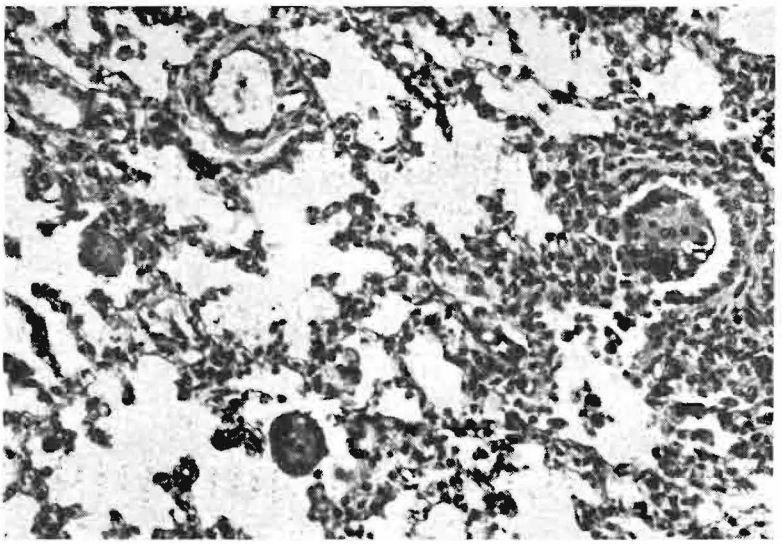

FIG. 3.—Lung. Giant cells in a respiratory bronchiole and an alveolar sac. Eosinophilic material in alveolus (right). Slight thickening of some alveolar walls and a few macrophages in alveoli. x200.

FIG. 4.—Ileum. Lymphoid hyperplasia in submucosa. x30.

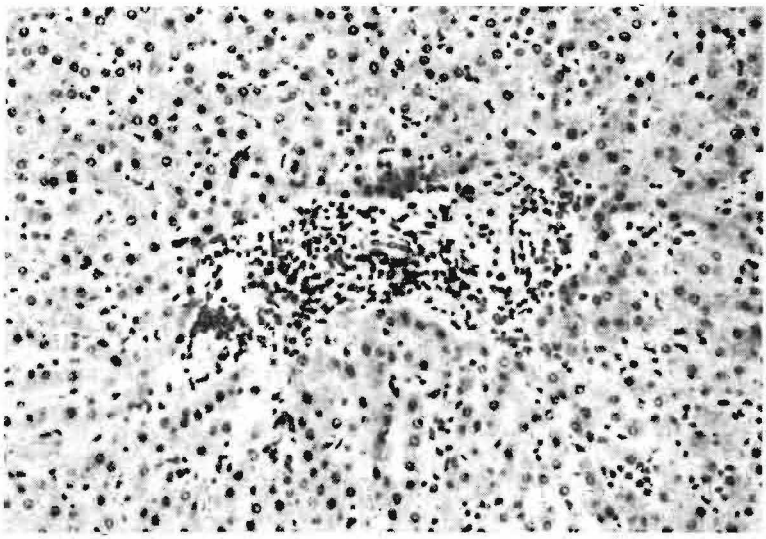

FIG. 5.—Liver. Cellular accumulations around bile ducts and bloodvessels. Proliferation of endothelial cells. x200.

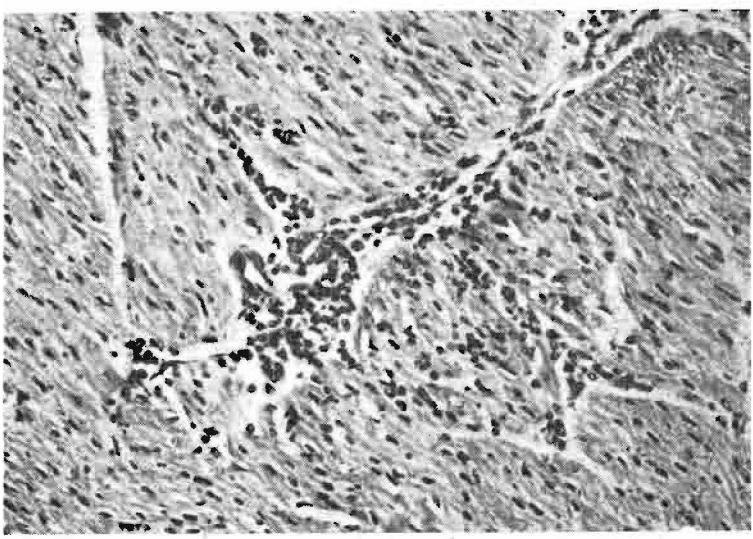

FIG. 6.—Myocardium. Infiltration of mononuclears, lymphocytes, and plasma cells. x200.

Discussion

That pneumonia of the calf frequently is not a sporadic disease but may occur enzootically or in the form of serious outbreaks has been recorded repeatedly for a century.[1 2 9 10] In a statistical study, Ottosen[11] demonstrated that the disease occurs in an enzootic form. An account of the disease, having many epizootological and clinical similarities to the entity observed by the authors, was reported in South America by Roberts[1] in 1938, who associated pneumonia with enteritis. This association was subsequently substantiated by other workers.[2 12 10 3 13 5 22] There is some agreement that the disease is usually precipitated by predisposing factors, under which circumstances the course of the condition results in economically grave consequences.[1 2 12 3 5]

Many workers have investigated the possibility of a bacterial aetiology,[3 14 15 16] invariably, however, concluding that bacteria are of secondary significance. The possible rôle of PPLO's has been investigated to some extent.[15 17 18] In a study of "shipping fever", Carter[17] only succeeded in isolating PPLO's from one case where pathological changes were essentially proliferative. In a subsequent study,[15] however, he failed to demonstrate these organisms.

This group has been found to be of secondary significance in porcine[19] and ovine[20] virus pneumonias.

The assumption of a viral or rickettsial aetiology has been well substantiated for some time by transmission studies.[12 10 21 3] Japanese workers[22] associate *Miyagawanella* with pneumonia in cattle, and agents of the psittacosis-lymphogranuloma venereum group were also associated with respiratory infections in the U.S.A.[23] Neo-rickettsia have been incriminated in an acute form of bronchopneumonia in France.[24] Recently, para-influenza 3 virus has been associated with respiratory and intestinal involvement in Sweden[25] and the U.S.A.[26 27]

Though the authors made no particular aetiological investigation in this study, several samples were submitted to two laborotories for bacteriological and virological examination by routine methods. All results were negative, except in one case, which had an obvious secondary purulent bronchopneumonia, from which staphylococci, corynebacteria, and organisms of the coli-aerogenes group were isolated.

Much variation of the pathological aspects has been recorded, and Jarrett[7] attempted to classify calf pneumonias on a morphological basis. He also differentiated two types[28]—those characterized by epithelization of the alveoli and those with peribronchial lymphoid hyperplasia. In our series, both these pathological alterations were advanced in one case and as such resembled the cases described by Carter[15] in Canada. Peribronchial cellular accumulations have been noted by some workers[4 13 5 15]. In the majority of our cases this change was not pronounced, the most prominent alteration being in the alveolar septa.

It has been suggested that giant cells are derived from syncytial masses protruding from the alveolar wall.[28] In this series there was little correlation between the occurrence and morphology of these two structures

(Fig. 3). Where, however, hyperplasia of the bronchial epithelium was advanced and a tendency to the formation of syncytial masses in the epithelium was evident, many giant cells were also present in the alveoli.

The inclusion body pneumonia described by Jarrett[28] was not observed. In our cases the vesicular basophilic structures observed in hyperplastic bronchial epithelium appear to be identical to those described by Ottosen,[5] who suggested that they may be virus colonies. A study of different stages of these bodies indicates that they are possibly products of hypersecretory activity in goblet cells.

In recent times, generalized pathological changes have been associated with this type of pneumonia.[13 5] These were of a chronic nature in our series and are a possible explanation for protracted unthriftiness in the presence of very limited pulmonary involvement. The finding of myocarditis is in conformity with clinical symptoms noted, and the occurrence of mortality.

Summary

The widespread occurrence of a distinctive entity in cattle characterized chiefly by chronic pneumonia, is reported in South Africa. The disease is particularly prevalent during the wet summer months in calves maintained under intensive farming systems.

Animals of all breeds between the ages of one to four months are highly susceptible. The course of the disease is markedly aggravated by predisposing factors such as faulty housing, nutrition, hygiene, and the presence of parasitism and concurrent diseases.

Clinical symptoms are insidious, but pyrexia, diarrhoea, dyspnoea, tachycardia and progressive emaciation may be obvious. The severity is dependent on the degree of adversity of the environment; at times grave economic sequelae result from underdevelopment and mortality. Therapeutic treatment is of limited value; suitable prophylactic measures, however, are successful in controlling the disease.

Pathological alterations are of a generalized nature and characterized by cellular accumulations and proliferative changes. Consolidated portions of lungs show peribronchiolar lymphoid hyperplasia in conjunction with thickening of alveolar walls. Associated changes are enteritis, hepatitis, nephritis, lymphoid hyperplasia, and myocarditis.

The salient literature on similar pneumonias, which appear to occur universally, is discussed.

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THE ISOLATION OF VIRUSES ASSOCIATED WITH INFERTILITY IN CATTLE: A PRELIMINARY REPORT

John Maré* and S. J. van Rensburg†

INTRODUCTION

The disease entity commonly referred to as "epivag" was first described in Kenya by Daubney, Hudson and Anderson in 1938.[1] It was not until 1949, however, that the disease was encountered in South Africa.[2] On a basis of clinical examination and herd histories, a survey was carried out by the Field Section of the Division of Veterinary Services, to determine the extent to which this disease occurred in South Africa. This survey revealed that the disease was widespread in the Transvaal, while only a few infected farms were found in Natal and the Orange Free State. The Cape Province was apparently free of the disease.[3]

These field observations revealed that bulls in herds showing vaginitis did not always show symptoms of epididymitis, and it has been suggested by van Rensburg[4] that two separate diseases actually occur; namely, "contagious epididymitis and vaginitis" and "contagious anterior vaginocervicitis". The Kenya workers, in their early descriptions, also indicated that two separate entities might exist. In England, Millar[5] recognized two infectious forms of infertility of unknown aetiology. He later isolated a viral agent in chicken embryos.

Several other virus isolates have been made from cattle showing genital infections. McIntosh, Haig and Alexander 1954[6] isolated a virus (Rustenburg virus) in chicken embryos and baby mice from vaginal exudate. This virus, after serial passage, caused a mild vaginitis in susceptible heifers. Kendrick and McKercher isolated a virus from vaginal exudate on the chorio-allantoic membrane of hens' eggs.[7] The agent was found to be different from the "Rustenburg virus" in its laboratory host range. While this virus grows easily in tissue culture of calf kidney cells, the Rustenburg virus does not. The infectious pustular vulvovaginitis virus was described by Kendrick, Gillespie and McEntee,[8] who isolated it from an outbreak of "vesicular venereal disease".

Epididymitis and vaginitis still appear to be very prevalent in South Africa, and attempts to elucidate the aetiology have been made during the last few years. Investigations to determine the rôle of bacteria were inconclusive. A number of viruses have been isolated from herds in which epididymitis and vaginitis occurred. Preliminary investigations to determine the importance of these viruses form the basis of this report.

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HERD OBSERVATIONS

During the past two years several visits have been made to herds in which the clinical syndrome "epivag" was causing sterility and reduced fertility in both bulls and cows. In some bulls epididymitis was evident, in others not. In heifers and cows, vaginitis was observed, varying from a very severe to a very mild form. In all the cows examined, the vaginitis was accompanied by vaginal discharges, usually of a very profuse, odourless, mucopurulent type. The vaginites observed were confined to the anterior vagina and no signs of a pustular or vesicular vaginitis were observed. A brief resumé of the clinical, bacteriological, and virological findings in the herds visited follows.

HERD 1

Situated in the Boksburg district, this Friesland dairy herd comprised 69 cows, two bulls and a small number of heifers. The bulls were run continuously with the cows. Two bulls had recently been sold to prevent inbreeding, no genital abnormalities being evident and both bulls being apparently fertile. The herd history revealed that vaginitis had been a problem on this farm for several years. The vaginitis took the form of an anterior vaginocervicitis, accompanied by copious purulent discharges. Cows showing these discharges seldom conceived. Five cows had aborted on this farm during the past three years, four at five months, and one at two and a half months.

Two recently introduced bulls were examined, bull 1 showing subacute orchitis of the left testicle, and unusual firmness in both the head and tail of the right epididymis. Bull 2 showed a small, firm enlargement of the head of the right epididymis. Semen of both these bulls was of low density and poor quality, a large number of neutrophiles and epithelial cells being present. The semen brucella agglutination test was negative for both bulls. Virus isolation was attempted, using embryonated eggs inoculated into the yolk sac, baby mice by intracerebral and intraperitoneal inoculation, and tissue culture. From each semen specimen a virus was isolated in tissue culture. These viruses, both of which were found to give a monocytial cytopathogenic change, have been designated "B1", and "B2". The two bulls, from which the viruses were isolated, were disposed of a few months after examination, suffering from severe epididymitis and orchitis.

Vaginal discharges were collected from twenty-two cows showing acute anterior vaginitis with discharges varying from sero-purulent to a very mucoid sticky pus. Several unserved heifers between the ages of three and six months were showing vaginal exudates. From one vaginal discharge, a virus was isolated in tissue culture, the cytopathology being similar to that of the two previous isolates. This virus has been designated virus "G26". Of the vibrio agglutination tests performed on three cows, one was positive and the other two negative.

HERD 2

A Friesland herd, situated in the Boksburg district, approximately ten miles from the previous herd, was visited at the request of the owner. This owner complained about the condition of his animals, many of which had shown persistent vaginitis for over six months. His main cause for concern was, however, not the very low conception rates which accompanied this condition, but the fact that almost every bull introduced into the herd became sterile within six months, as a result of orchitis and epididymitis.

On examination of the herd, it was found that most of the cows were showing vaginal discharges. These animals also showed an acute anterior vaginitis, with very profuse muco-purulent discharges. Specimens were taken for virus isolation. Of the three bulls examined, two had only recently been introduced into the herd, and had not as yet served, while the third was an old bull which had been in the herd for several years without showing any sign of an epididymitis or orchitis. All three bulls were clinically normal. From vaginal discharges, two viruses were isolated in tissue culture, these viruses being designated "C3" and "P10".

One of the two young bulls mentioned, after having been used in the herd for ten weeks, was removed for experimental purposes. Semen was taken from this bull at regular intervals, but no virus could be isolated. Two virgin heifers which were inseminated with his semen, developed the typical vaginitis syndrome described above within four days. From discharges obtained from each heifer, virus was isolated. These viruses have been designated "X" and "Y". The vaginitis in the heifers persisted for 43 days in the one, and for over 90 days in the other.

HERD 3

A large cattle ranch near Middelburg in the Eastern Transvaal, was visited at the request of the owners. This herd of over 5,000 head. comprising Aberdeen Angus, Hereford, Afrikaner and a few hundred Frieslands, was examined, and seventeen of the fifty bulls were culled as sterile, due to very pronounced epididymitis and orchitis. A large number of cows and unserved heifers showing discharges were examined, vaginal discharges being collected for virus isolation. Once again the vaginitis was of an antero-cervical type accompanied by copious purulent discharges. Rectal examination of cows revealed a high incidence of peri-oöphoritis and salpingitis in the herd.

Semen was taken from the seventeen culled bulls. Three viruses were isolated in tissue culture from this herd; one from a bull showing gross, bilateral, chronic epididymitis, one from a cow with a purulent vaginitis, and one from an unserved heifer showing an acute vaginitis accompanied by a copious sero-purulent discharge. These viruses have been designated "Bantam", "C.375", and "F.H.335".

HERD 4

This Friesland herd, near Vaalwater in the Northern Transvaal, numbered about 60 cows, two bulls and a few heifers. Since having moved to this particular area from a farm in the highveld, the owner had been plagued by persistent vaginitis in his cows and unserved heifers. He had

for some time been douching his cows and treating them with various vaginal bacteriostats, with very little success. Vibrio agglutination tests were performed on six cows, all with negative results.

No epididymitis or orchitis had been observed in the bulls on this farm. One bull had apparently lost its libido, after which a second bull was introduced. The latter bull was examined soon after introduction, but appeared to be normal and its libido unimpaired. Semen was taken by electrical ejaculation for semen examination and virus isolation. Three months after visiting the farm the owner informed us that his new bull seemed to be losing its libido. A virus was isolated in tissue culture from the semen of this bull. This virus has been designated "F.B." virus. The changes in the semen picture of this bull were identical to those seen in bulls experimentally infected with virus "F.H. 335."

Examination of the cows revealed mild to acute vaginitis, accompanied by fairly tenacious muco-purulent discharges. Specimens were taken for virus isolation.

HERD 5

A small Ayreshire herd at Lyttelton, near Pretoria, was visited, after a private practitioner had reported an outbreak of acute purulent vaginitis which would not respond to antibiotic treatment or permanganate douching.

On examination of this herd, one cow was found to be clean, while all the others showed discharges. An acute anterior vaginitis was seen in a few cows, while the rest showed a very mild anterior vaginitis. From discharges taken for examination, a virus "Irwin" was isolated in tissue culture. No abnormalities were observed in the bull. This bull had been introduced into the herd after the commencement of the vaginitis syndrome. Vibrio agglutination tests performed on eight animals in this herd proved negative.

SUMMARY OF VIRUS ISOLATES.

Herd	Virus	Animal	Type of specimen	Symptoms shown by animal
1	B1	Bull	Semen	Subacute orchitis.
1	B2	Bull	Semen	Mild epididymitis.
1	G26	Cow	Vaginal discharge	Acute purulent vaginitis.
2	C.3	Cow	Vaginal discharge	Acute purulent vaginitis.
2	P.10	Cow	Vaginal discharge	Acute purulent vaginitis.
2	X	Heifer	Vaginal discharge	Acute purulent vaginitis.
2	Y	Heifer	Vaginal discharge	Acute purulent vaginitis.
3	Bantam	Bull	Semen	Chronic bilateral epididymitis.
3	C. 375	Cow	Vaginal discharge	Acute purulent vaginitis.
3	F.H. 335	Heifer	Vaginal discharge	Acute purulent vaginitis.
4	F.B.	Bull	Semen	No Symptoms.
5	Irwin	Cow	Vaginal discharge	Acute purulent vaginitis.

Experimental

The classification of the twelve virus isolates is at present confined to a rough grouping on a basis of virus neutralization and the type of inclusions observed.

Microscopic examination of haematoxylin-phloxin stained monolayers was carried out with a view to determining the differences which exist between the various isolates in respect of their inclusions. Virus "B1" showed very distinct acidophilic, intracytoplasmic inclusions, whereas all the other isolates showed large, acidophilic, intranuclear inclusions of the "A" type.[9]

Serum-virus neutralization tests revealed that viruses "F.H. 335", "C.3", "X", "Y", "F.B." and "Irwin" are serologically identical, while viruses "B.1", B.2", "P.10", "G.26", "Bantam" and "C.375" are serologically quite different from this group.

The three groups of viruses are thus:—

Group I: One isolate:—virus "B.1"—intracytoplasmic inclusions, not neutralized by "F.H. 335" antiserum.

Group II: Five isolates:—"B.2", "P.10", "G.26", "Bantam" and "C.375"—intranuclear inclusions; possibly identical viruses, not neutralized by "F.H.335" antiserum.

Group III: Six isolates:—"F.H.335", "C.3", "X", "Y", "F.B." and "Irwin"—intranuclear inclusions; all neutralized by "F.H.335" antiserum, probably identical viruses.

Studies on virus isolates

Group I viruses

Virus "B.1":—As mentioned earlier, microscopic examination of stained monolayers revealed intracytoplasmic inclusions of the type seen in the Pox group of viruses. The original isolation of this virus was done in tissue culture, using calf kidney line cells. After two generations in tissue culture, the virus was propagated successfully on the C.A.M. of 10 day-old hens' eggs, and caused very distinct pock-like lesions after 4 days.

Serum-virus neutralization tests in tissue culture revealed that virus "B.1" could be neutralized by vaccinia-immune calf and rabbit serum. It was also demonstrated that virus "B.1" haemagglutinin is inhibited by vaccinia antiserum. No neutralization of the virus with "F.H.335" antiserum could be demonstrated. From the tests thus far carried out, it appears that virus "B.1" is closely related to vaccinia virus.

Pathogenecity of virus "B.1." In an attempt to determine the pathogenecity of this virus, two clean virgin heifers were inoculated intravaginally, each receiving 1 ml. of eighth tissue culture passage virus. No reaction was observed, and virus could be reisolated from one of the two heifers for 48 hours, but not thereafter. No evidence exists to incriminate this virus in the clinical syndrome under discussion.

GROUP II VIRUSES

Viruses "B.2", "P.10", "G.26", "C.375" and "Bantam." Although these viruses in their growth characteristics and cytopathogenesis are very similar to the Group III viruses, they must be excluded from that group on serological grounds. No neutralization of the Group II viruses has been demonstrated as yet.

Virus "B.2" could not be successfully adapted to growth in embryonated eggs or in infant mice.

GROUP III VIRUSES

The viruses in this group are regarded as similar, if not identical, on the basis of serum-virus neutralization tests. It is with these viruses that the most extensive pathogenicity trials have been carried out.

Virus "F.H.335". After a small preliminary trial, in which the pathogenicity of both virus "F.H.335" and virus "C.3" for heifers was conclusively shown, a much larger trial, including both heifers and bulls, and using only virus "F.H.335", was carried out. As usual, all the animals in this experiment were examined clinically and virologically before the trial was commenced.

Pathogenicity of virus "F.H.335" in heifers. Four clean virgin heifers were inoculated intravaginally, each with 1 ml. of eighth tissue culture passage virus. After 48 hours the animals were markedly restless, tails were raised and extended, and buttocks and tails were soiled with discharge. Speculum examination revealed a marked hyperaemia of the anterior vagina accompanied by fairly copius muco-purulent exudates. After six days all the test heifers showed acute anterior and posterior vaginitis accompanied by very copious mucopurulent discharges. These acute symptoms persisted until the 24th day, after which a gradual abatement was observed. Mild symptoms of vaginitis were however seen for up to five months after infection. Virus could be re-isolated from discharges from the above heifers 9 days, but not 14 days, after infection.

Re-infection of two of the above heifers with virus fifty days after the first infection, resulted in a mild vaginitis of short duration, virus being re-isolated for only three days after inoculation. Two months after this "challenge", the same two heifers received virus once more. A mild vaginitis again followed. Virus could not be re-isolated at 48 hours, nor thereafter.

Rectal examinations of the heifers in the pathogenicity trial, revealed only slight changes in the thickness and tone of the vaginal and uterine walls. Smears made from vaginal discharges revealed that bacteria were absent up to the third week, after which a variety of organisms could be demonstrated.

Serum, taken before the trial was undertaken, showed no antibodies to virus "F.H.335", whereas serum, taken 30 days after infection, revealed very high antibody titres to this virus.

Pathogenicity of virus "F.H.335" in bulls. On two occasions prior to infection with virus, six bulls were examined clinically, and semen was taken to determine the norm for these animals. Each bull then received 5 ml. virus intraurethrally, in the region of the sigmoid flexure.

Two to three days later the bulls showed marked restlessness, swishing of the tail and frequent urination: symptoms of an acute urethritis. After eight days acute inflammatory changes of the penis and of the preputial mucosa were observed. Rectal examination was accompanied by considerable discomfort, and revealed enlarged and oedematous seminal vesicles. Hyperaemia of the scrotal skin, and mild, painful enlargement of one or both testicles were observed in some bulls, the consistency of the testicles remaining abnormal for several months. During the course of the second month after infection, signs of a transient epididymitis were seen, these being slight enlargement, tense or oedematous consistency, and evidence of pain on palpation. One bull, which was repeatedly re-infected intra-urethrally, showed a marked vesiculitis and a pronounced balano-posthitis.

Virus could be re-isolated from semen of all bulls, for 8, but not 15 days after infection.

Semen examinations

Semen taken at weekly intervals throughout the trial, revealed a gradual increase in the percentage morphologically pathological spermatozoa (35–89%) in five of the six bulls. The most frequent abnormalities observed were deviations in the shape of the head, especially thickening of the galea capitis and mild narrowing of the post-nuclear cap. Motility of spermatozoa deteriorated, while the alkalinity of the semen increased. Only after six months could the semen quality once more be regarded as satisfactory.

One bull was slaughtered after six months. Pathological and histopathological examination showed mild inflammatory changes in the epididymis, ampullar portion of the vas deferens, the seminal vesicles, colliculus seminalis and the penis mucosa.

Virus "F.H.335" was inoculated directly into the tail of the epididymis of a susceptible bull, which was slaughtered seven days later. The tail of the epididymis of this bull was enlarged to approximately twice its former size, while there was, in addition, a marked oedema of the scrotum and of the connective tissue of the spermatic cord. Microscopic examination revealed a pronounced orchitis and epididymitis with dense cellular infiltration and sperm extravasation.

Intratesticular inoculation of virus in another bull failed to elicit any significant changes, and when slaughtered after seven days, only slight interstitial oedema with mild cellular infiltration could be demonstrated in the testes.

Natural transmission of virus "F.H.335". A clean cow was served by an artificially infected bull nine days after infection. After 48 hours

an acute anterior vaginitis accompanied by a copious, streaky, purulent discharge was seen. High titre virus was isolated from the discharge.

After five days the condition had become even more acute, the discharge once more yielding high titre virus. This vaginitis persisted for more than a month, but virus could no longer be isolated on the twelfth day or thereafter. Smears showed no bacteria. High titre antibodies to virus "F.H.335" were demonstrated 30 days after infection. This cow did not conceive from the abovementioned service.

Serum-Virus Neutralization tests with Virus "F.H.335".

Tests carried out on sera obtained from cows and bulls in herds 2, 3, 4 and 5, revealed significant antibody titres against virus "F.H.335".

Comparison between virus "F.H.335" and the Infectious Pustular Vulvovaginitis (I.P.V.) virus. The viruses causing infectious pustular vulvovaginitis (I.P.V.) and infectious bovine rhinotracheïtis (I.B.R.) have been shown by two groups of workers to be identical.[10] [11] Cross neutralization tests have been carried out to compare the I.P.V./I.B.R. virus with virus "F.H.335." Complete cross-neutralization between these viruses has been demonstrated. Intranasal and intratracheal instillation of virus "F.H.335" into four susceptible animals failed to elicit any febrile reaction or respiratory symptoms whatsoever.

Discussion

From the result of the small pathogenicity trial carried out with the vaccinia-like virus "B.1", it appears that no vaginitis syndrome can be attributed to this virus. No experiments with virus "B.1" have been performed in bulls, so far.

The Group II viruses have not been examined very extensively as yet, due to fear of cross-contamination with virus "F.H.335." At this stage this group must be regarded as being of unknown significance. The grouping is only on a basis of their similar cytopathology and serological dissimilarity with the Group III viruses. It is thus quite conceivable that the members of this group are, in fact, not identical viruses, but until further investigation has been carried out, they will be grouped together for convenience sake.

The Group III viruses, of which "F.H.335" has become the serotype, have been isolated from four widely separated farms in the Transvaal, where clinical "epivag", or a similar vaginitis syndrome was in evidence. A number of animals on all four farms has shown high titre antibodies to virus "F.H.335."

Cows experimentally infected with virus "F.H.335" show an acute, persistent vaginitis indistinguishable from the naturally occurring disease. The pathogenicity of this virus for the bull has been clearly shown, but no epididymitis of the type observed on "epivag" farms has been produced experimentally with this virus.

The virus has been transmitted from bull to cow by coitus, but as vaginitis has been observed in unserved heifers on infected farms, it would appear that this is not the only mode of transmission.

Serologically, virus "F.H.335" is identical to the I.B.R./I.P.V. virus. The clinical disease associated with virus "F.H. 335", however, differs from the diseases caused by the I.B.R./I.P.V. virus in several respects. Whereas the vaginitis seen with virus "F.H.335" is predominantly of an anterior, cervical type, that seen with I.P.V. is, as the name indicates, of a posterior vulvar type. The pustules and ulcers seen with I.P.V. have not been observed in association with virus "F.H.335". No febrile response or respiratory disease resulted from intratracheal and intranasal instillation of virus, whereas the I.B.R./I.P.V. virus produces a marked febrile reaction and respiratory symptoms.

Comparison between virus "F.H.335" and the Rustenburg virus revealed that the former grows easily in tissue culture, but not at all in eggs or mice, whereas the latter does not grow in tissue culture, but multiplies easily in both eggs and mice. The "California" virus of McKercher differs from virus "F.H.335" in its cytopathology, while Millar's virus grows easily in eggs, and in this respect differs from virus "F.H.335".

Summary

Several outbreaks of "epivag" and of vaginitis of unknown aetiology are described. From specimens taken from these outbreaks, twelve virus isolates have been made in tissue culture.

On a basis of cytopathology and serum-virus neutralization tests, these viruses have been grouped into three groups:

Group I: one isolate—vaccinia-like virus.

Group II: five unidentified viruses.

Group III: six serologically identical viruses.

The Group I isolate is regarded as incidental. The Group II viruses have not been studied very intensively and no claims as to their pathogenicity are made. Extensive experiments with virus "F.H.335" were carried out to determine its pathogenicity. It was shown that this virus is pathogenic for both the cow and the bull. High titre systemic antibody response followed experimental infection with this virus, while antibodies were demonstrated on four of the five farms involved in the investigation.

Virus "F.H.335" was found to be serologically identical to the I.B.R./I.P.V. virus, but differed from this virus in its clinical manifestations. No similarity between virus "F.H.335" and other virus isolates could be demonstrated.

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INVESTIGATION INTO THE CAUSE OF ABORTION IN ANGORA GOATS IN SOUTH AFRICA

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Introduction

The first importation of Angora goats into South Africa was made from Turkey by Col. Henderson in 1838. Up to 1896, when the last importation was made, some 3,000 goats had been imported. The rams were used to a large extent for cross-breeding on our indigenous goats and the number of better cross-bred and pure Angora goats increased rapidly, so that by 1911 they numbered four and a half million. From 1912, however, a decline in the industry took place due to a number of reasons, so that by 1950 less than 500,000 Angora goats remained.

Since 1949 a spectacular rise in the price of mohair occurred, and from an average price of 20.3d./lb. the price rose to 108.3d./lb. for the period July 1959–June 1960 paid for mohair from mature goats. During the 1960 summer sales the world record price of 320d./lb. was reached for super summer kids' hair. With the return of confidence in mohair fibre and the industry, one would have expected a sharp increase in the number of goats. The increase has been very gradual, however, and by 1960 the number of Angora goats in South Africa was only about one million. The main limiting factor in the increase was a high incidence of abortion.

Incidence of Abortion in South Africa

Although subsequent investigation proved that a fairly high incidence of abortion had been noted amongst Angoras for at least 60 years, the matter was not brought to the notice of the veterinary authorities until the early 1950's, when the increasing value of mohair brought the matter to the fore. At that time some farmers reported losing up to 80% of their potential kid crop and the general consensus of opinion was that abortions had been on the increase since 1933.

Extensive investigations were started in 1956 and the following interesting facts on the nature of abortion in the Angora goat came to light:

(*a*) Abortion, as an acute economic problem, is confined to the Angora goat. Many of the heavily affected farms run Merino, Persian and Dorper sheep and Boer goats, but only an isolated case of abortion is found amongst these breeds.

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(*b*) An analysis of the geographical distribution of high and low abortion rate farms covered by our investigations, failed to reveal any significant localization of either type. In most instances high and low abortion rate farms were found to be bordering on one another.

(*c*) A special effort was made to determine at what stage of pregnancy most abortions took place. The conclusion arrived at is that abortions occur from two weeks after conception to full term with peaks following windy weather conditions, and after shearing or dipping, shortly before the actual kidding season. Apart from these peaks, it was also shown that loss of the foetus occurs mainly at two stages of pregnancy, i.e. very early and at between three-and-a-half and four-and-a-half months of pregnancy.

Early abortion or resorption of the foetus usually occurs between the third and sixth weeks of gestation and is not easily noticed by the farmer. During our investigations enough instances of this early abortion were found to indicate its importance. The abortions that are easily observed by farmers are those that occur between three-and-a-half and four-and-a-half months of pregnancy. Most of these foetuses show evidence that they have been dead in the uterus for some time before being expelled. They are partly decomposed and in some instances have undergone maceration whereby all the soft tissues of the foetal body are resorbed and only the bones remain in the uterus or vagina.

(*d*) This type of abortion is usually not attended by the unfavourable consequences such as retained placenta or metritis, which frequently characterize the condition in other species. It therefore does not have a detrimental effect on the future breeding ability of the ewe. The aborting ewe is usually in an excellent condition. Another characteristic feature is that she often shows heat just before or just after aborting. She will then take the ram and may conceive and kid normally. On the other hand, especially in early abortion, a ewe may become pregnant and abort up to three times during one breeding season.

(*e*) A number of observations and experiments lead to the conclusion that the tendency to abort is due to an innate weakness in the ewe herself.

The ram to which the ewe is mated has no effect on abortion. This was proved by mating ewes individually to different rams and even to Boer goat rams. Conversely, when Angora rams are mated to Boer goat ewes, the incidence of abortion is in proportion to the amount of Angora blood present in the ewes.

The tendency for abortion to recur is strongly developed in the Angora ewe. Aborting ewes were tagged on ten farms and the kidding results were compared to ewes which had not aborted previously on the same farms. It was found that 45% of the ewes aborted again, whereas the overall abortion rate on the ten farms was 23%.

Ewes of all ages may abort, but in general the incidence appears to increase with age and successive pregnancies, with the result that it is higher among old ewes than young ones. A ewe may give birth to two or

three normal kids before she starts aborting. After one abortion the ewe has a marked tendency to abort in subsequent pregnancies and in this manner many become habitual aborters.

(*f*) During the slump in mohair the number of goats decreased and only a few stud breeders persevered to maintain and improve the excellence of their studs. It is obvious that they had to resort to a very high degree of inbreeding. These goats form the basis of our expanding industry, and with the probable unconscious tendency to retain aborters due to their showing up well on hair and constitution, it may be expected that the better bred goats would be more liable to abort. This was proved to be the case by an experiment run on six farms, where the kidding percentages between stud and flock ewes grazing together were compared. Of the stud ewes 30% aborted as against only 15% of the flock ewes.

The unconscious tendency to select aborting lines was found to be fairly widespread, especially amongst potential or young breeders, where the best ewes, as far as hair and conformation were concerned, were selected from the flocks for stud breeding purposes. These were frequently the ewes that aborted and did not raise a kid. With the high price of mohair and the great demand for Angora goats, everything possible was done to try and raise a kid born from such an aborter. If careful handling and pampering failed, she was sold and, unfortunately, such ewes show a strong tendency to kid the first one or two seasons on the new farm before aborting again. Thus the foundation stock of many new Angora farmers is made up of aborters. The seriousness of this position may well be realized.

(*g*) An exhaustive search through the world literature failed to reveal a similar problem in any other country where Angoras are kept.

Investigations to Determine the Cause of Abortion

The problem of abortion in Angora goats appeared to be peculiar to South Africa and most of its characteristics differed widely from the customary pattern of abortion in other species. It therefore presented a problem of unusual complexity and necessitated efforts at systematic investigation of all possible aetiological factors, including infections, nutritional deficiencies, toxic agents such as poisonous plants, climatic and other environmental conditions and the genetic make-up of the Angora goat itself.

(*a*) *Infections*

Whenever abortion occurs on a large scale, as frequently seen in Angora goats, an infection is suspected. Every effort was made, therefore, to identify an infective causal agent.

Material obtained from aborted foetuses, afterbirths, discharges from the uterus of ewes and the semen of rams were subjected to all the usual methods of culturing and isolation in order to determine whether a bacterial organism or a virus was responsible. The material was also

subjected to a detailed microscopical examination. In no instance could an organism be found that could be incriminated as a significant cause of abortion in Angora goats.

Blood serum from a large number of affected as well as normal ewes was subjected to various serological tests, and although a few samples yielded positive results for brucella infection, no organism could be found by the standard cultural or microscopical methods used to diagnose this disease.

Both naked eye and microscopical examination of various portions of the female genital tract did not reveal any evidence of inflammatory changes, such as would be present if an infection were responsible.

In transmission experiments attempts were made to produce abortion by contact, by introducing aborters to "clean" farms and by administering material from aborted foetuses and discharges in various ways to normal pregnant Angora and Merino ewes, without any success.

The negative results of all these efforts are corroborated by the statement made earlier, that this type of abortion is peculiar to the Angora in South Africa. It is most unlikely that any infection will show such a specificity for a single breed of one species of ruminant in one country only.

(*b*) *Environment*

Since abortion storms are frequently observed under severe climatic conditions or after pregnant animals have been subjected to handling, e.g. shearing, dosing or dipping, these factors are considered by many to be the principal cause. However, these instances may well be fortuitous.

In one instance there was an interval of three weeks between service of two groups of ewes. Later both groups were shorn at the same time. There was an immediate storm of abortions amongst the ewes which had been served first, followed by one in the second group three weeks later. In other words, the ewes aborted at about the same stage of pregnancy irrespective of shearing.

During the first half of 1958, the Eastern Cape, where the overwhelming majority of Angora goats are found, was in the grip of a severe drought and adverse conditions prevailed. In comparison 1959 was an excellent season. Kidding results on eight farms during these two years were as follows:—

	1958	1959
No. of ewes	3,572	3,836
No. of known pregnant ewes	2,155 (80%)	2,778 (91%)
No. of ewes that aborted	783	715
Percentage pregnant ewes that aborted	27%	20.5%

The difference in the percentage pregnant ewes can be attributed to the unfavourable climatic conditions prevailing during 1958. A much wider difference in the aborting percentage would be expected if unfavourable climatic conditions were the cause of abortion.

It is clear that such adverse conditions are merely precipitating factors.

(*c*) *Internal Parasites*

A comprehensive survey of the infestation with helminthic parasites and coccidiosis failed to show any correlation between these factors and the incidence of abortion.

(*d*) *Nutrition*

A common belief amongst many farmers is that deficiencies of vitamins and minerals are directly responsible for the premature loss of Angora kids.

The vitamin principally concerned with fertility and gestation is vitamin A. Experiments carried out on a number of farms in which various types and levels of vitamin A were administered, produced no difference in the abortion rate between groups of ewes that were given vitamin A and those that were kept as controls.

The main Angora goat farming areas are notoriously subject to severe droughts, while deficiencies of certain essential minerals, notably phosphorus, copper, cobalt and manganese occur in various parts of South Africa. A probable lack of iron in the system was also considered by many to be of major importance.

A large number of determinations of these minerals in the blood serum of ewes that aborted and those that kidded normally, revealed that there was no significant difference between the mineral content of these two groups. All the values obtained for the minerals fall within the normal range.

In another series of experiments ewes on eleven farms were dosed regularly with a mineral compound while sufficient controls were kept. After two months of dosing no significant differences could be found in serum analysis between the two groups, indicating that the administration of the various minerals did not materially affect their levels in the blood serum. The abortion rate among the ewes receiving the mineral compound was 16.7% and among the controls 16%.

Nutritional deficiencies as the cause of abortion could be eliminated on the grounds of the negative results of a large number of experiments and observations.

(*e*) *Genetic influence and hormonal imbalance*

The observations and experiments had therefore established the following crucial facts:—

(*a*) The abortions were not due to any specific infections.

(*b*) Environmental factors played a secondary rôle in influencing the incidence of abortion.

(*c*) Abortion was only a problem amongst Angora ewes, and the more highly bred the animal, the greater the tendency to abort.

(*d*) The tendency to abort in a given ewe was not influenced by the ram to which she was mated.

(*e*) The tendency to abort was greatest in older ewes and aborting ewes tended to abort repeatedly.

These factors point to a constitutional weakness in the ewe herself. The post mortem examination of over forty Angora ewes slaughtered during the course of our investigations in the field revealed the following characteristics in regard to the ovaries.

The ovaries of ewes that had aborted, were actually aborting, or had dead foetuses in the uterus on post mortem, revealed the invariable presence of developing follicles. In some cases fairly large follicles were present and in one case a ewe, slaughtered four days after an abortion, had a newly formed corpus luteum in one ovary, indicating that she had come on heat prior to, or just after abortion. No large corpus luteum with soft consistency, vascularity and yellow colour could be found. In some cases a small, pale and fibrous corpus luteum was present. In others, the corpus luteum had regressed to complete atresia, only scar tissue being left; in some cases no trace of a corpus luteum could be found. The ovaries of all normal pregnant ewes slaughtered, showed the presence of a large corpus luteum of pregnancy and no follicle formation.

These observations were corroborated by van Rensburg and van Rensburg[15], who examined the ovaries of twelve Angora goats that aborted and nine that kidded normally at post mortem examination and by laparotomy from 24 days after conception to 13 days post partum. The aborters revealed marked regression and atresia of the corpus luteum, while the normal pregnant ewes revealed a large *corpus luteum graviditatis* with no follicle formation in the ovaries.

As a result of these observations, it was concluded that abortion might be due to some hormonal imbalance which prevented the foetus from developing to full term.

A histological study was made of the corpora lutea and hypophyses of four normal pregnant ewes and of nine aborters. Sections of the corpus luteum were stained by haematoxylin-eosin and from the hypophysis by the Mallory-Azan method.

Two completely different pictures were presented by the two groups, as is evident from the findings detailed in tables 1 and 2.

TABLE 1: CORPUS LUTEUM

	Normal Ewes.	Aborters.
Connective Tissue	Stroma not prominent.	Stroma prominent.
Lutein Cells.....	Large and well packed. Nuclei mainly vesicular; cytoplasm clear, slightly vacuolated and/or homogeneous. Few pycnotic nuclei associated with intenser eosinophilic cytoplasm	Most lutein cells show pycnotic nuclei, and some karyorrhexis. Cytoplasm mainly homogeneous with strong eosinophilic colouration.
Indications.....	Active corpus luteum.....	Regressing to complete atresia of corpus luteum.

TABLE 2: HYPOPHYSIS

	Normal Ewes.	Aborters.
Acidophiles.....	Densely packed. Cytoplasm well filled with brick-red staining granules with mostly vesicular nuclei. Some more orange in colour with depleted granules and pycnotic nuclei. Both types of cytoplasm might be present in one cell. Brick-red and partly red cells at periphery of "acini." Orange, degranulated acidophiles with pycnotic nuclei mainly around periphery of hypophysis, especially ventrally	Mostly small and not densely packed. Cytoplasm mostly homogeneous and orange coloured with pycnotic nuclei, especially around periphery of pars distalis. Some orange cells, especially near the centre, with vesicular nuclei tending to become pycnotic. Brick-red cells with vesicular nuclei very scarce.
Indications.....	Acidophiles actively secreting	Marked depletion of acidophile activity.
Basophiles.....	Relatively few. More numerous in upper central area. Mostly darker staining, compact cytoplasm and nuclei tending to pycnosis, situated around periphery of "acinus." Some large basophiles with vesicular nuclei and vacuolated cytoplasm found, mainly in centre of "acinus."	More numerous, especially centrally and ventrally, with large cells. Nucleus becomes pycnotic while cell is still large and cytoplasm vacuolated, and tends to become more pycnotic as cytoplasm becomes smaller and more compact. Some large cells with vesicular nuclei present.
Indications.....	Basophiles low to normal activity	Basophiles show marked activity.

The following two cases further illustrate these indications of the hormonal imbalance.

A ewe, pregnant with a four-week twin, showed one active corpus luteum and one undergoing regression. The acidophiles showed a tendency to become quiescent and the basophiles were markedly active. The supposition of impending abortion was supported by the history of three successive previous abortions.

A second ewe with a history of previous abortion was slaughtered four days after abortion. There were no signs of the corpus luteum of pregnancy, but a newly formed young, active corpus luteum was present. Both the basophiles and acidophiles were active with the basophiles showing a slightly higher activity.

DISCUSSION

The necessity of the corpus luteum in the goat for the full duration of pregnancy has been proved by Drummond-Robinson and Asdell,[1] Meites[6] and Short,[14] who found that its enucleation during any stage of pregnancy invariably produced abortion.

Raeside and Turner[12] could not detect any progesterone in the venous drainage of the pregnant and non-gravid uterine horns in the goat, indicating that progesterone secretion from the foetal membranes, if any, is very small and insufficient to maintain pregnancy in the absence of a corpus luteum. This is in direct contrast to the position in some other species like the cow, sheep and mare.

The findings on the hypophyses are in accordance with those of Pearce,[9] Purves and Griesbach,[10 11] Meites[6] and Greep,[5] who consider that luteotrophic hormone is secreted by the acidophiles while the follicle stimulating and luteinizing hormones are secreted by basophiles.

The results further conform with the findings of Evans and co-workers,[2 3 4] Meites,[6 7] Moore and Nalbandov,[8] who consider luteotrophic hormone (L.T.H.) also gonadotrophic in its effect, and essential for the maintenance of the corpus luteum and its secretion of progesterone.

These results, therefore, support the view that abortion in Angora goats in South Africa is due to defective L.T.H. secretion causing regression of the corpus luteum, deficiency of progesterone, and death of the foetus due to a consequent atresia of the maternal cotyledons. This is probably due to an inherent weakness of the ewe which is also probably hereditary.

Conclusions

The investigations leave little doubt that the cause of large scale losses due to abortion in Angoras in South Africa is an inherent weakness in the hypophysial-gonadal axis mainly typified by failure of the alpha cells of the anterior hypophysis to produce sufficient luteotrophic hormone to support the corpus luteum of pregnancy. The consequent lack of progesterone causes regression of the maternal cotyledons with death and expulsion of the foetus, as well as releasing the inhibition of follicle stimulating hormone, thus initiating follicular development.

This inherent hypophysial inadequacy is probably hereditary and much further work is necessary to elucidate the genetics involved. In the meantime the only solution to the problem would appear to be the elimination of all aborters and their surviving progeny from breeding flocks. The fact that many aborters only declare themselves after having borne one or more live kids, makes the identification of all breeding goats and the keeping of complete breeding records essential.

Summary

1. Investigations into large scale abortions among Angora goats in South Africa are reported.

2. The cause was shown to be an inherent weakness in the hypophysial-gonadal hormone axis characterized by premature regression of the

alpha cells of the anterior hypophyses, consequent inadequate secretion of luteotrophic hormone causing regression of the maternal cotyledons with death and expulsion of the foetus. This condition is considered to be hereditary.

3. Other causes such as infections, malnutrition and adverse environmental conditions were eliminated.

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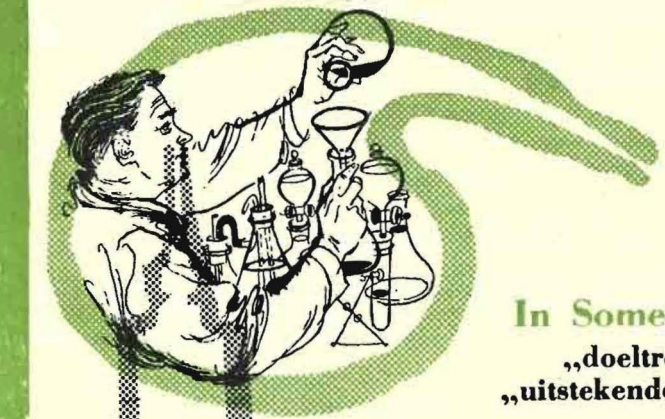

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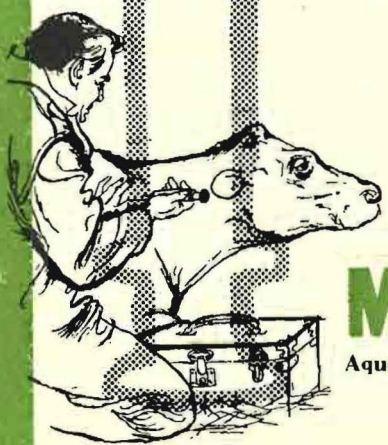

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THE CHEMOTHERAPY OF NEMATODE PARASITES OF SHEEP AND CATTLE

W. T. Harrow*

An extremely competent review of the therapy of parasitic gastro-enteritis in sheep and cattle was published just over a year ago[7] and it is the intention in this present paper to discuss developments since that time rather than to reiterate material which has already been adequately dealt with elsewhere.

As Gibson points out, parasitic gastro-enteritis is caused by some six or eight species of nematode occurring in different parts of the alimentary canal, and is really a complex of diseases varying according to the species of worms involved. One of the major deficiencies of the anthelmintics in current use is their specificity, due to their chemical or pharmacological characteristics, against certain worms.

Simple copper salts, for example, are only active in acid media, so that the usefulness of copper sulphate is limited to the abomasum. Phenothiazine, especially when finely ground, is mainly absorbed from the small intestine and therefore may not reach the lower bowel in sufficient concentration to be really active against worms in that part of the gut. Bephenium hydroxynaphthoate shows a nematode specificity which is not accounted for in such terms. It is effective in the abomasum against *Haemonchus*, *Ostertagia* and *Trichostrongylus axei*, but in the small intestine, although very highly active against *Nematodirus* and *Cooperia*, has little action on the trichostrongyles.

The other major deficiency of the commonly used anthelmintics is their lack of activity against the immature stages of the common nematodes, which are, of course, frequently as pathogenic as the mature forms. Further, their removal together with the adults ensures a more thorough and lasting anthelmintic action.

It is not surprising, therefore, that research effort over the last few years has been directed almost exclusively to the development of compounds having a wider range of activity as regards both species and stages of maturity. A good deal of work has gone into attempts to improve phenothiazine in these respects, and the effect of particle size on activity has been well established. Unfortunately, very fine micronisation which reduces particle size to less than 10 microns may reduce efficiency against parasites in the large intestine and caecum.[19] Micronisation also greatly increases the mammalian absorption of phenothiazine[15], and besides potentially increasing the general toxicity of the drug, it may lengthen the period of photosensitivity after dosing in young calves.[17]

* c/o Imperial Chemical Industries Limited, Pharmaceuticals Division, Alderley Park, Macclesfield, Cheshire, England.

Baker and his colleagues[1] and Forsyth and Scott[6] have now clearly demonstrated that the purity of phenothiazine is quite as important as particle size in determining its efficiency. From Baker's figures it may be deduced that purified phenothiazine is of the order of 15 per cent more effective than that of National Formulary specification of the same particle size.

It is, however, important to know the method used in determining the purity of a given sample. The so-called total nitrogen method is unreliable, since it assumes that all the nitrogen in a sample is derived from phenothiazine, whereas, in fact, nitrogenous impurities are very common. Errors of up to 10 per cent. may occur, unless a method is used which determines the actual phenothiazine content, such as the chromatographic method[10] or infra-red spectrophotometry.

Work on the organic phosphorus compounds has been very extensive since their introduction as anthelmintics some three years ago[16] and the activity of some eight or nine of them has now been reported upon. In general, they are very active against *Haemonchus*, *Trichostrongylus axei* and *Ostertagia*, although according to Dunsmore[4] many of them have no advantage over good quality phenothiazine against these parasites. However, Stampa[18] found high activity against *Oesophagotomum*, and Meldal-Johnsen *et al.*[13] that they were effective against *Cooperia* and *Nematodirus* also. Meldal-Johnsen states that prestimulation of the oesophageal groove is necessary before dosing and disagrees with Stampa concerning activity against *Oesophagostomum*.

Riek and Keith[16] made the important observation that these compounds are effective against the immature stages of many of the common cattle nematodes.

Undoubtedly the main difficulty with the organic phosphorus compounds so far has been their somewhat narrow safety margin and unpredictable toxicity. This toxicity lies in their property of inhibiting cholinesterase and this appears to vary according to climatic or geographical conditions. Riek and Keith[16], for example, noted that a dose which was safe in Queensland, Australia, was toxic in Victoria, and Forsyth[5] has suggested that some pastures may contain a cholinesterase-inhibiting factor which has an additive effect to that of the organic phosphorus compounds. The multiplicity of these compounds, which have been tested, suggests strenuous attempts on the part of the manufacturers to overcome the problem of toxicity which certainly seems to be the major drawback in an otherwise highly promising series.

Quite recently Kingsbury[11] has suggested that certain organic phosphorus compounds may have a synergistic action with phenothiazine, and further work is awaited with interest.

Having previously established the value of bephenium embonate' Rawes and Scarnell[14] demonstrated the higher anthelmintic activity of bephenium hydroxynaphthoate. Whereas the embonate was only effective against adult *Haemonchus*, *Ostertagia* and *Cooperia*, and both adult and larval stages of *Nematodirus*, the hydroxynaphthoate was also active

against immature *Haemonchus* and *Ostertagia* and adult *Trichostrongylus axei*. It is noteworthy that there is an apparent species resistance on the part of the trichostrongyles in the small intestine to both the embonate and the hydroxynaphthoate. The bephenium compounds are of special interest owing to their very high activity against immature helminths.

Probably the most interesting recent introduction is that of 2-(β-methoxyethyl) pyridine or "Promintic"* (called "methyridine"** hereafter), first described by Broome and Greenhalgh[3] as having high anthelmintic activity in all parts of the alimentary canal of mice when it was given either orally or subcutaneously. This property is probably unique and arises from the fact that the compound is absorbed from the site of administration and excreted into the bowel along its whole length.

Methyridine is highly active against immature worms including those having a migrating phase. This may be because its mode of excretion brings it into contact not only with the adult worms in the lumen of the bowel, but also with those forms which lie embedded in the mucous membrane or beneath the mucus covering the bowel wall.

In vitro experiments have shown that the drug passes through the cuticle of the worm and paralyses it by means of a depolarizing neuromuscular block[2]. The absorption of methyridine is dependent on the acidity of the surrounding medium and anthelmintic activity decreases as hydrogen ion concentration increases until at pH3 the drug is ineffective.

The first trials of methyridine in ruminants were carried out by Walley[20] in 491 sheep and 435 cattle. In all experiments he used a standard dose of 200 mg./kg. for both subcutaneous and oral administration. The anthelmintic activity of the compound was investigated by post-mortem worm counts in 400 sheep and 111 cattle and in the rest by faecal egg counts. Excellent results were obtained in the small intestine, especially against *Ostertagia*, *Trichostrongylus*, *Cooperia* and *Nematodirus* spp., and also against *Trichuris* in the caecum and large intestine.

In the abomasum results were not always consistent, particularly against *Haemonchus*. Although these worms were almost completely eliminated in the majority of animals, considerable numbers were left in a few. It has not been possible to show nematode species resistance to methyridine, so that it is concluded that the variation in effect is almost certainly due to the variation in abomasal pH which is known to occur in individual animals.

Because activity against *Haemonchus* is limited in a relatively small proportion of animals and the drug is so highly active in the remainder, the total number of worms removed from the dosed group is still considerably higher than with other agents.

Walley also showed that methyridine has some action against tapeworms and lungworms, but none against liver fluke or coccidia.

* "Promintic". Trade mark of Imperial Chemical Industries Limited.
** South African Patent Application No. 4515/60.

Following the demonstration of the anthelmintic efficiency of methyridine, it became necessary to study the effect of the drug under field conditions. Many anthelmintics vary considerably, particularly in their toxicity, under varying degrees of worm infestation and different conditions of diet and climate.

Field trials were therefore set up at a number of centres throughout the British Isles in order to gain as wide an experience as possible of these varying conditions. Material was not available in sufficient quantity for this work until June, which meant that trials in lambs on Spring grass were not possible in Britain and another series was therefore set up in Australia. Here it was possible to dose lambs from the age of six weeks in a variety of climates from temperate to sub-tropical. Trials were also set up in New Zealand to assess any possible effect of lush clover on the action of methyridine.

Groves[9] has summarized the results of the field trials carried out in Britain by some forty veterinarians, reporting excellent clinical and anthelmintic results in over 2,500 cattle and sheep. Field toxicity trials on a further 630 animals were carried out. The drug was well tolerated, although it sometimes caused a local reaction at the injection site. However, the reaction disappeared without trace in most cases within a week or so. An overdose of 375 to 400 mg./kg. subcutaneously caused incoordination and stumbling in about one third of 50 ewes and 100 lambs. Seven of these animals collapsed and four died within four hours. By the end of this time the remainder had recovered.

Young[21] has described his experiences with methyridine in Eastern Scotland in the treatment of 80 sheep and 31 cattle. He particularly notes the effectiveness of the drug in a flock of lambs which had been clinically affected with both trichostrongyles and *Nematodirus* some time previously, and two months after dosing with phenothiazine and bephenium salts their condition was declining further. Within ten days of treatment with methyridine the fall in bodyweight had stopped and five lambs had reached killing weight. Three weeks later, a further 17 lambs had reached killing weight and in the three months following 53 lambs were sent away fat. Scouring ceased within five days of treatment, appetities were enhanced and at about ten days the fleeces showed a remarkable improvement. Thirty one calves and young cattle showed signs of severe worm infestation. With the exception of nine, all the animals were markedly emaciated and scouring profusely and were treated by Young at standard dosage rates. The scouring stopped within five days and the animals recovered, except one, which, although responding to the anthelmintic treatment, succumbed.

Macrae[12] reports similar experiences, with dramatic clinical recovery. In one herd the methyridine dose was divided into amounts not exceeding 10 mils. and injected at different sites. This procedure prevented the occurrence of local reactions.

Gracey and Kerr[8] carried out an experimental trial of methyridine in 80 six months old lambs in Northern Ireland, leaving half untreated

as controls. The infestations consisted mainly of *Trichostrongylus* spp. with rather smaller numbers of *Nematodirus* and *Strongyloides*. Before treatment, and five, ten and twenty-four days after treatment, faecal worm egg counts were done on all 80 lambs and they were all weighed at fortnightly intervals. While the worm egg count in the controls remained at about 500 per gramme throughout the whole period, that in the test lambs fell from 500 to less than 100 and remained at this low level for the whole period of forty days. These authors are the first to report the entire elimination of *Strongyloides* worms by methyridine. A clinically observable result of treatment was the cessation of scouring. Live weight records showed an average gain in the treated lambs of $3\frac{1}{2}$ lbs. over the control lambs during the trial period.

Eight treated and six untreated lambs were slaughtered and total worm counts made. The average number of worms in the test lambs was 412, while in the control lambs it was almost 6,000. Methyridine appeared to have completely eliminated *Cooperia*, *Haemonchus* and *Bunostomum* and greatly reduced the number of *Trichostrongylus*, *Strongyloides* and *Ostertagia*. No systemic toxic effects were observed, although an abscess developed at the injection site in one lamb and slight local congestion occurred in three others.

In Australia very similar results were obtained in the same types of infection in over 1,000 sheep and some 250 calves. Particularly good results were obtained against *Bunostomum phlebotomum*.

The most striking effect of methyridine in all these trials was a rapid and spectacular clinical recovery. Animals which were severely ill, down and scouring, were up and eating and well on the way to recovery, in many cases within forty-eight hours. Also full therapeutic doses of the drug were well tolerated even by calves which were so severely affected that phenothiazine dosing would have been considered dangerous.

Methyridine probably approaches the ideal drug more nearly than any other at present known. It is particularly easy to administer, its injectability being most useful especially in restive or severely debilitated animals. It has a far wider spectrum of activity than the other drugs at present in use and has a reasonable margin of safety.

The ideal anthelmintic would be more constant in action in the abomasum and have an even lower toxicity. However, it has, of course, yet to be found, and in the meantime intensive work on the synthesis and the evaluation of new compounds continues.

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INVESTIGATION INTO AND THE DEVELOPMENT OF HEXACHLOROPHENE AS AN ANTHELMINTIC

C. J. Bosman, P. W. Thorold and H. S. Purchase*

INTRODUCTION

Historical:

Some of the earliest work with hexachlorophene (2, 2'-dihydroxy-3, 3' 5, 5' 6-hexachlorodiphenylmethane) was reported by Kerr[4] who investigated it against *Raillietina cesticillus* in chickens. He found it effective but it reduced egg production and was very toxic to birds suffering from Blackhead.

Hirschler[3] injected an alcoholic solution subcutaneously in sheep infested with *Fasciola hepatica*. Not only did eggs disappear from the faeces but no flukes were found at subsequent post mortem examination. This result was confirmed by Dorsman[1]; he injected hexachlorophene in an olive oil base subcutaneously into three bovines infested with *F. hepatica* at a rate of 40 mg./Kg. One animal died after treatment, the others only showed transient symptoms. The same author found 5 mg./kg. effective against *F. hepatica*, as shown by autopsy.

Federman[2] treated 1,011 sheep infested with *F. hepatica* with hexachlorophene (911 orally and 100 subcutaneously) at the rate of 10 and 20 mg./kg. Six weeks later faecal examination showed 89% and 76.6% cures respectively. In a number of the sheep subcutaneous injection produced local inflammation but the swellings disappeared after 14 days. He also confirmed by post mortem examination that 20 mg./kg. gave a 100% cure in sheep, whilst 10 to 40 mg./kg. was effective in cattle when dosed orally. He also found this compound effective against *Moniezia expansa* in lambs at a dosage rate of 15 mg./kg.

Kerr and Green[5] tested various halogenated compounds and showed that hexachlorophene had the best taeniacidal activity.

Aims and Problems

In some areas of South Africa where *F. hepatica* is rife, stock are particularly susceptible to the toxic effects of chlorinated hydrocarbon anthelmintics, especially when dosed during the winter months.

Such an area studied is the mountainous region of the grassveld which has an annual rainfall of over 20'' and $\pm$ 10°C. of frost every night during the months May to August. This is the so-called maize triangle, which includes the Eastern Orange Free State and the Highveld of the Eastern Transvaal. The altitude averages 4,500 ft. above sea level,

* c/o Cooper & Nephews S. Af. (Pty.) Ltd., P.O. Box 2963, Johannesburg.

the soil is acid and the grass cover is usually referred to as "sourveld." The majority of grass species is palatable only during the very young stages. Animals in these areas have to exist on frosted, dry, standing grass of low nutritional value during winter.

It is known that the resistance of the liver to damage by chlorinated hydrocarbons is correlated to its glycogen and protein contents and the availability of certain amino acids, e.g. methionine. It is therefore probable that the low tolerance of stock to these drugs during winter is connected with the general low plane of nutrition.

Materials and Methods

Materials:

I. Hexachlorophene in a vegetable oil to give ± 15 mg./kg. live weight when dosed at the rate of 1 ml./10 lb. live weight.*

II. A proprietary product (Hexaphine) containing 8 g. of hexachlorethane and 7 g. of phenothiazine per fluid ounce.

III. A mixture (T/C Mix): 87.5% tetrachlorethylene plus 12.5% carbon tetrachloride, a water miscible formulation.

Egg Counts

Two grammes of sheep faeces were used. Where electricity was available, these were liquified in a Waring blendor, otherwise the faecal material was pressed through a coffee strainer. This was then strained through an 80 mesh sieve, the strained matter was poured into a quart-size fruit jar, ± 1 litre of water added and the mixture well stirred. The liquid was left to settle for three minutes and the supernatant water decanted and the procedure repeated until the supernatant fluid was clear. The sediment and remaining water were then poured into an 8-oz. wide-mouthed bottle; sedimentation and decanting were repeated leaving precisely 10 ml. in the bottle. One ml. of the stirred sediment was examined microscopically in McMaster slides. The number of eggs counted was multiplied by 10 and then divided by 2 to get the e.p.g. Egg counts were made on the day of dosing, eight days later and occasionally at longer intervals.

In cattle, 4 grammes of faeces were weighed and the same technique of examination carried out, but no precise counts were made.

Autopsies

Animals with high fasciola and paramphistome egg counts at the time of treatment were selected for autopsy, which was carried out 18–90

* In the preparation of the hexachlorophene oil solution an arithmetical error occurred and the material used in the Free State was actually 8.8% over strength. The material used for trials in the Eastern Cape Province was of correct concentration.

hours after dosing, so that affected liver flukes could still be present in the gallbladder, bile-ducts and duodenum. This procedure eliminated the necessity of carrying out autopsies on untreated animals.

Weights

Cattle were weighbanded or their weights estimated. Sheep were weighed on a scale.

RESULTS

Therapeutic Efficiency of Hexachlorophene against Fasciola hepatica *and* Paramphistomum *spp.*

(i) *Cures confirmed by autopsies.* Table 1 gives the post mortem examination results in cattle and sheep known to be infested at the time of dosing hexachlorophene at different levels.

TABLE 1.

Rate of dosage mg./Kg.*	No. of animals dosed.	*F. hepatica.*	No. of animals dosed.	*Paramphistomum* spp.
7.5	7 sheep	0	5	A few present
10.0	1 sheep	0	1	0
15.0	18 sheep	0	2	0
20.0	2 sheep	0	1	0
7.5	9 cattle	0	8 cattle	Present in 2/8
10.0	4 cattle	0	2 cattle	A few present in one.
12.5	1 calf	0	—	—
15.0	4 cattle	0	3 cattle	0
18.0	1 heifer	0	—	—

*mg. of hexachlorophene per Kg. live weight of the animal dosed.

At dosage rates of 7.5 mg./kg. and higher, autopsy results show complete cures of liver fluke infestation. Similarly, at dosage rates of 10 mg./kg. or more, *Paramphistomum* spp. were well controlled.

Of five animals showing clinical symptoms of infestation by young paramphistome worms, three were treated with hexachlorophene at 15 mg./kg. The treated animals recovered and the two undosed controls died. Post mortem examination confirmed the clinical diagnosis.

(ii) *Cures confirmed by Faecal Egg Counts.* Some 110 infested sheep were dosed with hexachlorophene at dosage rates of 7.5–30 mg./kg.; in only 18 (16%) fasciola eggs, in reduced numbers, were seen after treatment. A group of 35 sheep known to be infested with *Paramphistomum* spp. was dosed at similar rates and only 3 sheep (7%) were positive on examination for eggs after treatment.

Infested cattle were dosed at the rate of 15 and 20 mg./kg. No fasciola eggs were recovered after treatment in 20 out of 25 animals treated, nor in 14 out of 18 animals infested with paramphistomum. However, it must be mentioned that in 3 of these animals eggs were found 48 hours after dosing, which would probably be too soon for all the dead flukes and eggs to have been passed.

Field Comparison of the Safety of Hexachlorophene vis-a-vis Other Chlorinated Hydrocarbons

The safety of hexachlorophene was compared with two other anthelmintics known to cause ill effects in cattle and sheep when dosed during the winter in certain parts of Africa.

The development of increased sensitivity to these drugs as winter progressed was studied on eight farms. Table 2 typifies this phenomenon in sheep which had a light liver and conical fluke infestation and were dosed with therapeutic amounts.

TABLE 2.

"Goewerneurskop"—Clocolan District, Orange Free State.

Date	"*Hexaphine*"	"*T/C Mix*"	*Hexachlorophene.*
25/5/60	3 sheep 1	2 sheep 1	5 sheep 1
13/6/60	3 sheep 2	1 sheep 2	7 sheep 1
28/6/60	2 sheep 3	1 sheep 2	6 sheep 1

1. No reaction. 2. Intoxication. 3. Severe symptoms.

Field Trials with Hexachlorophene

In preliminary pilot toxicity trials it was found that sheep and cattle showed no clinical signs of toxicity at dosage rates of up to 30 mg./kg. hexachlorophene and that the LD_{50} was around 50–60 mg./kg.

Hexachlorophene controlled liver flukes and paramphistomes at a dosage rate as low as 10 mg./kg. In all, 8,865 sheep (Table 3) were treated at precise and estimated dosage rates of 7.5 to 30 mg./kg. and those inspected at autopsy showed no lesions of hexachlorophene poisoning. Only 17 of the sheep died in from 41 hours to 7 days after dosing during these trials and their deaths were all attributable to unrelated causes. Hexachlorophene also appeared safe for cows in calf and in milk, ewes in lamb, and ewes with lambs, provided they were handled and dosed carefully.

TABLE 3.
Dosage of Livestock with Hexachlorophene in Different Parts of South Africa.

Type of stock dosed	Region	No. of stock	Dosage rate
Ewes in lamb	O.F.S. (1)	572	10–15 mg./Kg.
Ewes in lamb	Eastern C.P. (2)	149	10–15 mg./Kg.
Ewes with lamb at foot	O.F.S.	2,131	10–15 mg./Kg.
Ewes with lamb at foot	Eastern C.P.	467	10–15 mg./Kg.
Dry stock mixed	O.F.S.	4,395	15 mg./Kg.
Dry stock mixed	Eastern C.P.	1,151	15 mg./Kg.
Total No. of sheep dosed		8,865	
Cows in calf	O.F.S.	35	11 @ 20 mg./Kg. or over
Cows in milk	O.F.S.	78	
Cows in milk	Transvaal	12	89 @ 15 mg./Kg.
Mixed stock stock	O.F.S.	362	389 @ 10 mg./Kg.
Mixed stock	Transvaal	24	46 @ 7½ mg./Kg.
Mixed stock	Eastern C.P.	24	
Total No. of cattle dosed		535	

(1) O.F.S. Orange Free State.
(2) Eastern Cape Province.

DISCUSSION

Toxicity following Dosing with Certain Worm Remedies

It is a phenomenon well known in South Africa that in certain areas and at certain times of the year, both sheep and cattle become sensitive to therapeutic doses of carbon tetrachloride, tetrachlorethylene and hexachlorethane.

In these trials, hexachlorophene at higher than therapeutic levels proved to be safe for stock, whereas intoxication followed dosing with the other chlorinated hydrocarbon anthelmintics.

The majority of the remarkably few animals which died during field trials revealed on post mortem evidence of enterotoxaemia, a finding which is all too common where sheep not immunized against this disease are dosed with anthelmintics. Losses in dosed flocks, which had been protected against enterotoxaemia, were negligible.

It is accepted that animals grazing frosted, standing grass in certain areas of South Africa lose their resistance to toxicity following therapeutic dosing of chlorinated hydrocarbon anthelmintics. It is highly probable, therefore, that under these conditions the tolerance of animals to this group of remedies is decreased still further by the debilitating effect of worm infestation.

Effects of Hexachlorophene on Liver and Conical Flukes

During these trials a number of sheep were specially slaughtered at different times after medication (18–48 hours) to study the effect of hexachlorophene on *Fasciola hepatica*. Some macroscopically normal flukes,

as well as affected ones, were found in the duodenum, pointing to an expulsion of the parasites by an outgoing tide of bile. The first change observed in an affected fluke was eversion of the ventral sucker, closely resembling the protruding eye of a crab; from this dark fluid flowed. The disintegration of the cells within the fluke's body then started from the posterior end and extended forward all along the outer branches of the digestive tract.

The second stage then set in; the hind end of the fluke turned progressively more yellow, firstly a light yellow, then a light yellow-green, and this extended forward. The colour now changed to light pea green which in its turn became a darker leaf green. After this, the parasite became transparent as a result of the disintegration of the body cells. The fluke now looked as if it were a transparent green flake; this often caused the bile ducts to appear to be filled with a dark green pus, but on closer examination it was found that the duct contents consisted of disintegrated fluke bodies mixed with bile fluid. The front part of the fluke only turns transparent at this later stage and it is always a darker green colour than the rest of the body. Finally, any fluke bodies, which have not disintegrated, start to dehydrate and become dark brown, like dry autumn leaves.

The reason why liver flukes were found in animals soon after treatment, in all stages from apparently normal individuals to those in advanced degeneration, may be due to the fact that the parasites in the smaller bile ducts are affected by the drug earlier than those in the main ducts. This is likely, because the systemic anthelmintic must enter the bile excretory system through the capillary blood vessels and bile ducts. The flush of affected flukes from the smaller ducts apparently simply push out the parasites in the larger, main ducts, and that also is presumably why some of the flukes found in the duodenum are normal in appearance.

An explanation for the effectivity of hexachlorophene in vegetable oil at low dosage may be that it is in a digestible oil and therefore readily taken up, enters the bloodstream and is excreted into the bile ducts. Hexachlorophene also differs in its action from other chlorinated hydrocarbons in that it was effective even on the parasites in thickened and calcified bile ducts, present in chronic bovine fascioliasis.

The manner in which hexachlorophene affected paramphistomes was as follows:—The normal colour of paramphistomes is light pink posteriorly and anteriorly, with a bright red portion in the middle. After treatment the digestive tract became lighter in colour while the rest of the body turned a deep reddish purple. The affected paramphistomes loosened their grip, the posterior sucker lost its circular shape, and the body became long and threadlike. If pricked with a needle or pin, the body did not contract. This lengthening of the dead fluke body was also observed in liver flukes.

Up to the present it has hardly been possible to find any anthelmintic that had a reasonable efficiency against adult paramphistomes. The trials in the Orange Free State and Transvaal proved that hexachlorophene in vegetable oil at a dosage rate of 10 to 15 mg./kg. live weight gives excellent results against *Paramphistomum* spp. There was also an indication that the above remedy may be effective against the immature stages.

Summary and Conclusions

1. The paper records succinctly the results of many detailed field trials.

2. In comparative "Hexaphine" and "T/C Mix" field trials carried out in winter, on grassveld farms, these drenches produced pathognomonic symptoms and even death, but 20 mg./kg. hexachlorophene did not affect the sheep and there was only slight liver damage at 30 mg./kg. as shown by increased bilirubin levels (determined by Onderstepoort collaborators.)

3. The efficacy of hexachlorophene as an anthelmintic against *Fasciola hepatica* and *Paramphistomum* spp. was investigated in the Cape Province, Orange Free State and the Highveld of the Southern and Eastern Transvaal. It was clearly demonstrated by autopsy and by faecal counts that hexachlorophene dissolved in vegetable oil given orally at a rate of 10–15 mg./kg. was effective against both liver and conical flukes.

4. In field trials 8,865 sheep were treated safely with 15+ mg./kg. hexachlorophene. These flocks included sheep of all ages and many pregnant and suckling ewes. A dose range of 7.5–20 mg./kg. was found to be safe in a total of 535 cattle.

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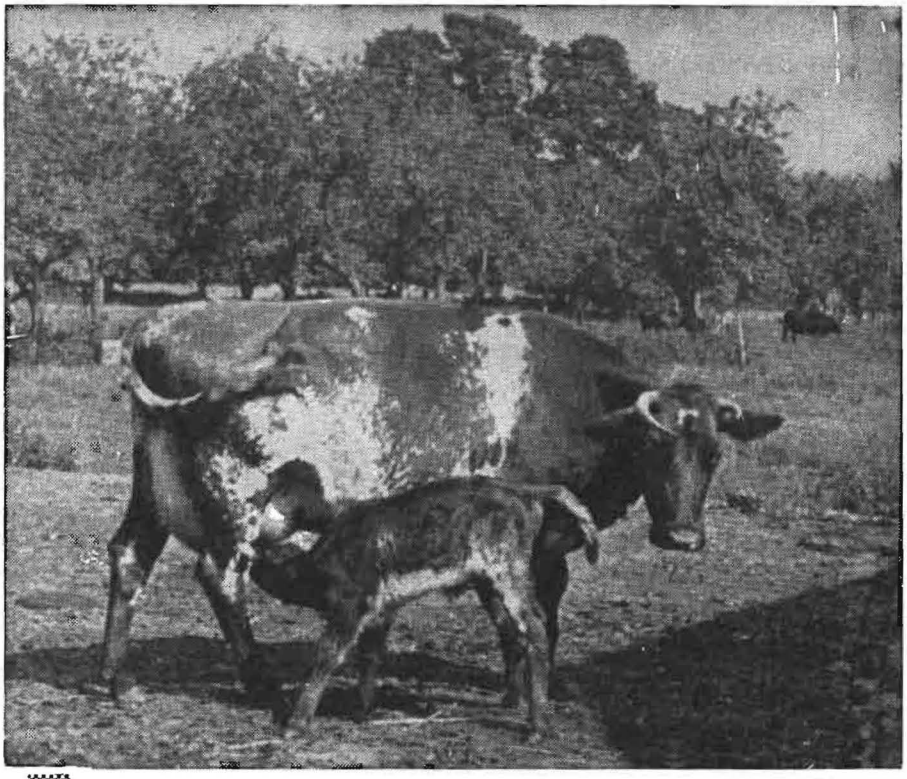

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"TRANSPORTATION OF ANIMALS BY RAIL."

I. "THE BEHAVIOUR OF CATTLE DURING TRANSPORTATION BY RAIL"

J. H. R. Bisschop*

INTRODUCTION

The problem of how to maintain the health, bodily condition and economic value of livestock during transportation by rail over long distances, has long exercised the minds of those concerned: in this country, the South African Railways, the Livestock and Meat Industries Control Board, the Department of Agricultural Technical Services through its Divisions of Animal Husbandry and of Veterinary Services, Agricultural Unions and Farmers' Associations, etc.

In 1955 and again in 1960 and in 1961, investigations were carried out conjointly by the Railways, the Meat Board and the Divisions of Animal Husbandry and of Veterinary Services, to enquire into the prevailing methods of cattle transport by rail and to study the behaviour of the cattle in transit, with the object of formulating scientifically sound instructions and regulations for their treatment and handling prior to and during loading, for their resting, feeding and watering *en route*, for proper ventilation of the trucks, for the prevention of bruising, etc.

This paper deals with the behaviour of cattle transported by rail from Outjo and from Gobabis in South West Africa, to the Cape Town abattoirs, during August, 1955 and April, 1960.

EXPERIMENTAL ANIMALS

(i) *The Outjo consignment* consisted of 110 approximately four-year-old dehorned steers of very mixed breeding, including Shorthorn, Afrikaner, Brown Swiss, Simmenthaler, Hereford, Sussex, Redpoll and South Devon types which, on the hoof, graded Nos. I, II and III.

(ii) *The Gobabis consignment* included cattle belonging to two owners. The one batch consisted of 164 approximately four-year-old steers, including Shorthorn, Afrikaner, Simmenthaler, Redpoll, South-Devon and Brahmin types; on the hoof they graded mostly Nos. I and II with a few primes and Nos. III. Of the 164 head, 128 were polled, or dehorned. The second batch were all Afrikaner cattle, all horned and in poor condition. Of the 94 head 58 were steers and 36 cows. On the hoof they graded Nos. II, III and IV.

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Treatment prior to loading

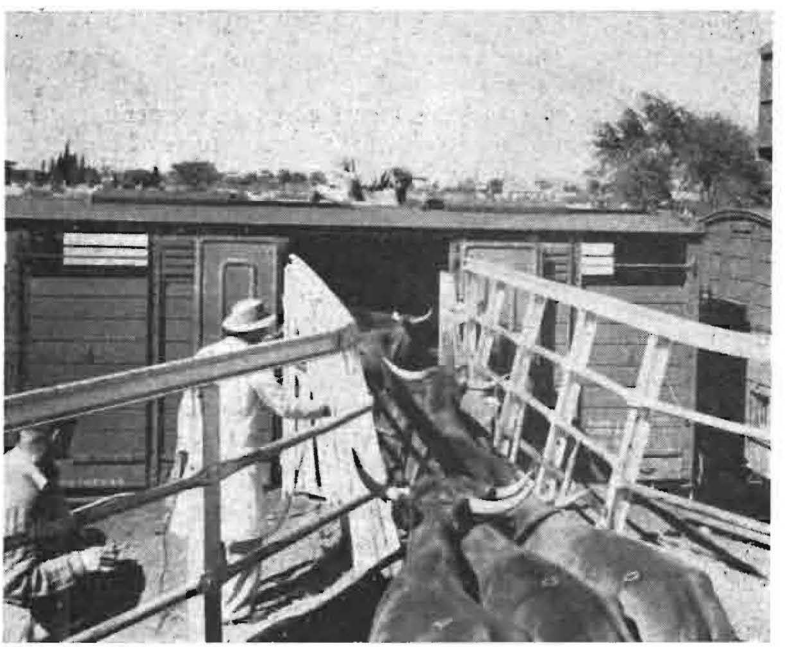
(i) *The Outjo steers* were selected during the morning, kept in a separate camp for the night with water available, and moved by road to town the next day, taking 8 hours to cover the 17 miles. They arrived at the railway kraals towards sunset, blowing somewhat and covered with dust. Although water was available, few if any of the steers took more than a few mouthfuls. No food was supplied.

(ii) *The two batches of the Gobabis consignment* travelled respectively 48 and 80 miles to railhead and were on the road for 2½ and 5½ days. They were in the railway kraals for 19 and 29 hours prior to loading, with water available, but without food.

Loading, off-loading and transhipping

Both at Outjo and at Gobabis, the cattle were loaded between 8 and 10.30 a.m. The sexes and horned and dehorned cattle were loaded separately.

From the holding kraals the number of cattle to go into one truck or truck compartment were drafted into the loading kraals which were triangular or funnel-shaped[1] and led to the loading crush. (See Photo No. 1). The animals converged onto the crush and pushed past one



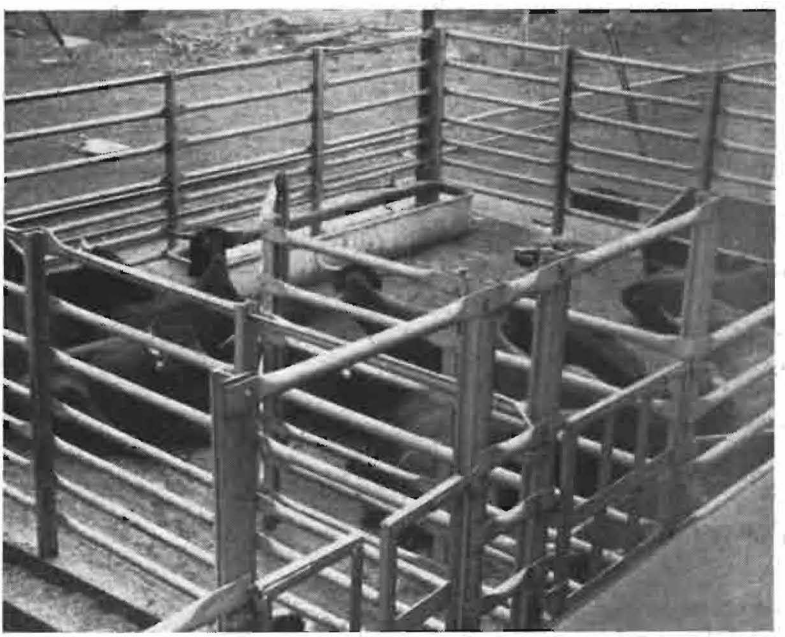
Loading crush at Gobabis.

[1]Loading kraals should have one side in line with the loading crush and cattle should be moved single file along this side into the crush, which should have no corners against which shoulders, ribs or hookbones can be injured and should be lined with sheet iron up to five feet high.

another into it. They were forced into and through the crush by the free use of electric prodders which caused many of the animals to move violently against the sides of the crush, or into other cattle. On several occasions animals already in a truck tried to force their way back through the crush into the loading kraal. They met the oncoming animals head-on and in a few instances tried to climb over them. Trying to stop them with electric prodders[2] made the confusion worse. Where the train was carefully shunted and the truck doors placed squarely opposite the crush, the sharp edges of the doors were bad enough as causes of bruising, but where the doors extended beyond the crush, they constituted a real menance to the shoulders, ribs and hookbones of the cattle.[3]

At Outjo the cattle were loaded into narrow-gauge trucks and transferred to standard-gauge trucks at Usakos, 187 miles and 12½ hours later; at Gobabis they were loaded directly into standard double-bogie trucks, of type G.7, with not more than 12 head per truck section.

After trans-shipment at Usakos, the Outjo steers were off-loaded for food, water and rest at Windhoek and De Aar; the Gobabis cattle at Upington and Beaufort West. During both journeys loading became



Loading fence in restkraals at Beaufort West.

[2]CHARLES, B. D., (1960) says: ". . . when indiscriminately used, as it often is, to force cattle through shutes, animals are cruelly stimulated by electric goaders . . . Cattle have been killed by excessive use of the goader or "dog", which must be regarded as a very potent weapon in causing a rapid rise in blood pressure." (Austr. Vet. Jl. 36, 124–126).

[3]It is suggested that truck door edges constitute one of the most potent causes of bruising during transport by rail and should be adequately padded during loading and off-loading.

easier at successive resting centres. The animals soon learned what was expected of them. With a little patience and with the judicious use of "slaps"[4] and, when unavoidable, of a prodder, little difficulty was experienced. At Usakos and Windhoek crushes were used; at Upington and Beaufort West short fences projected into the resting kraals to facilitate loading[5] (see photo 2), but at De Aar no such aids were available and the cattle were handled without any trouble.

Length and duration of transport by rail

(i) *The Outjo steers* travelled 1,707 miles by rail in 90 hours' actual running time or at an average of 19 miles per hour. They spent 4 hours in the feeding and watering kraals at Windhoek and 8 hours in the kraals at De Aar.

(ii) *The Gobabis cattle* travelled 1,521 miles in 114 hours, at an average of only 13 miles per hour and spent 5 hours in the kraals at Upington and at Beaufort West.

Animal behaviour after loading

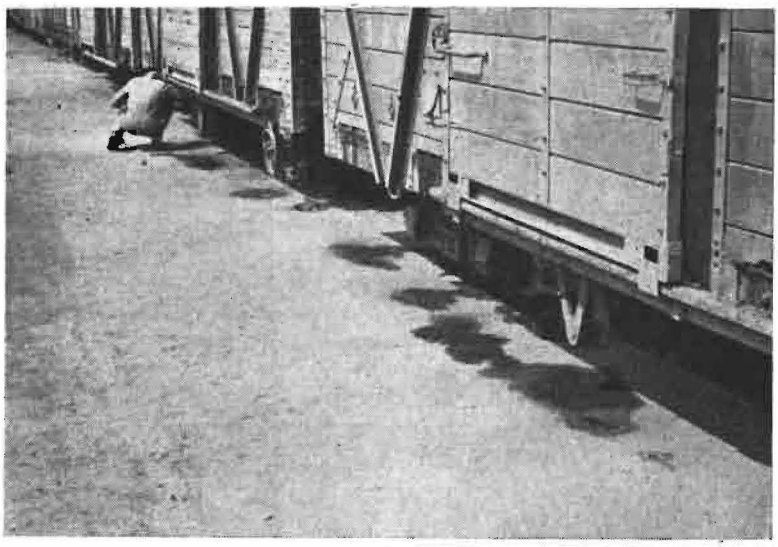
(i) *At Outjo* 1½ hours elapsed between loading and departure. During this time the steers were very nervous and restless, showed trembling especially of the hind-flanks, and kept on butting each other and changing their positions in the trucks. They defaecated and urinated so copiously that they soon stood inches deep in faecal slush. On either side of the trucks the ground became wet and in places the urine ran in little streams away from the trucks. (See photo 3).

Urine from cattle trucks at Outjo.

[4]"Slaps" or loading whips have short wooden handles to which are nailed pieces of old tarpaulin, 3 to 4 layers thick and measuring about 15–18 inches long by 4–5 inches wide.

[5]Whatever help these fences were in loading, was more than offset by the way they interfered with the free movement of the cattle in the kraals, and by the bruising so caused.

This state of nervousness lasted the 4 hours to Otjiworongo, where urine still ran out of the trucks (see photo 4). The steers had stopped



Urine from cattle trucks at Otjiwarongo.

trembling, but still moved about and butted each other. During the 8½ hours run from Otjiwarongo to Usakos the animals settled down and stopped butting and moving about. They stood resting, mostly with their heads low, and some with their eyes closed and apparently asleep. During this run urination and defaecation stopped. It appeared as if the steers had drained themselves pretty well of their intestinal contents and free body moisture.

(ii) *At Gobabis*, 3 hours elapsed between loading and departure. At no time during this period did the experimental animals in any of the eleven trucks show nervousness, trembling or more than normal defaecation and urination. The floors of the trucks were practically dry when the train left and were still so, nine hours later, at Windhoek.

No explanation can be offered for this difference in behaviour.

ANIMAL BEHAVIOUR IN THE TRUCKS DURING THE JOURNEY

(i) *The Outjo steers* took some 6 to 8 hours to become accustomed to the trucks and to the movements of the train in motion. From Usakos to Cape Town they did not again show nervousness, even after loading, nor did they at any time defaecate or urinate excessively; if anything, these functions were decreased.

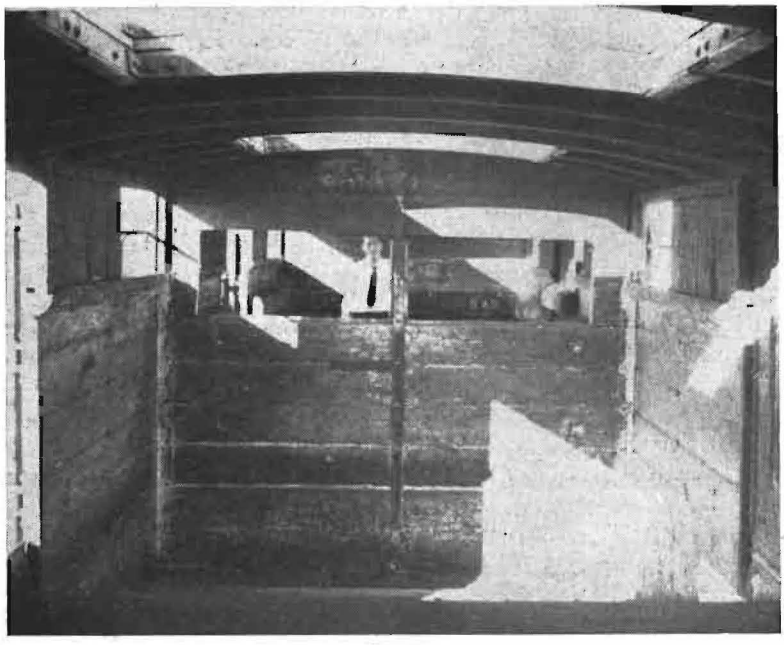
Whenever inspected *en route*, the steers were as a rule found standing next to each other across the trucks, with their heads held low. The impression was gained that they spent much of their time sleeping. Often too, oxen, up to two per truck section, were found lying down, apparently without any ill effects.

(ii) *The Gobabis cattle* were observed much more closely during transit than were the Outjo steers. To do so while the train was moving,

a "window" was cut in the end of the truck next to the observation coach (see photo 5). Through this window one looked into the unpadded half

Observation window from staff coach into cattle truck.

of the truck and through a second "window" in the dividing partition, into the padded half (see photo 6).



Observation window between non-padded and padded sections of cattle truck.

Twelve horned steers occupied each section. Records were kept of how they moved about in the truck: whether they stood across the truck or in line with its length; whether they appeared at rest or not; and of any steers lying down. At times it was difficult to be sure if any or of how many, were lying down. In order to obtain more accurate information about this aspect, counts were made in both sections of each of the eleven trucks, whenever it was possible to do so at stations. Such counts were made through the vents in the roofs of the trucks.

(*a*) Observations between Gobabis and Windhoek

Table I gives details of the behaviour of the two observation groups between Gobabis and Windhoek. It will be seen (Table 1) that between loading and departure both groups milled about in the truck, but that soon after departure they settled down, and stood next to each other across the truck, facing indiscriminately in either direction. They maintained this position even during the period from 3.00 to 4.15 p.m. when the train was delayed at a siding. The animals became somewhat restive when the train wound its way through hills down to Windhoek, and showed considerable uneasiness there while being shunted about. Even so, the steers in the unpadded section were standing still during 29 out of the 35 observations and those in the padded section during 24 out of the 34 observations made. In terms of individual animals 96% of the steers in the observation truck stood across the truck when observed at quarter-hourly intervals over a period of about 12 hours. This position is obviously the most comfortable one for cattle being transported by rail.

Cattle at rest in a truck, hold their necks straight or low, while those not at rest hold their heads high and look around. Using this as an index, the table shows that during the journey 93% of the animals in the unpadded, and 88% of those in the padded section of the observation truck appeared to be at rest, the difference being due primarily to one ox in the padded section, which kept his head high and looked around actively for more than 3 hours on end.

(*b*) Between Windhoek and Upington

This journey took from 2 a.m. on Tuesday until 9 a.m. on Wednesday. Observations were made at quarter-hourly intervals from 8 a.m. to 7 p.m. on Tuesday. They are recorded in Table II. It will be seen (Table II) that for both groups the animals stood still during 32 out of the 35 observations made. In terms of individual animals 86% stood across the truck when observed as against 14% which stood in line with the truck or at an angle, and respectively 85% and 82% of the steers in the unpadded and padded sections were at rest when observed. A number of animals lay down in the truck during the day.

One animal in each section was selected in order to obtain information about the way in which the steers changed their position in the truck during transit. The table shows that these "index" oxen moved about considerably during the course of an eleven hour period.

TABLE I.
GOBABIS STEERS
BEHAVIOUR OF STEERS FROM GOBABIS TO WINDHOEK

Time	Train moving or standing	Group I Unpadded part of truck					Group II Padded part of truck					Remarks
		Movement or not of Steers	Position of Steers		Position of heads		Movement or not of Steers	Position of Steers		Position of heads		
			Across	Other	Held high	Other		Across	Other	Held high	Other	
9.15 a.m.	S	Milling about	—	—	—	—						Directly after loading.
9.30 a.m.	S	Standing still	12	0	—	—	Milling about	—	—	—	—	Group II just loaded
9.45 a.m.	S	Standing still	10	2	—	—	Standing still	10	2	—	—	
10.00 a.m.	S	Milling about	—	—	—	—	Milling about	—	—	—	—	
10–12	—	—	—	—	—	—	—	—	—	—	—	No observations made.
12.00	S	Standing still	—	—	—	—	Standing still	—	—	—	—	
12.15 p.m.	M	Standing still	—	—	—	—	Standing still	—	—	—	—	Train left Gobabis at 12.10 p.m.
12.30 p.m.	M	Milling about	—	—	—	—	Milling about	—	—	—	—	
12.45 p.m.	S	Standing still	12	0	—	—	Milling about	—	—	—	—	At siding.
1.00 p.m.	M	Standing still	12	0	—	—	Settling down	—	—	—	—	
1.15 p.m.	M	—	—	—	—	—	—	—	—	—	—	No observations.
1.30 p.m.	M	Standing still	12	0	0	12	Standing still	12	0	0	12	
1.45 p.m.	M	Standing still	12	0	0	12	Milling about	—	—	—	—	
2.00 p.m.	M	Standing still	8	4	—	—	Standing still	12	0	2	10	
2.15 p.m.	M	Standing still	12	0	3	9	Standing still	7	5	4	8	
2.30 p.m.	M	Standing still	12	0	2	10	Standing still	12	0	3	9	
2.45 p.m.	M	Standing still	12	0	2	10	Standing still	12	0	2	10	
3.00 p.m.	S	Standing still	11	1	0	12	Standing still	12	0	1*	11	*The same Steer, a ¼ bred Brahmin × Afrikaner
3.15 p.m.	S	Standing still	12	0	1	11	Standing still	12	0	1*	11	
3.30 p.m.	S	Standing still	10	2	0	12	Standing still	12	0	1*	11	
3.45 p.m.	S	Standing still	12	0	0	12	Standing still	12	0	1*	11	
4.00 p.m.	S	Standing still	12	0	0	12	Standing still	12	0	1*	11	
4.15 p.m.	S	Standing still	12	0	1	11	Standing still	12	0	1*	11	
4.30 p.m.	M	Standing still	12	0	0	12	Standing still	12	0	1*	11	
4.45 p.m.	M	Standing still	11	1	2	10	Standing still	11	1	1+1*	10	
5.00 p.m.	M	Standing still	12	0	0	12	Standing still	12	0	1*	11	
5.15 p.m.	M	Standing still	12	0	1	11	Standing still	12	0	1*	11	
5.30 p.m.	M	Standing still	9	3	2	10	Standing still	12	0	1*	11	
5.45 p.m.	M	Standing still	12	0	1	11	Standing still	12	0	1+1*	10	
6.00 p.m.	M	Standing still	12	0	1	11	Standing still	12	0	1*	11	
6.15 p.m.	M	Standing still	12	0	1	11	Standing still	12	0	2	10	
6.30 p.m.	M	—	—	—	—	—	—	—	—	—	—	No observations
6.45 p.m.	M	Standing still	12	0	0	12	Standing still	10	2	2	10	
7.00 p.m.	M	Milling about	—	—	—	—	Milling about	—	—	—	—	
8.00 p.m.	M	Standing still	12	0	—	—	Standing still	12	0	—	—	
9.00 p.m.	M	Standing still	12	0	—	—	Milling about	—	—	—	—	Arrived Windhoek 9.10 p.m.
10.00 p.m.	S	Milling about	—	—	—	—	Milling about	—	—	—	—	
11.00 p.m.	S	Milling about	—	—	—	—	Milling about	—	—	—	—	
Overall Percentages			96.0	4.0	7.0	93.0		96.0	4.0	12.50	87.5	
Standing still		29					24					
Moving about		6					10					

TABLE II
GOBABIS STEERS
BEHAVIOUR OF STEERS BETWEEN WINDHOEK AND UPINGTON—26.4.60.

Time	Train moving or standing	Group I—Unpadded part					Relative position of Index Steers	Group II—Padded part					Relative position of Index Steers	Remarks
		Movements of Steers	Position of Steers		Position of Heads			Movements of Steers	Position of Steers		Position of Heads			
			Across	Other	Held high	Other			Across	Other	Held high	Other		
8.00 a.m.	M	Standing still	9	3	12	0	—	Milling about	3	9	9	3	—	The steers in both sections appear ill at ease.
8.15 a.m.	M	Standing still	9	3	5	7	—	Standing still	12	0	2	10	—	
8.30 a.m.	M	Standing still	12	0	0	12	—	Standing still	12	0	0	12	—	
8.45 a.m.	M	Standing still	12	0	6	6	5	Standing still	12	0	6	6	8	
9.00 a.m.	S	Standing still	12	0	8	4	5	Standing still	12	0	5	7	8	
9.15 a.m.	M	Standing still	11	1	2	10	5	Standing still	12	0	2	10	12	1 steer in Group I lying down.
9.30 a.m.	M	Standing still	10	2	2	10	6	Standing still	12	0	4	8	12	2 steers in Group I lying down.
9.45 a.m.	M	Standing still	12	0	2	10	4	Standing still	10	2	0	12	12	All steers in Group I up—2 steers in Group II lying down.
10.00 a.m.	M	Standing still	12	0	0	12	4	Standing still	11	1	4	8	12	Index ox in Group II lying down.
10.15 a.m.	M	Standing still	11	1	2	10	4	Standing still	11	1	0	12	12	Index ox in Group II lying down—also 1 ox in Group I.
10.30 a.m.	M	Standing still	9	3	0	12	5	Standing still	11	1	0	12	12	Index ox in Group II lying down—also 1 ox in Group I.
10.45 a.m.	S	Standing still	5	7	4	8	10	Standing still	11	1	1	11	12	Index ox in Group II lying down—also 2 oxen in Group I.
11.00 a.m.	M	Standing still	10	2	1	11	5	Standing still	12	0	1	11	12	Index ox in Group II lying down—also 2 oxen in Group I.
11.15 a.m.	M	Standing still	11	1	1	11	5	Standing still	12	0	0	12	12	Index ox in Group II lying down—also 1 ox in Group I.
11.30 a.m.	M	Standing still	11	1	0	12	2	Milling about	—	—	3	9	8	1 steer in Group I lying down.
11.45 a.m.	M	Standing still	9	3	1	11	2	Standing still	12	0	1	11	6	3 steers in Group I lying down.
12.00 noon	S	Milling about	—	—	—	—	5	Standing still	10	2	3	9	6	All steers standing.
12.15 p.m.	S	Standing still	12	0	1	11	5	Standing still	12	0	1	11	7	All steers standing.
12.30 p.m.	M	Standing still	12	0	0	12	5	Standing still	12	0	2	10	6	Index ox of Group II lying down.
12.45 p.m.	M	Standing still	9	3	2	10	5	Standing still	10	2	0	12	6	Index ox of Group II and one more lying down.
1.00 p.m.	M	Standing still	6	6	1	11	6	Standing still	9	3	1	11	6	2 Steers in Group I and 3 in Group II lying down. Index steer of Group II up.
1.15 p.m.	M	Standing still	0	12	—	—	6	Standing still	0	12	—	—	6	5 Steers lying down in each group—rest stand in between the others.
1.30 p.m.	S	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
1.45 p.m.	M	Milling about	—	—	—	—	7	Standing still	12	0	3	9	11	All steers standing.
2.00 p.m.	M	Standing still	12	0	1	11	9	Standing still	12	0	3	9	8	
2.15 p.m.	M	Standing still	11	1	1	11	7	Standing still	12	0	4	8	8	1 Steer in Group I lying down.
2.30 p.m.	M	Moving about	—	—	3	9	8	Moving about	—	—	3	9	7	1 Steer in Group I lying down.
2.45 p.m.	M	Standing still	11	1	0	12	7	Standing still	5	7	3	9	8	1 Steer in Group I lying down.
3.00 p.m.	M	Standing still	11	1	0	12	7	Standing still	8	4	3	9	7	1 Steer in Group I lying down.
3.30 p.m.	M	Standing still	11	1	0	12	7	Standing still	12	0	1	11	11	1 Steer in Group I lying down.
4.00 p.m.	M	Standing still	11	1	0	12	8	Standing still	12	0	1	11	10	All steers standing.
4.30 p.m.	M	Standing still	12	0	0	12	7	Standing still	12	0	1	11	11	
5.00 p.m.	M	Standing still	12	0	2	10	7	Standing still	12	0	2	10	8	
5.30 p.m.	S	Standing still	12	0	0	12	7	Standing still	7	5	1	11	0	
6.00 p.m.	M	Standing still	12	0	1	11	8	Standing still	8	4	1	11	10	
6.30 p.m.	S	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
7.00 p.m.	M	Standing still	8	4	0	12	7	Standing still	—	—	—	—	—	
Overall Percentages			85.2	14.8	13.1	84.9			86	14	18	82		
Standing Still		32						32						
Moving about		3						3						

(c) Between Upington and Beaufort West

The train left Upington at dusk on Wednesday, arrived at De Aar the next day at 11 a.m., left again at 3 p.m. and arrived at Beaufort West early on Thursday morning. Observations were made at half-hourly intervals from 8 a.m. to 6 p.m. on Thursday. The results are given in *Table III.* It will be noted that although more observations were made while the train stood at stations than while it was in motion, the steers in both sections of the observation truck were more at ease than during the earlier part of the journey. Only during one period of observation and in only one section, were the steers found moving about. In terms of individual animals, 82% and 95% of the steers in unpadded and padded sections respectively stood across the truck during observations and 87% and 89% were found with their heads at rest. Again a number of animals lay down in the truck during the day. It will also be noted that the "index" oxen moved about much less than during the previous day.[6]

As stated, all the steers under observation were horned. It was noticed that the size and direction of the horns play an important part in the way animals travel. Animals with upright horns do not worry each other nearly as much as do those with horizontal or downward sloping horns. The former can keep their horns from being in the way by holding their necks horizontally, but the latter must hold their necks and heads very high or very low, that is, in positions they cannot maintain for any length of time. One Afrikaner grade steer, with horns about 18" long and sloping outwards and downwards, continually did damage to the sides and tops of the steers next to him and was set upon by them in retaliation whenever possible. At slaughter his was the worst bruised carcase of all the observation oxen.[7]

Animals lying down in trucks

Many stockmen believe that if cattle lie down while in transit by rail, the chances are that they will be badly trampled upon and bruised by the other animals, that is, if they survive at all.

During the 1955 test it was noticed that animals lay down in the trucks apparently without any bad results. It was, therefore, decided to collect more information about this aspect. *Table IV* gives the number of animals lying down in each section of the eleven trucks on 18 occasions during the journey. Accurate observations could be made only through the ventilation holes on top of the trucks and this could be done only when the train stopped at a station or siding for a sufficiently long time.

[6]No observations were conducted between Beaufort West and Cape Town, because the greater part of that journey took place during the night.
[7]From observation it would appear as if horns are amongst the most potent causes of bruising and of unrest of cattle in trucks, kraals and lairages.

TABLE III.

GOBABIS STEERS
BEHAVIOUR OF STEERS BETWEEN PRIESKA AND BEAUFORT WEST

Time	Train moving or standing	Group I—Unpadded					Relative position of Index Steers	Group II—Padded					Relative position of Index Steers	Remarks
		Whether steers move about or not	Position of Steers		Position of Heads			Whether animals move about or stand still	Standing Position		Position of heads			
			Standing across truck	Other position	Head High	Other position			Across truck	Other position	Held High	Other position		
8.00 a.m.	S	Standing still	12	0	3	9	12	Standing still	12	0	1	11	10	
8.30 a.m.	M	Standing still	12	0	1	11	12	Standing still	11	1	1	11	10	
9.00 a.m.	M	Standing still	12	0	2	10	12	Standing still	12	0	1	11	10	
9.30 a.m.	S	Standing still	12	0	1	11	12	Standing still	6	6	0	12	10	2 Steers in Group II lying down.
10.00 a.m.	M	Standing still	11	1	3	9	12	Standing still	8	4	0	12	12	1 Steer in Group I lying down and 2 in Group II.
10.30 a.m.	M	Standing still	11	1	3	9	12	Standing still	11	1	1	11	?	1 Steer in Group I lying down and Index Ox in Group II.
11.00 a.m.	S	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
11.30 a.m.	S	Standing still	12	0	1	11	12	Standing still	11	1	1	11	—	Index ox of Group II lying down.
12.00 noon	—	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
12.30 a.m.	S	Standing still	12	0	1	11	12	Moving about	—	—	7	5	10	
1.00 a.m.	—	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
1.30 a.m.	—	—	—	—	—	—	—	—	—	—	—	—	—	
2.00 a.m.	S	Standing still	12	0	1	11	12	Standing still	10	2	1	11	10	2 Steers in Group II lying down.
2.30 a.m.	S	Standing still	12	0	0	12	11	Standing still	11	1	0	12	10	1 Steer in Group II lying down.
3.00 a.m.	—	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
3.30 a.m.	M	Standing still	11	1	2	10	9	Standing still	5	7	—	—	9	1 Steer in Group I lying down and 2 in Group II.
4.00 p.m.	M	Standing still	6	6	3	9	9	Standing still	7	5	—	—	9	3 Steers in Group I lying down and 2 in Group II.
4.30 p.m.	M	Standing still	9	3	1	11	10	Standing still	10	2	—	—	9	3 Steers in Group I lying down and 2 in Group II.
5.00 p.m.	—	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
5.30 p.m.	S	—	—	—	—	—	—	—	—	—	—	—	—	No observations.
6.30 p.m.	S	Standing still	11	1	0	12	9	Standing still	11	1	—	1	9	1 Steer in Group I lying down and 1 in Group II.
Overall Percentage			92.3	7.7	13.1	86.9			94.7	5.3	10.8	89.1		
Standing Still		14						13						
Moving about		0						1						

The data (Table IV) indicate that, as the cattle became accustomed to the train, the number of trucks in which cattle were found lying down and the number per truck increased, until, during the afternoon of the second day, 38 animals or 14.8% of the total, were resting prone in 10 out of the 11 trucks (16 sections). At 10 p.m. that night 46 head or 17.9% were lying down in 9 trucks (16 sections); the next day up to 32 animals or 12.8% in 11 trucks (16 sections) and on the fourth day up to 44 head or 17.1% in 11 trucks (20 sections). For the whole journey the average for the 18 observations works out at 25 head or 9.62% in 8 trucks (13 sections).

A greater percentage of animals lay down in the padded than in the unpadded trucks, and also more in the front sections than in the rear sections of the trucks, but the differences do not appear to have any biological significance. The percentages in the last vertical column of the table indicate that the position of the truck in the train had no influence on the number of cattle lying down.

No correlation was found between the number of animals lying down in a truck and the magnitude or intensity of the bruises found on their carcases.

Animal behaviour in kraals at feeding and watering centres

A. Food Consumption

(i) It is accepted that up to the time they left the farm, *the Outjo steers* were on a normal food intake and that, during their trek to town, the wayside grazing covered maintenance requirements. From arrival at the Outjo railway kraals until off-loaded at Windhoek, ± 40 hours later, they were without food. Between Windhoek and De Aar they were without food for 47 hours and from De Aar to Cape Town for about 37 hours. At Cape Town, while awaiting slaughter, the steers were fed hay twice a day.

(*a*) *At Windhoek*: The steers were off-loaded at 7.45 a.m. on a chilly morning. Two observation groups of eleven each were put into separate kraals with water available. About 10 minutes later they were supplied with good quality lucerne hay, placed on the kraal floor, along the fence opposite to the water trough.

While no food was available the steers took no interest at all in water, but all of them pounced upon the lucerne hay the moment it was put down. Possibly because it was unknown to them, they ate it more intermittently than continuously and moved about quite a lot while feeding. After about 30 minutes most of the oxen appeared to have appeased their hunger and wandered about, butting each other, desultorily picking at the remaining hay and beginning to take interest in water. After about an hour they started to lie down and rest.

(*b*) *At de Aar*: The steers were off-loaded on a warm sunny day between 11.30 a.m. and 12 noon. The two observation groups were

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GOBAE

Number of Animals

Truck No.	Padded or Unpadded	No. of Animals	25.4.60						26.4.60																				
			3.00 p.m.			4.00 p.m.			10.30 a.m.			11.45 a.m.			1.30 p.m.			3.40 p.m.			4.30 p.m.			6.30 p.m.			10.15 p.m.		
			F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total
1	P	22							2	1	3	1		1	2	2	4	3	2	5		2	2				2	1	3
2	U	24										1		1	3	1	4		1	1							2	2	4
3	P	23										1		1	1		1										2		2
4	U	24													1	3	4		1	1				1	1	2		6	6
5	P	20	1		1	1		1	2	1	3	8	2	10	3	3	6	6	4	10	2	1	3	4	1	5	6	3	9
6	N	24										2	1	3	2	1	3		3	3	1	1	2		2	2	3	3	6
7	P	24					1	1	1	1	2	1	1	2	1		1	1	1	2		1	1						
8	U	24								1	1		2	2	3		3	2	1	3	2		2				3	1	4
9	P	24					1	1				2		2	3	1	4	4	3	7		1	1		1	1	4	3	7
10	U	24		2	2				1		1	2		2	2	1	3	3	1	4	2		2	1	1	2			
11	P/U	12/12							2	1	3		1	1					2	2	1		1	2		2	4	1	5
		257	1	2	3	1	2	3	8	5	13	18	7	25	21	12	33	19	19	38	8	6	14	8	6	14	26	20	46
Percentage of possible			1.2			1.2			5.1			9.7			12.8			14.8			5.4			5.4			17.9		

Out of a possibility of 2,250 times (125 × 18), the 125 cattle in the padded trucks lay down 258 times = 11.47%
Out of a possibility of 2,376 times (132 × 18), the 132 cattle in the unpadded trucks lay down 187 times = 9.87%
F. = Front section.
H. = Hind section.

TABLE IV.

ABIS—CATTLE

s Lying Down in the Trucks.

27.4.60									28.4.60														29.4.60			Total for front section	Total for hind section	Total for whole truck	Percentage of possible
8.00 a.m.			11.30 a.m.			8.30 p.m.			8.10 a.m.			10.45 a.m.			12.30 p.m.			2.45 p.m.			5.30 p.m.			4.45 p.m.						
F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total	F.	H.	Total				
1	1	2				8	2	10					2	2	1	5	6	4		4	1	1	2	1	1	2	26	20	46	11.62
3	2	5				2	1	3		1	1	1		1	1	1	2		1	1	1		1	1		1	15	10	25	5.78
	2	2				1		1	1	1	2				2		2	2		2					1	1	10	4	14	3.38
2	1	3					3	3	2		2				1	2	3	1	2	3	1		1	2	1	3	11	20	31	7.18
1	2	3	3	3	6	2		2	5	3	8	3	3	6	3	3	6	3	3	6		1	1	3	4	7	56	37	93	25.8
1	1	2	3	1	4	1	2	3	1	5	6	1	1	2	1	5	6	3	2	5	2		2		1	1	21	29	50	11.57
1	1	2	1		1	1		1					1	1	1	2	3	1	3	4	4	1	5		4	4	13	17	30	6.94
1		1		2	2	1	1	2	1	1	2	1	1	2	2	3	5	2	6	8	1	3	4				19	22	41	9.49
			4	1	5	1	1	2		1	1	4	2	6	1	1	2	6	1	7	1	4	5				30	21	51	11.80
			2	1	3		2	2				2		2	4	2	6					1	1		1	1	19	12	31	7.18
			2		2	3		3	2		2	2		2	3		3	1	1	2	1	2	3	1	1	2	24	9	33	11.11
																														4.17
10	10	20	15	8	23	20	12	32	12	12	24	14	10	24	20	24	44	23	19	42	12	13	25	8	14	22	244	201	445	
7.8			8.9			12.8			9.3			9.3			17.1			16.3			9.7			8.6			55	45	100	9.62

again put into separate kraals in which both water and lucerne hay were available, the hay again spread out on the kraal floor along the fence away from the water trough.

As at Windhoek, the steers made straight for the hay when off-loaded and probably because they were by now acquainted with it, they ate continuously and avidly with little or no moving about for about 20 minutes, during which not a single ox drank any water. Having satisfied their immediate demand for food, the animals repeated the wandering about, desultorily picking the remaining food, butting each other and then having a drink and finally lying down to rest.

After some 3–3½ hours after off-loading the oxen were all up again and quite obviously hungry once more and looking for food. They consumed what little hay remained which was fit to eat and appeared generally restless.

At 5 p.m. both groups were given a further supply of hay and the same procedure of avid feeding for 15–20 minutes, followed by butting, walking about, picking at the remaining hay, drinking and finally lying down to rest and ruminate, was repeated.

(*c*) *At Cape Town*: The oxen were off-loaded on a cold, rainy day, during a downpour, at 8.30 a.m. The observation groups were placed in kraals under a roof, but the floors were awash, and because the hay had to be placed on the floors, it soon became sodden and could not be weighed back. Food intake could, therefore, not be determined. As at Windhoek and De Aar, when put into their kraals, the steers went straight for the food and were not interested in the water. The food available on arrival consisted of wheaten chaff, which quite obviously was not liked. Nevertheless, the animals all ate of it for about 10 minutes and then went through the same sequence of actions as described for Windhoek and De Aar. At 2 p.m. both observation groups were given fair quality lucerne hay and all the oxen ate avidly and continuously for at least 20 minutes, thereafter repeating the routine described.

For the next 3 days, until the observation groups were slaughtered, the steers were fed lucerne hay twice a day with identical reactions to those described above. In recapitulation these may be summarised as follows:—

(i) A rather surprisingly short period of intensive feeding, during which the oxen apparently ingested sufficient hay (probably about four to five pounds) to satisfy their immediate demands.

(ii) A period of fidgeting, walking about, desultory picking at the remaining food, drinking, possibly urinating and defaecating and finally lying down to rest, ruminate and sleep.

(iii) A period of rest for anything up to an hour.

(iv) A period when the animals again felt hungry and during which they were restless and moved about searching for food.

Table V gives details of the amounts of hay eaten by the observation groups at Windhoek and at De Aar. The amounts and percentages of food wasted through the present method of feeding hay from the kraal floors are also given.

TABLE V.

OUTJO STEERS.

Food Consumption of Observation Groups at Windhoek and De Aar

Station	Period of Rest	Group	Number of Steers	Weight of hay eaten	Hay eater per steer	Weight of hay wasted	Percentage of hay wasted
Windhoek	4 hours	1	11	66 lbs.	6.0 lbs.	42 lbs.	39%
		2	11	79 lbs.	7.2 lbs.	46 lbs.	37%
		Totals	22	145 lbs.	6.6 lbs.	88 lbs.	38%
De Aar	8 hours	1	11	148 lbs.	13.6 lbs.	93 lbs.	39%
		2	11	111 lbs.	10.1 lbs.	130 lbs.	54%
		Totals	22	259	11.8 lbs.	223 lbs.	46%

The data show that during the 4 hours at Windhoek, the average food consumption amounted to 6.6 lbs. per steer, while at De Aar, during 8 hours in which the steers were fed twice, the average amounted to 11.8 lbs. per head, or practically double that at Windhoek.

The table further shows an overall wastage of 38% of the lucerne hay at Windhoek and of 46% at De Aar. The necessity to introduce a more efficient method of feeding hay to cattle in transit by rail, needs no emphasis.

(ii) With regard to the *Gobabis cattle* it has already been stated that no food was provided in the railway kraals prior to loading, so that on arrival at Upington they had had nothing to eat for at least 68 hours. From Upington to Beaufort West they were without food for 38 hours, and from Cape Town for 27 hours.

Like the Outjo steers, the Gobabis cattle showed little or no interest in water when put into the resting kraals. A few smelt at the troughs and took a sip or two, but then turned to the hay. Obviously their first objective was to appease their hunger. They then drank, and after some more eating and possibly another drink, lay down to rest. Towards the end of the four hours in the kraals most of the animals were once more feeding and drinking, after which they tended to lie down again.

To reduce wastage, uncut hay was fed out of racks and chaffed hay out of troughs. Table VI gives food intake averages at Upington, Beaufort West and at Cape Town, as well as percentages wasted where hay was fed from the kraal floors or from racks. There was no wastage from the troughs.

TABLE VI.

GOBABIS STEERS.

Food Consumption of Observation Groups at Upington and Beaufort West.

Station	Date	Feeding Period	How fed	Type of hay	Number of Steers	Average intake per steer (lbs.)	Percentage of hay wasted
Upington.....	27.4.60	4 *hours* 12.45–4.45 p.m.	Deep troughs	Chaffed lucerne hay	24	3.3 } 4.0	—
			Shallow troughs	Chaffed lucerne hay	24	4.7 }	—
			Hay racks	Whole lucerne hay	24	4.6	27
			From floor	Whole lucerne hay	12	4.5	49
Beaufort West...	29.4.60	4 *hours* 8.30–12.30 p.m.	Deep troughs	Whole lucerne hay	12	4.7 } 4.2	—
			Shallow troughs	Chaffed lucerne hay	12	3.7 }	—
			From floor	Whole lucerne hay	24	2.9	48
Cape Town.....	30.4.60	3 *hours* 2.30–5.30 p.m.	Deep troughs	Whole lucerne hay	12	5.0 } 5.4	—
			Shallow troughs	Chaffed lucerne hay	12	5.7 }	—
	1.5.60	2 *hours* 9.30–11.30 a.m.	Deep troughs	Chaffed lucerne hay	12	4.4 } 4.8	—
			Shallow troughs	Chaffed lucerne hay	12	5.3 }	—

It will be seen that the average intake per 4 hours in the resting kraals was considerably smaller than for the Outjo steers, and that the percentages wasted by feeding from the kraal floors was at least as high. It would seem that the most efficient and economical way to feed cattle "*en route*" is to offer uncut hay out of racks, supplied with shallow troughs to catch the hay which falls through.

For 1,000 lbs. live-weight steers, about 8 lbs. of lucerne hay per head, per day, constitutes a maintenance ration. Tables V and VI indicate that resting periods of 4 hours are not enough to supply them with a maintenance amount and that from 6 to 8 hours will be necessary to do so. Daily off-loading for periods of at least 6 hours obviously is not practical.

As an alternative, fast journeys without any stopovers for feeding and watering should be investigated. It is suggested that a test train of slaughter cattle from South West Africa be dispatched to Cape Town on a fast passenger train schedule and the results, in terms of animal behaviour, live and carcase weights, carcase grades, bruises, etc., be compared with a trainload of comparable cattle run according to the prevailing schedule for livestock trains. The reader is reminded that the train conveying the Gobabis cattle to Cape Town averaged 13 miles per hour for 1,521 miles.

B. Water Consumption

(i) *The Outjo steers* were without water for ± 38 hours prior to arrival at Windhoek, for about 48 hours from there to De Aar, and for ± 37 hours on to Cape Town.

As already stated, the observation cattle were not interested in water when put into the resting kraals.

(*a*) *At Windhoek*: The one observation group was in its resting kraal at 7.50 a.m. At 7.55 a.m. and again at 7.57 and 8.25 a.m. an ox sniffed at the water but it was not until 8.39 a.m., or 49 minutes after water became available, that a steer actually drank. Of the other observation group several animals nosed the water when put into their kraal, but it was 23 minutes before any of them swallowed water.

(*b*) *At De Aar*: The cattle were off-loaded just before noon on a warm day. After eating avidly of the lucerne hay on the kraal floor, the first steer to take a few sips of water, did so after seven minutes in the first observation group and after nine minutes in the second.

(*c*) *At Cape Town*: The animals were off-loaded on a cold, rainy day and put into their kraals by 9 a.m. In the one observation group the first steer to drink did so after one hour and 23 minutes, and in the second after 1½ hours. Notwithstanding the long periods without water, the steers first ate and then drank: the warmer the weather, the sooner after eating.

Table VII gives for the two observation groups together, that is, for 22 steers, for each successive hour at Windhoek, De Aar and Cape Town, the number of times they drank, and the average intake per drink in gallons; also the average consumption per steer.

TABLE VII.
Water Consumption of Outjo Steers.

Station	Period	Total intake in gallons	Times that steers drank	Gallons (average per drink)
Windhoek	8.00 a.m. to 9.00 a.m.	26.03	27	0.96
	9.01 a.m. to 10.00 a.m.	11.26	8	1.41
	10.01 a.m. to 11.00 a.m.	20.76	25	0.83
	11.01 a.m. to 12.00 noon	22.16	17	1.30
	8.00 a.m. to 12.00 noon	80.21	77	1.04
	Average per 22 steers	—	22	3.65
De Aar	11.30 a.m. to 12.30 p.m.	44.71	39	1.15
	12.31 p.m. to 1.30 p.m.	12.10	11	1.10
	1.31 p.m. to 2.30 p.m.	33.58	20	1.68
	2.31 p.m. to 3.30 p.m.	11.20	9	1.24
	3.31 p.m. to 4.30 p.m.	13.99	15	0.93
	4.31 p.m. to 5.30 p.m.	12.11	15	0.81
	5.31 p.m. to 6.30 p.m.	9.30	10	0.93
	6.31 p.m. to 7.30 p.m.	1.56	6	0.26
	11.30 a.m. to 7.30 p.m.	138.55	125	1.10
	Average per 22 steers	—	22	6.30
Cape Town	9.00 a.m. to 10.00 a.m.	1.15	1	1.15
	10.01 a.m. to 11.00 a.m.	6.32	6	1.15
	11.01 a.m. to 12.00 noon	4.02	7	0.57
	12.01 p.m. to 1.00 p.m.	11.49	8	1.44
	1.01 p.m. to 2.00 p.m.	9.77	??	?
	2.01 p.m. to 3.00 p.m.	24.81	5	4.96
	3.01 p.m. to 4.00 p.m.	9.20	2	4.60
	4.01 p.m. to 5.00 p.m.	6.32	21	0.30
	9.00 a.m. to 5.00 p.m.	63.31	50	1.27
	Average per steer	73.08	22	3.32
	Grand totals for 3 stations	282.07	252	1.12
	Average for 22 steers for 3 stations	291.84	22	4.42

The data show that during the 4 hours at Windhoek the average consumption amounted to 3.65 gallons, during the 8 hours at De Aar to 6.30 gallons per steer, and during the first 8 hours at Cape Town to only 3.32 gallons per head. The influence of the inclement weather at Cape Town is very evident.

To compare the average intakes of water at the 3 centres more critically, it is necessary to do so for comparable periods, i.e. for the shortest total period of observation at any one centre. On this basis it is found that during the first 4 hours after off-loading:

(*a*) the oxen at Windhoek drank 77 times, and on the average 1.04 gallons per drink;

(*b*) the oxen at De Aar drank 79 times, and on the average 1.27 gallons per drink; and

(*c*) the oxen at Cape Town drank 22 times, and on the average 1.07 gallons per drink.

These figures show that at Windhoek and at De Aar, there was little if any difference in the inclination of the oxen to drink (77 as against 79 times), but that at Cape Town, owing to the prevailing cold weather, they showed much less inclination to drink (only 22 times). It is also interesting to note that during these first four hours after off-loading, the average consumption per drink did not vary much from centre to centre, and was highest where the temperature was highest, i.e. respectively 1.04–1.27 and 1.07 gallons at Windhoek, De Aar and Cape Town, or an overall average intake of 1.15 gallons, for the 178 times the animals drank.

For De Aar and Cape Town the period from 2 to 5 p.m. can be compared. During these 3 hours—

(*a*) the oxen at De Aar drank 48 times and on the average 1.34 gallons per drink;

(*b*) the oxen at Cape Town drank 28 times, and on the average 1.44 gallons per drink.

Again, there was a marked difference in the inclination of the steers to drink at the two centres, but very little difference in the average intake per drink.

During the first four hours after off-loading, the observation groups averaged 3 drinks per head at Windhoek and at De Aar, compared with only 1 drink per head at Cape Town. For the period from 2 to 5 p.m., the group averaged 2 drinks per head at De Aar, compared with again only 1 at Cape Town.

The data in Table VII also show that at Windhoek and De Aar, under normal climatic conditions for the time of the year, the general tendency of the animals was to feed and drink during the first hour after unloading, then rest for about an hour and then drink well again during the next hour. Under the prevailing weather conditions at Cape Town, no specific tendency is apparent from the data.

At Cape Town water intake data were collected for the observation groups of steers for several days, up to the time they were slaughtered. These data are given in Table VIII.

TABLE VIII.
OUTJO STEERS.
Water consumption at Cape Town.

Dates and Times of Observations	No. of hours	No. of steers	Total intake (gallons)	Intake per steer (gallons)
From 9 a.m. to 5 p.m. on 22.8.55	22 (8)	22	73.08	3.92 (3.32)
5 p.m. on 22.8.55–7 a.m. on 23.8.55	22 (14)	22	13.22	3.92 (0.60)
From 7 a.m. to 4 p.m. on 23.8.55	26.5 (9)	22	25.85	3.45 (1.18)
4 p.m. on 23.8.55–9.30 a.m. on 24.8.55	26.5 (17.5)	22	49.94	3.45 (2.27)
From 9.30 a.m. to 4.30 p.m. on 24.8.55	26.5 (9)	11	21.23	5.38 (1.93)
4.30 p.m. on 24.8.55–10 a.m. on 25.8.55	26.5 (17.5)	22	75.90	5.38 (3.45)
From 10 a.m. to 3.30 p.m. on 25.8.55	5.5	11	10.34	0.94

The data in this table show that the observation steers consumed considerably less water during the first two days than during the third day after arrival, by which time the weather had become much warmer. However, while on the day of their arrival the observation steers consumed 85% of their water intake during daylight, during the next two days they consumed respectively 66% and 64% of their intake during the hours of darkness. Apparently, the same thing was about to happen on the fourth day.

(ii) *The Gobabis cattle* were without water for 48 hours up to Upington, for 38 hours to Beaufort West and for 27 hours to Cape Town.

Table IX gives the periods spent at each of these centres and the average consumption in gallons per steer for these periods.

TABLE IX

Water Consumption of Gobabis Steers.

Station	Period in rest kraals	Number of Steers.	Average water intake per head. (gallons)
Upington.....	4 hours. (12.45 to 4.45 p.m.)	48	1.55
Beaufort West	4 hours. (8.30 a.m. to 12.30 p.m.)	48	5.56
Cape Town	3 hours. (2.30 to 5.30 p.m.)	24	1.92
	2 hours. (9.30 to 11.30 a.m.)	24	0.88
	3½ hours. (11.30 a.m. to 3.00 p.m.)	24	2.68
	Total for 8½ hours	24	5.48

It is not warranted to compare the intakes given in Tables VIII and IX for the different resting centres, but it is of interest to note that during their 121 hour journey to Cape Town, the Outjo steers consumed on the average 13.3 gallons of water, and the Gobabis steers 12.2 gallons during their journey of 148 hours.

C. REST

To ascertain how much rest the observation steers got while in the feeding and watering kraals *en route* to Cape Town, a record was kept of the number of animals lying down at the end of successive periods of 15 minutes each. It was not possible to record for how long each animal lay down and whether they ruminated or slept. That many did sleep was shown by the way in which they lay, with their eyes closed and with their heads against their bodies. Quite a few of the oxen appeared to sleep standing.

The results of these observations are given in Tables X and XI for the Outjo and Gobabis observation groups respectively.

TABLE X.

REST OF OUTJO STEERS.

The number of animals lying down while in the feeding and watering kraals *en route*.

Period	Windhoek				De Aar				Cape Town			
	I	II	I and II	Remarks	I	II	I and II	Remarks	I	II	I and II	Remarks
	11	11	22		11	11	22		11	11	22	
7.45– 8.00 a.m.	0	0	0									
8.00– 8.15 a.m.	0	0	0									
8.15– 8.30 a.m.	0	0	0									
8.30– 8.45 a.m.	0	0	0									
8.45– 9.00 a.m.	0	0	0									
9.00– 9.15 a.m.	0	0	0									
9.15– 9.30 a.m.	3	3	6						0	0	0	
9.30– 9.45 a.m.	6	8	14						0	0	0	
9.45–10.00 a.m.	10	11	21						1	0	1	
10.00–10.15 a.m.	11	11	22	16 steers sleeping					0	3	3	
10.15–10.30 a.m.	6	5	11	Aeroplane overhead					0	6	6	
10.30–10.45 a.m.	0	5	5						0	7	7	
10.45–11.00 a.m.	4	9	13						0	4	4	
11.00–11.15 a.m.	0	0	0	Railway engine whistled					2	4	6	
11.15–11.30 a.m.	0	0	0						2	1	3	
11.30–11.45 a.m.	4	1	5						9	0	9	
11.45–12.00 noon	8	7	15		0	0	0		7	4	11	
12.00–12.15 p.m.	10	11	21		0	0	0		7	6	13	
12.15–12.30 p.m.	10	8	18		0	0	0		0	7	7	
	34%	38%	36%									

12.30–12.45 p.m.		0	0	0		0	6	6	
12.45– 1.00 p.m.		4	6	10		0	7	7	
1.00– 1.15 p.m.		10	10	20					No observations.
1.15– 1.30 p.m.		11	11	22	All steers in Gr. I sleeping	0	0	0	No observations.
1.30– 1.45 p.m.		6	8	14	Measured water in trucks and upset the steers				No observations.
1.45– 2.00 p.m.		3	10	13		5	2	7	Hay given to both groups.
2.00– 2.15 p.m.		7	4	11		0	0	0	
2.15– 2.30 p.m.		7	5	12		0	0	0	
2.30– 2.45 p.m.		5	4	9		0	0	0	
2.45– 3.00 p.m.		6	4	10		0	0	0	
3.00– 3.15 p.m.		1	1	1		0	0	0	
3.15– 3.30 p.m.		0	2	2		2	0	2	
3.30– 3.45 p.m.		0	10	10		5	4	9	
3.45– 4.00 p.m.		0	10	10		7	5	12	
4.00– 4.15 p.m.		1	4	5		4	5	9	
4.15– 4.30 p.m.		6	1	7		1	4	5	
4.30– 4.45 p.m.		8	0	8	Hay given to Gr. II	0	0	0	
4.45– 5.00 p.m.		11	0	11		0	0	0	
						17%	24%	21%	
5.00– 5.15 p.m.		5	0	5					
5.15– 5.30 p.m.		0	0	0	Hay given to Gr. I				
5.30– 5.45 p.m.		0	0	0					
5.45– 6.00 p.m.		0	0	0					
6.00– 6.15 p.m.		0	0	0					
6.15– 6.30 p.m.		0	0	0					
6.30– 6.45 p.m.		8	10	18					
6.45– 7.00 p.m.		11	10	21					
7.00– 7.15 p.m.		11	11	22					
7.15– 7.30 p.m.		11	11	22					
		39%	39%	39%					

TABLE XI.

REST OF THE GOBABIS CATTLE

The number of animals lying down while in the feeding and drinking kraals en route.

Period	Upington				Beaufort West						Cape Town			
	A	B	A & B	Remarks	A	B	C	D	A, B, C & D	Remarks	A	B	A & B	Remakrs
	Out of 12	Out of 12	Out of 24		Out of 12	Out of 12	Out of 12	Out of 12	Out of 48		Out of 12	Out of 12	Out of 24	
8.30– 8.45 a.m.					0	0	0	0	0	A cold windy day				
8.45– 9.00 a.m.					0	0	0	0	0					
9.00– 9.15 a.m.					0	0	0	0	0					
9.15– 9.30 a.m.					0	0	0	0	0					
9.30– 9.45 a.m.					2	0	0	2	4					
9.45–10.00 a.m.					6	7	8	6	27					
10.00–10.15 a.m.					8	9	9	12	38					
10.15–10.30 a.m.					6	10	10	12	38					
10.30–10.45 a.m.					7	10	11	12	40					
10.45–11.00 a.m.					12	12	12	12	48	Because of cold steers tend to lie close together				
11.00–11.15 a.m.					12	11	7	10	40					
11.15–11.30 a.m.					9	7	2	3	21	Clouds thin out and sun shines through				
11.30–11.45 a.m.					6	1	1	3	11					
11.45–12.00 noon					6	2	3	10	21					
12.00–12.15 p.m.					4	7	7	12	30					
12.15–12.30 p.m.					8	7	8	10	33	Clouds close in and cold wind blows				
12.30–12.45 p.m.														
12.45– 1.00 p.m.	0	0	0											
1.00– 1.15 p.m.	0	0	0											
1.15– 1.30 p.m.	0	1	1											
1.30– 1.45 p.m.	1	1	2											
1.45– 2.00 p.m.	4	4	8											
2.00– 2.15 p.m.	3	9	12											
2.15– 2.30 p.m.	9	11	20	Overcast with cool wind										
2.30– 2.45 p.m.	12	12	24								0	0	0	Strong cold wind blows
2.45– 3.00 p.m.	12	12	24								1	0	1	
3.00– 3.15 p.m.	11	9	20								0	0	0	
3.15– 3.30 p.m.	12	8	20								0	0	0	
3.30– 3.45 p.m.	11	4	15								0	0	0	
3.45– 4.00 p.m.	11	9	20								0	1	1	
4.00– 4.15 p.m.	6	4	10	Steers frightened by persons passing							5	9	14	
4.15– 4.30 p.m.	1	5	6								3	5	8	More hay put in troughs and this chases steers up
4.30– 4.45 p.m.											2	6	8	
4.45– 5.00 p.m.											4	3	7	Strong cold wind blows
5.00– 5.15 p.m.											3	2	5	
5.15– 5.30 p.m.											2	1	3	
5.30– 5.45 p.m.														
Percentages:	51.7	49.4	50.6		44.8	43.2	40.6	54.2	45.7		13.9	18.8	16.3	

At the bottom of each vertical column is given the percentage of "animal x time" units which stood and/or lay down during the whole observation period.

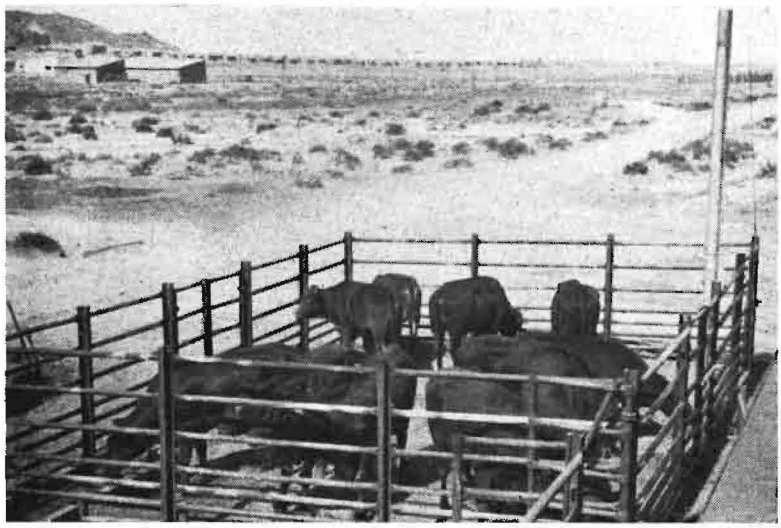
(1) *The Outjo steers*

(*a*) *At Windhoek*: The resting kraals are situated right next to the shunting yards. On several occasions during their 4 hours in the kraals, the oxen were frightened to such an extent that those lying down got up. The first time was when an engine blew off steam nearby, the second when an engine whistled, the third when an aeroplane flew overhead and on several further occasions the animals were disturbed by cars and lorries which stopped right next to the kraals.

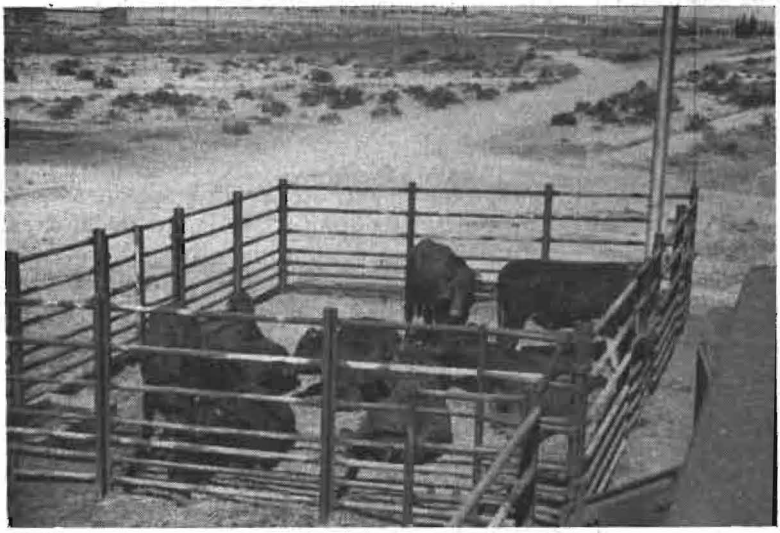
The data in Table X show that for the first 1½ hours in the kraals (up to 9.15 a.m.) all the oxen remained standing. Then they started to lie down, and an hour later at 10.15 a.m., all 22 oxen were resting. During the next two hours, they were disturbed frequently, but between 12 noon and 12.30 p.m. most of them were resting again.

(*b*) *At De Aar*: The resting kraals are situated well away from the shunting yards and except for engines bringing in trucks, and for occasional motor vehicles, prevailing conditions are conducive to rest.

Table X shows that at 12.45 p.m. or 1 hour after arrival in their kraals, steers started to lie down (at Windhoek after 1½ hours) and that 45 minutes later, at 1.30 p.m., all of them were resting (at Windhoek after 60 minutes). (See photos 7, 8 and 9). For the next hour, up to 2.30



At 12.45 p.m., all 11 steers were standing, feeding and drinking.



At 1.05 p.m., 3 steers standing and 5 steers lying down.

At 1.20 p.m., all steers lying down and several are asleep.

p.m. the majority remained resting, but from then onwards till 4.45 and 5.00 p.m., when the two groups received some more hay, the majority of the steers were up and looking for more food. After feeding for the second time, the steers started to lie down once more at 6.30 p.m. Within 15 minutes, 18 out of the 22 were resting and within 32 minutes all were lying down, and remained so till loading time.

Probably because they were by then used to the procedure, the observation steers at De Aar ate more rapidly and avidly, started drinking sooner and lay down to rest sooner than at Windhoek. It must again be stressed, that the oxen appeared to adapt themselves very quickly and very satisfactorily to the procedure and facilities at the resting stations.

The observations at Windhoek and De Aar, show clearly that where oxen are off-loaded during a long railway journey, they will first feed, then drink and then lie down to rest. The observations at De Aar indicate further that after some 3–4 hours, the animals are again hungry and move about their kraals looking for food. If food is supplied, they will satisfy their hunger, probably drink water and again lie down to rest and ruminate or sleep.

(*c*) *At Cape Town*: The holding kraals at the abattoirs are situated well away from the slaughter halls, are closed in by a high corrugated iron fence and are quite restful. Although under roof, the kraals of the observation steers were awash while it rained and their floors remained cold and wet throughout the observation period. When the sun came out it dried up a small part of the kraal of one group of steers. It was very noticeable how the steers crowded into this small area.

Probably because of the inclement weather and possibly also because of the poor wheaten chaff supplied as food, the steers showed relatively little inclination to lie down and rest. Table X shows that it was not until 12.15 p.m. or 3 hours after off-loading that more than half of the 22 steers were lying down at the same time; also that at no time during the day did more than 13 of the 22 steers rest during the same quarter of an hour.

(ii) *The Gobabis steers*

Table XI shows that the behaviour of the Gobabis steers in the kraals *en route* was very similar to that of the Outjo steers and that, if anything, they spent more time resting. The behaviour of the Gobabis observation groups confirms the pattern shown by the Outjo steers, namely, that cattle when off-loaded, first eat, then drink and then lie down to rest.

D. Ruminal movements

Ruminal movements were counted only on the steers in the Outjo observation groups, and only where crushes were available.

Table XII gives the number of ruminal contractions per 5 minutes for each of the 22 steers on the farm at Outjo, at Windhoek, and for three successive days at Cape Town. It also gives the group average for each date.

TABLE XII.

Ruminal Movements—Outjo Steers.

(Number of ruminal movements per five minutes).

Serial Numbers of Steers.	On farm near Outjo 13.8.55	At Windhoek 18.8.55	At Cape Town 22.8.55	At Cape Town 23.8.55	At Cape Town 24.8.55
1	5	0	0	7	3
2	0	—*	0	2	4
3	2	0	0	2	5
4	7	0	2	9	5
5	4	1	1	5	5
6	5	1	0	4	4
7	6	4	2	5	4
8	3	0	1	—*	7
9	5	2	0	4	3
10	6	4	5	5	3
11	5	0	2	2	4
12	6	5	0	—*	3
13	0	1	3	6	6
14	3	2	0	3	3
15	5	2	4	3	0
16	7	5	0	6	4
17	4	0	0	1	5
18	4	0	0	6	3
19	5	4	2	—*	9
20	5	2	0	3	4
21	3	2	0	—*	—*
22	2	3	0	8	2
	92	38	22	81	86
	4.2 *a*	1.8 *b*	1.0 *c*	4.5 *d*	4.1 *e*

a. Taken after 3.30 p.m., after steers had been in kraals all day.

b. Taken after 12.30 p.m., after steers had rested in kraals with food and water for 4 hours.

c. Taken after 8.00 a.m., directly after off-loading and before food and water were made available.

d. Taken after 10.00 a.m., after about 24 hours' rest with food and water.

e. Taken after 10.00 a.m., after about 48 hours' rest with food and water.

* Animals too fidgety to handle.

It is realised, because of the circumstances in which the counts were made, the data in the table are subject to considerable experimental error. They are nevertheless of comparative value, that is, from place to place and from date to date.

The table shows that the average number of ruminal contractions decreased from about 4 per 5 minutes on the farm near Outjo to about 2 at Windhoek and to only one contraction per 5 minutes on arrival at Cape Town. After 24 hours of rest, with food and water available, the average number of contractions was back to normal and was still normal 24 hours later.

The railway journey of 5 days reduced the number of contractions on the average by 75%, notwithstanding two periods of rest *en route* with food and water. After reaching Cape Town, 24 hours of continuous rest with food and water re-established normality.

E. Rumination

At Windhoek, De Aar and at Cape Town it was attempted to record the number of Outjo steers that ruminated during the periods of observation and also for how long they chewed the cud. The data in Table XIII show to what extent the attempt was successful.

TABLE XIII.

RUMINATION—OUTJO STEERS.

Periods	Windhoek			De Aar			Cape Town		
	No. of steers	No. of steers ruminating	Remarks	No. of steers	No. of steers ruminating	Remarks	No. of steers	No. of steers ruminating	Remarks
7.45 a.m.– 8.00 a.m.	22	0	Steers fed lucerne hay						
8.00 a.m.– 8.15 a.m.	22	0							
8.15 a.m.– 8.30 a.m.	22	0							
8.30 a.m.– 8.45 a.m.	22	0							
8.45 a.m.– 9.00 a.m.	22	0							
9.00 a.m.– 9.15 a.m.	22	0					22	0	
9.15 a.m.– 9.30 a.m.	22	0					22	0	
9.30 a.m.– 9.45 a.m.	22	0					22	0	
9.45 a.m.–10.00 a.m.	22	3	1 steer for 3 minutes, 1 for 25 and 1 for 28 minutes				22	0	
10.00 a.m.–10.15 a.m.	22	1	For 20 minutes				22	0	
10.15 a.m.–10.30 a.m.	22	2	1 for 13 and 1 for 17 minutes				22	0	
10.30 a.m.–10.45 a.m.	22	0					22	0	
10.45 a.m.–11.00 a.m.	22	1	For 25 minutes				22	3	1 for 25 and 2 for 30 minutes.
11.00 a.m.–11.15 a.m.	22	0					22	5	1 for 6 minutes, 1 for 11, 1 for 26 and 2 for 56 minutes.
11.15 a.m.–11.30 a.m.	22	1	For ? minutes				22	0	
11.30 a.m.–11.45 a.m.	22	0					22	3	2 for 60 minutes, 1 for ? minutes.
11.45 a.m.–12.00 noon	22	1	For ? minutes	22	0	Steers fed lucerne hay	22	1	For ? minutes.
12.00 a.m.–12.15 p.m.	22	0		22	0		22	4	1 for 39 minutes, 1 for 46 and 2 for 52 minutes.
12.15 p.m.–12.30 p.m.	22	1	For ? minutes	22	0		22	1	For ? minutes.
12.30 p.m.–12.45 p.m.	22	0		22	0		22	1	For 23 minutes.
12.45 p.m.– 1.00 p.m.	22	0		22	0		22	0	
1.00 p.m.– 1.15 p.m.	22	10	From 3–28 minutes	22	0				

1.15 p.m.– 1.30 p.m.		22	0				No observations from 1 to 2 p.m.
1.30 p.m.– 1.45 p.m.		22	0				
1.45 p.m.– 2.00 p.m.		22	1	For 33 minutes			
2.00 p.m.– 2.15 p.m.		22	0		22	0	
2.15 p.m.– 2.30 p.m.		22	0		22	0	
2.30 p.m.– 2.45 p.m.		22	1	For few minutes	22	0	
2.45 p.m.– 3.00 p.m.		22	1	For 4 minutes	22	0	
3.00 p.m.– 3.15 p.m.		22	1	For few minutes	22	0	
3.15 p.m.– 3.30 p.m.		22	0		22	3	1 for 35 minutes and 2 for more than an hour.
3.30 p.m.– 3.45 p.m.		22	0		22	1	For 5 minutes.
3.45 p.m.– 4.00 p.m.		22	2	1 for 2 and 1 for 33 minutes	22	1	For 45 minutes.
4.00 p.m.– 4.15 p.m.		22	2	2 for 15 minutes each	22	2	For 70 minutes.
4.15 p.m.– 4.30 p.m.		22	0		22	0	
4.30 p.m.– 4.45 p.m.		22	2	1 for 21 and 1 for 26 minutes	22	0	
4.45 p.m.– 5.00 p.m.		22	3	1 for 5 minutes, 1 for 10 and 1 for 15 minutes	22	3	For about 10 minutes each.
5.00 p.m.– 5.15 p.m.		22	0		22	28	From 5 to 70 minutes.
5.15 p.m.– 5.30 p.m.		22	0				
5.30 p.m.– 5.45 p.m.		22	0				
5.45 p.m.– 6.00 p.m.		22	0				
6.00 p.m.– 6.15 p.m.		22	0				
6.15 p.m.– 6.30 p.m.		22	0				
6.30 p.m.– 6.45 p.m.		22	0				
6.45 p.m.– 7.00 p.m.		22	1	For 32 minutes			
7.00 p.m.– 7.15 p.m.		22	3	1 for 10 and 2 for 30 minutes			
7.15 p.m.– 7.30 p.m.		22	1	For 10 minutes			
7.30 p.m.– 7.45 p.m.		22	18	From 2–38 minutes			

(i) *At Windhoek*: Rumination commenced 2 hours after the steers arrived in the rest kraals. From then on for 2½ hours, that is, until they were again loaded, ten steers or 45% of the observation groups chewed the cud for periods varying from 3 to 28 minutes. Some steers ruminated while standing; others while lying down.

(ii) *At De Aar*: Here too, none of the observation group steers ruminated during the first 2 hours. During the next 2½ hours, 8 oxen or 36% of the groups chewed the cud and by the end of the 8 hours' resting period, 18 steers or 82% of the groups had ruminated for periods from 2 to 38 minutes. Two steers chewed the cud for two periods each during the 4½ hours' rest.

(iii) *At Cape Town*: Rumination started after 1¾ hours in the lairage, and during the first four hours up to 1 p.m., 18 steers or 82½% of the observation groups chewed the cud, compared with 45% at Windhoek and 36% at De Aar. During the afternoon, from 2 to 5 p.m., another 10 steers or 44% of the groups ruminated, so that during the 7 hours of observation probably all the steers chewed the cud.

Not only did a much larger percentage of steers ruminate at Cape Town but, per steer, they did so for considerably longer periods, that is, from 5 to 70 minutes compared with a range of from 4 to 38 minutes at Windhoek and 3 to 28 minutes at De Aar. No explanation can be offered.

F. DEFAECATION

Table XIV gives the times at which the Outjo steers in the observation groups defaecated at Windhoek, De Aar and on the first day at Cape Town, and a description of the faeces passed.

It was particularly noticeable how few of the observed 22 steers defaecated.

At Windhoek, during 4 hours in the resting kraals 8 or 36% of the oxen dunged. At De Aar, during the first 4 hours, only 2 or 9% defaecated and during the 8 hours in the kraals there, a total of 10 steers or 46% passed faeces. At Cape Town the number was 2 or 9% during the first 4 hours and 6 or 27% during the whole observation period of 7 hours.

In all, at the three centres defaecation occurred only 23 times. In every case the amount passed was small. In 17 cases the faeces were hard and dry and in 6 they were normal in consistency. One ox at Cape Town dunged twice within half an hour.

Table XIV also shows that at Windhoek the first ox to do so, dunged just on 3 hours after off-loading, at De Aar 1 hour and 27 minutes, and at Cape Town 36 minutes after off-loading.

That so few steers defaecated at Windhoek can possibly be explained by the fact that during the first few hours after loading at Outjo, they were in a very nervous condition and dunged freely, leaving their intestinal tract relatively empty. The food intake at the two resting centres was insufficient to restore normal digestion and defaecation. Although no record was kept at Cape Town after the first day, it was evident that with food and water available in the lairages, defaecation, in terms of amount and consistency, returned to normal after 24 hours and remained so until the observation steers were slaughtered on the 5th day after arrival.

TABLE XIV.

DEFAECATION—OUTJO STEERS.

WINDHOEK			DE AAR			CAPE TOWN		
Time	Number of steers	Description of faeces	Time	Number of steers	Description of faeces	Time	Number of steers	Description of faeces
Steers were in kraals by 7.50 a.m.			Steers were in kraals by 11.40 a.m.			Steers were in kraals by 9.10 a.m.		
10.45 a.m.	1	Small amount, hard and dry	1.07 p.m.	1	Small amount, hard and dry	9.46 a.m.	1	Small amount dry and hard
10.50 a.m.	1	do.	1.57 p.m.	2	*a.* do.	11.20 a.m.	1	do.
10.52 a.m.	1	do.			*b.* do.	(No observations between 1.00 and 2.00 p.m.)		
11.07 a.m.	2	*a.* Small amount—normal	2.46 p.m.	1	do.	2.56 p.m.	1	Small amount, normal.
		b. Small amount—nearly normal	3.08 p.m.	1	Small amount, normal	4.10 p.m.	1*	do.
11.10 a.m.	1	Small amount, hard and dry	3.14 p.m.	1	Small amount dry and hard	4.28 p.m.	1	Small amount, very hard and dry
11.17 a.m.	1	do.	3.22 p.m.	1	do.	4.40 p.m.	1*	Small amount, thin and watery
11.20 a.m.	1	do.	3.53 p.m.	1	Small amount, normal	4.42 p.m.	1	Small amount, hard and dry
			4.18 p.m.	1	Small amount, dry and hard			
			4.38 p.m.	1	Strained but passed no faeces			
Total	8		Total	10		Total	6	

*Same steer.

G. Urination

The night prior to loading, the groups of observation steers were kraaled at the railway station at Outjo, with water available. During the night the animals apparently passed little urine, because next morning the kraals were quite dry.

As stated, the animals urinated very copiously during the first 4 or 5 hours after loading and must have lost most of their free body moisture.

Table XV gives the times at which steers urinated at Windhoek, De Aar and during the first day at Cape Town.

Table XV.
Urination Data—Outjo Steers.

Windhoek		De Aar		Cape Town	
Times of Urination	Serial Nos. of Steers	Times of Urination	Serial Nos. of Steers	Times of Urination	Serial Nos. of Steers
Steers in kraals at 7.50 a.m.		Steers in kraals at 11.40 a.m.		Steers in lairages at 9.10 a.m.	
11.40 a.m.	72	5.48 p.m.	33	9.10 a.m.	?
11.42 a.m.	?	5.49 p.m.	24	9.10 a.m.	?
12.50 p.m.	24	5.55 p.m.	26	10.00 a.m.	69
12.52 p.m.	?	5.58 p.m.	76	10.00 a.m.	77
Total	4	Total	4	10.04 a.m.	33
				10.52 a.m.	69
				10.53 a.m.	26
				10.55 a.m.	70
				10.58 a.m.	31
				11.01 a.m.	77
				11.02 a.m.	68
				11.20 a.m.	28
				11.30 a.m.	73
				11.30 a.m.	75
				11.43 a.m.	72
				12.22 p.m.	33
				12.31 p.m.	27
				12.31 p.m.	30
				12.35 p.m.	28
				12.46 p.m.	25
				12.55 p.m.	?
				12.58 p.m.	74
				No observations from 1.00–2.00 p.m.	
				2.08 p.m.	31
				2.40 p.m.	23
				2.55 p.m.	74+77
				2.58 p.m.	24
				2.59 p.m.	74
				3.05 p.m.	25
				4.30 p.m.	67
				4.35 p.m.	25, 27+28
				4.38 p.m.	?
				4.42 p.m.	?
				4.46 p.m.	?
				4.53 p.m.	?
				Total	22

(i) *At Windhoek*: During the 4 hours there, only 4 steers or 18% of the 22 under observation, urinated; the first after nearly 4 hours in the resting kraals.

(ii) *At De Aar*: During the 8 hours of rest, also only 4 steers or 18% urinated, the first after more than 6 hours in the kraals. It would appear from these data, as if at De Aar the animals were more dehydrated than at Windhoek. Even after 8 hours of free access to water, more than 80% had not urinated.

(iii) *At Cape Town*: The oxen started to pass urine as soon as they arrived in the lairages and during the 7 hours under observation, all of them urinated at least once; seven did so twice and three did so three times. This very different behaviour from that at the two resting centres can probably be ascribed to the relatively high average water intake at De Aar (6.30 gallons), the cool journey from there to Cape Town, and to the cold, rainy conditions encountered there.

No record was kept of animals urinating on the second and subsequent days at Cape Town, but it was quite apparent that the steers remained normal in their urination frequency and amount.

Summary

During August, 1955, and again during April, 1960, a study was made of the behaviour of cattle during transport by rail, on two train loads of slaughter cattle, respectively from Outjo and from Gobabis in South West Africa to the Cape Town city abattoirs. The study covered the behaviour of the cattle during loading, while in transit, while in the feeding and watering kraals *en route* and in the abattoir lairages prior to slaughter.

(*a*) *Loading and unloading*: At railhead the cattle were afraid of the loading crushes and trucks and it took considerable time and free use of electric prodders to load them. It was surprising how quickly they became accustomed to unloading and loading at the resting stations *en route*, without crushes and without the use of prodders.

(*b*) *Behaviour in the trucks*: After loading, the Outja cattle were very nervous, showed muscular trembling, moved about and butted each other, and urinated and defaecated copiously. They settled down after some 5 hours. The Gobabis steers settled down very soon after loading and showed no trembling or abnormal urination or defaecation. During the journey at any time, at least 85% of the animals stood next to each other, *across* the truck; the rest either stood in line with the length of the truck, or were lying down. Over 18 observations during the journey from Gobabis to Cape Town the percentage of the 164 animals lying down, varied from 1 to 19% with an average of 10%. At any time too, about 85% of the animals stood or lay resting or asleep with heads held low and eyes closed; the remainder stood looking round with heads held high.

(c) *Behaviour at resting centres and abattoirs*: Between unloading stations the runs varied from 27 to 40 hours, without food or water. On

being off-loaded into the resting kraals in which hay and water were always available, the cattle invariably made straight for the hay and showed no interest in water until they had appeased their hunger. After some 20–30 minutes of avid feeding, the animals would move about, drink, eat some more, have a second drink and then lie down to rest and sleep. About an hour later they would get up, and if food was available, would again eat, then drink and lie down once more.

(i) *Food consumption* varied from 2.9 to 6.6 lbs. of lucerne hay per head during rest periods of 4 hours and from 10.1 to 13.6 lbs. during 8 hour rest periods. Since a 1,000 lb. steer requires about 8 lbs. of lucerne hay per day for maintenance purposes, it follows that during the journeys of $5\frac{1}{2}$ days, with two periods of rest *en route*, the animals were on a negative intake balance.

(ii) *Water consumption* varied according to weather conditions. On sunny days the intake during 4 hour rest periods varied from 3.6 to 4.6 gallons per head, while on a chilly and rainy day (at the Cape Town abattoirs) the intake was only 1 gallon per head. During 8 hours on a sunny day the intake averaged 6.3 gallons, as against 3.3 gallons on a cold, rainy day. On sunny days the animals each drank on an average 3 times in 4 hours and 5 times in 8 hours, while on cold, wet days comparative figures were once and twice.

(iii) *Rest*: The time the animals lay down and rested at off-loading centres and in lairages after arrival at the abattoirs also depended upon weather conditions. During days of normal temperatures they spent from 39 to 50 per cent of the period in the kraals lying down, while at Cape Town under chilly and rainy conditions the percentage varied from 16 to 21.

(iv) *Ruminal movements* were determined only on the Outjo steers. Before leaving the farm for the railhead, the animals averaged 4.2 movements per 5 minutes. At Windhoek the count was 1.8 per animal per 5 minutes and soon after arrival at Cape Town only 1 movement per 5 minutes. The next day the count averaged 4.5 and after another 24 hours 4.1 movements per 5 minutes.

(v) *Rumination* was also determined only on the Outjo steers. At Windhoek 10 out of the 22 observation steers ruminated for from 3 to 28 minutes; at De Aar 18 out of the 22 for from 2 to 38 minutes and at Cape Town all the steers ruminated and some more than once, for from 5 to 70 minutes.

(vi) *Defaecation and urination* were only observed on the cattle from Outjo. After the profuse voiding of urine and faeces soon after loading, the animals passed very little water or dung during the journey, but after 24 hours at Cape Town these two functions appeared to have returned to normal.

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TRANSPORTATION OF ANIMALS BY RAIL

II. TRANSPORT OF ANIMALS BY RAIL

G. D. Sutton*

Railway Regulations

Animals are conveyed by goods train unless the owner makes special arrangements to send them by passenger train. A goods truck can be coupled to the rear of a passenger train, but then passenger train rates, which are expensive, are charged. Cattle, horses, mules and donkeys go loose in trucks. Sheep, goats and pigs may travel loose in trucks or be crated. A single sheep or goat or a calf under 3 months old may be sent in the van of a passenger train provided that adequate provision for securing is made. More may be sent if they are crated. Calves under two weeks old may be sent in sacks provided that the legs are not tied and that they are not kept in the sack longer than four hours. The time limit between acceptance and delivery of calves may not exceed 12 hours for calves up to four weeks old, 18 hours for calves four to eight weeks old and 24 hours for calves eight to twelve weeks old.

Dogs must be secured properly by collar and chain or be crated. There are special compartments for dogs in the vans of passenger trains.

Cats, rabbits and monkeys must be in crates, cages or hampers.

Special care is given to show stock. The owner must state that the animals are show stock so that they can have preferential treatment.

Quarantine stock must travel in sealed trucks.

Animals need not be accepted for transport if they are diseased emaciated, advanced in pregnancy or considered unfit for travel. An exception is made in the case of drought-stricken stock.

Planning the Journey

Plan the journey so that the animals travel on the most suitable trains: make sure that they do not have to wait at junctions for branch-line trains and make provision for trucks if the animals have to be transferred from standard to narrow-gauge trucks or *vice versa*. Animals should not be loaded or arrive on a Saturday afternoon, Sunday or Public Holiday. If this cannot be avoided, animals will be delivered, provided the consignor asks in writing for this to be done. A special delivery fee will be charged and arrangements for off-loading on arrival must be made.

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Type of Trucks

Four types of truck are used for transport of animals.

The old type I.Z. truck is a short truck with four wheels, 22 ft. long, 8 ft. wide and 6 ft. 9 inches high at the doors. The interior is a few inches smaller in each dimension. The total ventilation area is about 30 square feet, comprising a ventilation grille at each end of the truck and gaps between the boards in the upper two feet of the sides of the truck. The I.Z.U. truck is similar to the I.Z. truck, but has a solid partition across the middle dividing the truck into two compartments.

The new type I.Z. truck is the same size as the old type. The total ventilation area is $18\frac{3}{4}$ square feet. There is a ventilation grille at floor level in each end of the truck. These can be closed by means of a sliding shutter. There is a ventilation opening in each corner in the sides of the truck at roof level. These can also be closed by means of sliding shutters. From the outside, the sides appear to be completely closed, but actually the boards in the upper part of the truck both at the ends and sides overlap, leaving ventilation openings between them. The inside of these openings is guarded by a metal grille with round holes in it. At first sight, this truck appears to lack enough ventilation area, but on closer inspection this is found to be incorrect.

The G.Z. truck is a bogie-type with 8 wheels and better springs than the I.Z. types. It is twice the length of the I.Z. type and has the same width. A solid partition across the middle divides the truck into two identical compartments. Both have the same size as the I.Z. truck. The total ventilation area is $17\frac{2}{3}$ square feet in each compartment. Each compartment has a ventilation opening at floor level in the end of the truck. There is no ventilation opening in the partition. There is also a ventilation opening in the sides of the truck at roof level in each corner. There is no ventilation opening in the sides of the truck next to the partitions. There are louvre boards next to and at the same level as the corner openings in the sides of the truck. A sliding shutter regulates both the corner opening and the louvre boards. When the shutter closes off the corner opening, the louvre boards are open, and when the shutter closes off the louvre boards, the corner opening is open. There is thus a safety factor in this truck which ensures that sufficient ventilation is present, whatever the position of the shutter.

All these trucks have roof vents. These are used for loading goods such as coal and wood; they are not ventilation openings. The trucks are not used for animal transport only, but also for other goods, as it is uneconomical to reserve trucks for one purpose.

Ordering Trucks

When trucks are being ordered, 48 hours' notice is required, and 4 days if more than 10 trucks are required. If show stock is being transported, this must be stated. A deposit may be required when trucks are ordered. This is repaid if the trucks are used and retained if the trucks are not used. No guarantee is given that the trucks will arrive in time or that the type of truck ordered will be provided.

Preparation of trucks

First inspect the truck and make sure that the floor, sides, door fastenings, roof and ventilation openings are in order. Look for splintered wood, holes, nails, wire and loose projections which could injure animals. If these cannot be removed or repaired, reject the truck.

It is essential to clean the truck thoroughly. Sweep out any bedding, dung or other material which may be present. Scrape the floor and sides, using spades for adherent dirt. Scrub, using hard brooms and water. Greasy material is best removed by scrubbing, using a three per cent solution of washing soda.

Disinfect after cleaning, using as first choice a three to five per cent solution of formalin. It must be allowed to act for not less than 3 hours before being washed out, using plenty of clean water. A five per cent solution of caustic soda could be used, but will cause damage to the metal parts of the truck. If necessary, insects, such as ticks, can be killed by spraying the truck, using either DDT or BHC solutions or a mixture of both.

The use of bedding is discouraged, because of the danger of fire. If it is used, put in as little as possible and make sure that nothing projects outside the truck. Wheat straw makes the best bedding. Veld or other hay should not be used, because the animals will eat it and it may carry ticks. Sawdust and tan are unsatisfactory, because fermentation takes place when they become moist. Clean sand is satisfactory, particularly for pigs during hot weather, when the sand can be wet to help keep the pigs cool. Horses tend to eat sand.

If food is provided, use teff hay for preference, with veld hay as the second choice. Lucerne hay may be used for animals which are used to it, but there is always the danger of bloat in ruminants and colic in equines. A rough hay rack can be constructed at each end of the truck when sheep or goats are being transported, but this is not advisable for cattle or equines, as it may cause injury. Loose food or watering troughs should not be placed in trucks with animals.

Finally, attend to the ventilation openings and roof vents. See that all ventilation openings are fully open and fix the sliding shutters securely so that they do not close during the journey. The roof vents must be closed to prevent the danger of fire and sun scald.

Loading

Before loading, animals should be sorted into similar classes, so that each truck-load contains the same type of animal. Do not truck male and female, large and small, weak and strong, fat and lean, old and young or horned and hornless animals together. The different species must be kept separate. Animals which are likely to injure one another may not be loaded together. If possible, do not mix animals strange to each other for fear of fighting. Suckling calves, foals or lambs should not be separated from their dams.

The maximum number of animals which may be loaded in a truck is not specified. The animals should have reasonable room but the truck should be well filled to lessen the chances of injury when the train jerks. Because of the great variation in size, strength and condition of animals, it is difficult to make a hard and fast rule. As a rough guide, the following recommendation is made for the maximum number of adult animals which can be loaded unsecured into a truck of the I.Z. type or compartment of the G.Z. truck: cattle, 16; horses or mules, 8; donkeys, 20; sheep or goats, 60; pigs, 25. If the animals are secured in the truck and an attendant accompanies them, 4 large animals or 16 small animals are enough.

If the animals are in crates, cages or hampers, these must be strong and securely fastened to prevent escape. Secure labels in at least two places on different parts of the container.

Twelve working hours are allowed for the loading of a truck. After that demurrage is charged. Allow sufficient time before the train leaves for the loading of the stock, in case difficulty is experienced. Trained animals can be led into a truck. Untrained animals have to be driven in. Loading facilities exist at most sidings. The danger of injury can be lessened by placing bales of hay next to the doors of the truck so that the animals do not break away so easily or get a leg between the platform and the truck. Avoid noise and excitement, work firmly and calmly and try to encourage animals to enter the truck without using violence. The use of sticks, whips and prodders tends to terrify animals, make them obstinate and more difficult to handle. Prodders must not be used on pigs. An animal which refuses to enter a truck, will sometimes back into it. Animals must be fed and watered before being loaded. Secure the doors well after loading.

If animals are not tied in a truck, they should not have halters, ropes or riems on their heads or necks. If they are tied, a strong halter and rope should be used. The use of wire is not allowed. Unless an attendant travels with the animals, it is best for them to be left loose in the truck. If an attendant accompanies the animals, they must be secured to the ring bolts built into the truck. One upper section of one door must be open and securely fastened in this position so that the attendant can leave and enter the truck. The attendant may not use a lamp or candles and must have a four-gallon receptacle filled with water to use in the event of fire. Smoking is not allowed in the truck.

Transit

If the journey lasts less than 48 hours, animals are not off-loaded for food, water and rest. If it exceeds this period, the animals must be off-loaded within 36 hours of the time of trucking for feeding, watering and a rest of not less than 4 hours. Thereafter, they are fed, watered and rested at recognized stations designated for this purpose.

When there are only a few animals in a truck, they are watered and fed without off-loading.

Pigs must be watered *en route* every 12 hours by means of troughs or other suitable utensils placed temporarily in the trucks.

Dogs must be taken out of vans and dog boxes at reasonable intervals during the journey for exercise. Water receptacles must be kept clean and filled and care taken to see that there is sufficient food.

Animals must be inspected at regular intervals during transit. If injured animals are found, they must be off-loaded and taken care of at the nearest station on behalf of the owners, or, if seriously injured, be slaughtered or destroyed under supervision of a veterinarian or a member of the Railway or South African Police. If dead animals are found, it must be assumed that disease is present. A State Veterinarian must be called in to investigate and determine the cause of death and issue instructions for disposal of the carcase. If the trucks are already on the premises of a municipal abattoir, the municipal veterinarian should be called in. If he is not available, a State Veterinarian must be consulted or, failing him, a private practitioner.

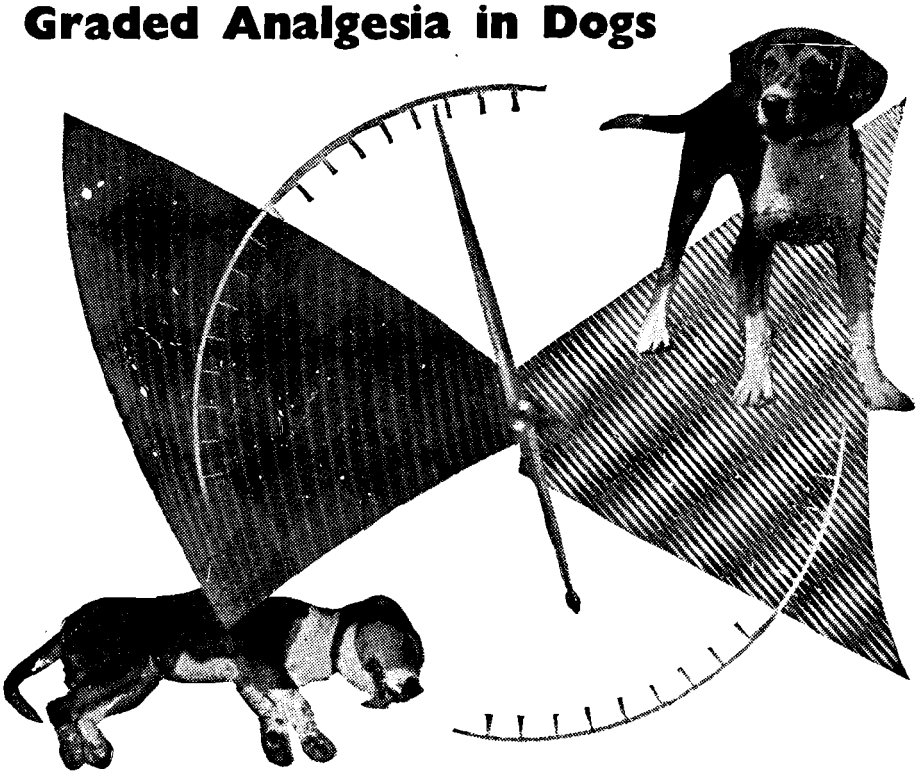
Off-loading

The consignee must off-load animals within three hours of arrival. If this is not done, animals may be off-loaded and placed in kraals. Any expense incurred will be charged to the consignee. Food and water must be provided as soon as possible after off-loading.

ACKNOWLEDGMENT.

The author wishes to record his thanks to the Director of Veterinary Services for his assistance in this matter and for permission to publish this paper.

Graded Analgesia in Dogs



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TRANSPORTATION OF ANIMALS BY RAIL

III ANIMAL TRANSPORT AND MEAT INSPECTION

L. W. van den Heever*

Introduction

As most animals presented for slaughter at the major abattoirs in the Union are transported there by rail, the effects of such transportation on slaughter stock have an important bearing on the ante and post mortem inspection of food animals and on the conditions which will lead to the meat eventually being passed as fit or condemned as unfit for consumption.

In spite of the general practice of requiring a 24 hour rest period prior to slaughter, this is mostly inadequate to permit of healing of traumatic conditions. If proper feeding and watering facilities are available, it may assist in recovery from fatigue and stress during this period.

The effect of rail transport will depend on a considerable variety and interplay of factors such as distance, climatic conditions, condition of stock, their age, sex and behaviour, type of vehicle used, care during loading and disembarkation, etc.

Inspection on arrival

This is an essential aspect of ante mortem inspection. One of the more important reasons for this is the detection of diseased or injured animals as they come off the loading ramp. Animals suffering from serious injury such as fractures, or inability to rise, may have to be stunned and bled immediately. Others may be able to make their own way to the stunning box for immediate slaughter. This is considered necessary both for humane reasons and to minimize the effects of bacterial infections on the body as a whole. Such emergency-slaughtered animals require special post mortem inspection because of the facility with which bacteria from open wounds and from the gastro-intestinal tract may penetrate the defences of the body and gain access to the bloodstream and to normally sterile tissues, particularly when the animal is severely fatigued and has suffered stress and pain[2]. In Australia, the meat from emergency-slaughtered stock may not be passed as fit for food, whereas in Europe[5] it is usually obligatory to conduct a bacteriological examination on portions of liver, spleen, lymph nodes and muscle prior to release of the carcase. This examination also includes a determination of the ultimate

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pH of the meat 24 hours after slaughter. In South Africa, serious consideration should be given to stricter requirements of inspection for such cases in view of the greater danger of food poisoning resulting from consumption of meat from such emergency-slaughtered animals.

Another reason for observing slaughter stock immediately after arrival is the importance of detecting conditions where prompt treatment may result in animals recovering so as to permit of normal slaughter. Heat stroke in pigs, ketosis in cattle, hypocalcaemia in sheep, dystokia and retained foetal membranes are examples of such conditions. Cavanagh[3] reports that 73% of sheep with hypocalcaemia have responded to treatment. Unfortunately, where livestock agents handle the animals on behalf of owners, they usually have no authority to incur expenses for such treatment unless the owners authorize the agents accordingly before-hand.

A further reason for inspection on arrival is the fact that infectious diseases may occur during prolonged transit if the animals were loaded during the incubation period. This holds good for diseases such as anthrax, foot and mouth disease, etc.; their detection is important from the public health and scheduled disease control point of view.

Where animals are dead in the truck on arrival, elimination of certain diseases such as anthrax is necessary, even if the actual cause of death is difficult to establish because of decomposition. Pfeiffer and Louw[8] have indicated how important such investigation is in order to prevent the slaughter of animals (in the same consignment) which may be in the early stages of one of the acute diseases which may also fall into the class of the zoonoses and therefore endanger public health.

Post mortem inspection

A variety of conditions influenced by transportation may be encountered:—

Bruising is probably the most common condition of food animals associated with transport. The Meat Inspection Regulations[9] made in terms of the Public Health Act require total condemnation of carcases showing evidence of generalized, extensive or serious bruising. Where the condition is more localized, trimming of affected parts is necessary before the rest of the carcase can be passed, and this invariably leads to some degree of mutilation and loss of weight. In addition, the carcase is less attractive to the buyer and especially where the more valuable parts of the carcase are affected and removed, a lower price per grade must be expected.

Trimming of bruised portions is necessary because the haemorrhage, contusion and tissue infiltration is a serious blemish and such parts show decreased keeping quality and rapid post mortem discolouration. It is also necessary for the inspector to cut in to such bruised parts to assess the depth and extent of contusion and haemorrhage, as the deeper tissues may be infiltrated with blood, etc. to an extent not proportionate to the surface changes. This is particularly the case in pigs, where even small surface bruises should be investigated prior to passing the carcase.

Decisions as to the extent of bruising and whether it warrants complete condemnation of the carcase are often difficult in borderline cases. Reference to the regional lymph nodes should always be made inasmuch as they indicate by enlargement, oedema, haemorrhage and discolouration, whether the condition is severe or not. Establishment of a high ultimate pH (over 6.2–3) of the meat confirms that the bruising was in fact sufficiently severe to affect the animal's metabolism prior to slaughter. This was demonstrated by van den Heever[12] and Meara *et al.*[7] using the Nitrazine Yellow method of Schönberg. Of 46 extensively bruised carcases examined, 28 showed inadequate lactic acid development in meat portions distant from the affected parts.

Where gangrene accompanies the bruising, a stricter evaluation is required. Gangrene is often seen over the bony prominences, such as the iliac and ischiadic tuberosities, in thin cattle. The consensus of opinion appears to be that such degrees of trauma are the result of violent collision between the truck walls and the tissues mentioned; careless shunting and sudden stops and starts are the most probable causes.

The incidence of bruising in food animals slaughtered at some of the major abattoirs during 1960 is indicated in Table I.

TABLE I.

Condemnations of Livestock due to Bruising at the Major Abattoirs of South Africa.

Centre	Slaughtered		Condemned		
			Carcases	%	Portions (lbs.)
Cape Town	Cattle:	139,349	642	0.46	54,264
	Sheep:	630,297	67	0.01	18
	Calves:	21,829	5	0.02	117
	Pigs:	43,328	35	0.08	—
Germiston	Cattle:	42,511	107	0.26	7,442
	Sheep:	111,534	4	0.004	130
	Pigs:	5,701	1	0.02	170
Pretoria	Cattle:	82,878	204	0.25	44,746
	Sheep:	184,234	12	0.007	—
	Calves:	4,924	4	0.08	—
	Pigs:	32,981	21	0.06	930
Johannesburg	Cattle:	289,539	596	0.21	70,011
	Sheep	933,338	66	0.007	144
	Calves:	51,551	22	0.04	17
	Pigs:	148,862	114	0.08	1,620
	Equines:	12,014	1	0.008	353
Durban	Cattle:	95,318	58	0.06	—
	Sheep:	490,520	38	0.008	—
	Calves:	9,206	9	0.10	—
	Pigs:	53,670	2	0.004	—
Bloemfontein	Cattle:	18,318	14	0.08	3,519
	Sheep:	83,601	8	0.01	
	Calves:	4,530	—	—	
	Pigs:	10,323	114	0.01	
Totals		3,500,356	2,031		183,482 lbs.
	Cattle:	667,913	1,619	.24	
	Sheep:	2,433,524	195	.008	
	Pigs:	294,865	174	.06	

Based on a monetary value of R10.00 per 100 lbs. carcase weight, and taking 375, 36 and 60 lbs. as average carcase weights for cattle, sheep and pigs respectively, it may be conservatively estimated that, at the abattoirs indicated in Table I, the value of carcases and portions condemned because of bruising amounted to R94,510.00 during 1960.

Referring to the variations in the percentage incidence of bruising at the different centres as reflected in Table I, it appears significant that this amounts to 0.46% in Cape Town and only 0.06 and 0.08 at Durban and Bloemfontein respectively. It seems probable that the fact that a large percentage of Cape Town's cattle is brought by rail from South West Africa may be partly responsible for the high incidence of bruising encountered there.

Comparison of the data in Table I with details furnished by Fewster[4], as summarized in Table II, is of interest in assessing whether our incidence of bruising is high or low.

TABLE II.

Actual and Percentage Incidence of Bruising in Australia in 1953

	Slaughtered	*Condemned*	%
Cattle.....	1,634,684	868	.05
Sheep.....	2,545,198	253	.01
Pigs.....	595,209	5	.0008

Fewster concludes that losses due to bruising, including loss of grade, based on an annual production of 900,000 tons of beef, exceeds £A2,000,000. The high average incidence of .24% in the major South African abattoirs compared with the average incidence of 0.05% in Australia indicates that there is room for improvement in rail transportation methods and procedures. At the same time it must be appreciated that Australian cattle are often moved by road on overland treks to the abattoirs.

(2) *Fatigue and stress* cause depletion of glycogen reserves which leads to poor acidification of meat, when the ultimate pH is reached 24 hours or so after slaughter. Hedrick[6] has shown that the incidence of "dark cutting" beef is related to stress of transport, and he maintains that the use of tranquillizers will assist. Blomkvist[1] associates stress during transportation with the severe muscle degeneration encountered in swine on the continent of Europe, and has devised a rubber bit for pigs which occupies their attention during transit and so reduces the effects of stress during this period. Thornton[10] has shown that the pH of the meat of abattoir-killed pigs (where transportation precedes slaughter) is on an average higher than in the case of farm-killed pigs, and a correlation between a high pH and the incidence of bone taint is well established.

Pigs are also particularly susceptible to exercise and starvation, and this also leads to glycogen depletion and high ultimate pH of the meat. Poor keeping and curing quality results.

Change of diet and starvation experienced during rail transport may precipitate ketosis in certain animals. Where such cases are slaughtered, the typical sweet smell of ketone bodies may be so noticeable at slaughter or on subsequent heating of meat specimens as to warrant condemnation of the carcase and viscera as unfit for food. The incidence of such cases is probably very low.

Thornton[11] describes changes in the colour of the livers of food animals subjected to stress, pain or prolonged transportation, and correlates such changes with depletion of liver glycogen reserves. The changes are of the nature of fatty degeneration and cloudy swelling, the other organs and the carcase being normal. A similar condition is seen in South Africa, especially where heavily fleeced sheep are transported over long distances in hot weather, the livers being a light yellowish brown or putty colour. Condemnation of the liver only is necessary, but a careful examination to exclude inflammatory states in the lungs, uterus, joints and tendon sheaths should precede a final decision.

Skin discolouration in pigs is always more prominent after scalding and scraping, and in view of the fact that the skin is edible, such changes command particular attention. Infectious diseases of an acute nature such as swine fever, erysipelas and pig paratyphoid should, of course, always be excluded. Discolourations, however, may be related to transport as follows:

(*a*) "*Lime*" *or disinfectant burn.* Where residues of lime or other chemicals used in disinfection of rail trucks remain on the floor, contact with the abdomen and backs of the hams may result in chemical irritation and discolouration.

(*b*) *Solar erythema* may be seen in white skinned pigs transported in trucks with roof openings permitting sun to burn the backs and ears of pigs, especially during long stationary periods.

(*c*) *Transit erythema* may result from prolonged exposure to cold wind in transit e.g. through open inspection gratings.

Summary

Some of the more important considerations of meat inspection in relation to the transport of food animals are dealt with, emphasis being placed on bruising and the incidence thereof in South African abattoirs, where the average incidence is 0.24% of slaughtered cattle condemned for bruising as compared with 0.05% in Australia. The reasons for inspection of livestock on arrival are indicated and reference is made to special post mortem examination procedures which may be adopted.

Acknowledgement

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TRANSPORTATION OF ANIMALS BY RAIL

IV. DISEASES OF RUMINANTS IN TRANSIT

K. van der Walt*

INTRODUCTION

Despite transportation of animals over long distances, relatively few ever become ill. Ruminants are more susceptible, especially mature cows and ewes in advanced pregnancy. Disturbances in ruminants range from atony of the forestomachs to acetonaemia, toxic indigestion, and, in the severest cases, transport tetany. All these metabolic disturbances have a common aetiological background.

PATHOGENESIS

Stress is primarily responsible for the general disease pattern which develops. Because the digestive system of the ruminant is notoriously susceptible to derangement under stress conditions, these animals suffer most often, especially if predisposing states such as advanced pregnancy, early lactation, heavy feeding prior to shipment, and starvation and thirst during transit, are present.

On loading, cattle unaccustomed to transport usually develop a watery diarrhoea within a few minutes, which persists for six to twelve hours. For the first few hours there are also marked muscular tremors, increased respiratory and pulse rates, profuse salivation and total cessation of ruminal movements. These symptoms of fright are the precursors of a stress syndrome which may persist for the duration of the journey.

The diarrhoea, salivation and increased respirations result in dehydration. Associated with electrolyte loss and paralysis of the forestomachs, the stage is set for prolonged ruminal atony, bowel stasis and constipation. Hyperadrenalism and increased muscular activity mobilize glycogen and lower the energy reserves of the body.

It needs only a state of advanced pregnancy or early lactation with its tremendous demands of sugar, proteins, electrolytes, calcium and phosphorus to precipitate a syndrome commonly known as transport tetany.

The most significant clinico-pathological finding in transport tetany is a hypocalcaemia. In these cases the parathyroid glands appear inadequately prepared to mobilize sufficient calcium for the increased demands.

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Practical experience supports the theory that the feeding of a ration containing sufficient calcium to satisfy requirements from current intestinal absorption predisposes the animal to a state wherein the parathyroid glands are incapable of meeting a sudden demand for calcium.[3]

These changes form the basis of metabolic derangements occurring in all types of animals during transportation. A thorough appreciation of these factors enables the veterinary surgeon to recognize and rectify predisposing causes and to institute rational treatment in cases where the disease develops.

Symptoms

Mature animals in the last four months of pregnancy or soon after calving are most commonly affected. Symptoms appear after twelve to twenty-four hours in transit or as long as forty-eight hours after loading.

Initially there are signs of anxiety, trismus, and muscular stiffness. This may be followed by progressive inco-ordination and mental disturbances associated with grinding of the teeth, foaming at the mouth, nystagmus, clonic spasms, galloping leg movements and eventual coma. The animal then remains quietly on its side for long periods, interrupted occasionally by clonic spasms.

Body temperature varies from about 104°F. during episodes of muscular activity, to subnormal if the animal lapses into coma. The pulse rate and respirations are similarly affected. There is complete atony of the forestomachs, urine retention and constipation.

Injuries are common and vary from superficial abrasions to fractures and severe lacerations of the udder and other appendages.

In slower developing cases the animals show depression, signs of dehydration and disinclination to move when unloaded. The eyes are sunken and the muzzle is dry. Food is refused but exceptional thirst is common. If free access to water is allowed, death may supervene.

Treatment

Advanced cases in pregnant animals cannot be treated very successfully and prevention by elimination of the predisposing causes should be the aim.

Preventative Treatment

Diet: We subscribe to the opinion held by Boda and Cole[1] that the incidence of milk fever, and we suggest to a large extent also that of transport tetany, can be lowered by feeding a low calcium, high phosphorus diet for about a month before transportation. This practice is based on the previously mentioned theory of insufficient stimulation of the parathyroid glands.

In our experience it is sufficient to replace lucerne with a good quality oat or wheat hay and to supply 30 gm. of mono-sodium phosphate per thousand pounds body-weight daily in the drinking water.

The animals should be watered before loading and every effort should be made to unload the animals at intervals of twelve hours for feeding and watering.

Sedation: As fright and apprehension play such an important rôle in the aetiology, the use of tranquillizers prior to loading is extremely useful[12]. These drugs cause an alteration in basic consciousness, depress the activity of the cerebral cortex by slowing metabolism and block response of the central nervous system to certain reactions of the sympathetic nervous system. Actual loading is facilitated and injuries are reduced significantly. The diarrhoea, which results from anxiety, does not occur to any marked extent and dehydration becomes insignificant. Muscular tremors and initial overactivity are depressed. The animals settle down much quicker to the new environment and feeding and drinking is resumed earlier.

Chlorpromazine hydrochloride (Largactil) has a strongly depressing effect on the brain stem. The drug is adrenolytic; in addition it has a parasympatholytic action, which reduces intestinal spasm and peristalsis, as well as the flow of bronchial and salivary secretions. Injected intramuscularly at the rate of 1.0 mg./kg. bodyweight, the drug attains maximum bloodlevels after about one and a half hours and the effects last for about six hours.[2] The drug is usually administered as a five per cent solution, which may cause a temporary local reaction at the site of injection. This is of no consequence, except in animals which are slaughtered within thirty-six hours after the injection.

Promazine hydrochloride (Sparine, Wyeth) is used fairly extensively when shipping animals. The recommended dose ranges from 0.4 to 1.0 mg./Kg. by intramuscular injection.[7 9 10]

Perphenazine (Trilafon, Scherag) is more potent weight for weight than the previously mentioned drugs[6] and its use in shipping cattle,[4] swine and sheep[5] has been recommended. Injected intramuscularly, Perphenazine is effective within twenty to forty-five minutes and the effect lasts from six to thirty-six hours. Animals weighing less than 800 lbs. should receive 10 mg./100 lbs. bodyweight, from 800 to 1,100 lbs., 100 mg.; and from 1,200 to 1,500 lbs., 125 mg. Animals weighing more than 1,500 lbs. are given 150 mg.[8]

Symptomatic treatment

After symptoms have developed, treatment is aimed at correcting the various underlying disturbances.

Excessive water intake in the dehydrated animal can have fatal consequences; initially only small amounts of water should be allowed at suitable intervals, and intravenous fluids should not be administered at excessive speed, nor should glucose solutions, given intravenously, be of a concentration higher than twenty per cent.[11]

The hypocalcaemia is corrected first by giving an intravenous calcium borogluconate solution, as used in the treatment of milk fever. This is followed by two to four litres of twenty per cent dextrose in physiological saline intravenously and fifty units of plain insulin intramuscularly. The small dose of insulin assists in the initial phosphorylation of glucose in a body where all physiological processes are severely disturbed. If the animal is comatose, a suitable stimulant (4–8 mg. of strychnine hydrochloride) is indicated.

A long-acting corticotropin (100 units) is given to stimulate corticoid action, which is inadequate at this stage due to the exhaustion of both the pituitary gland and the adrenal cortex. Prednisolone (50–100 mg.) is given simultaneously to assist in the immediate mobilization of glycogen and to combat stress in general.

A broad spectrum antibiotic will assist in preventing pneumonia caused by accumulated bronchial secretions and inhaled ruminal contents.

Rumen stasis is treated by the dosing of propionic acid (30–60 cc.) or vinegar combined with sugar. Every effort should be made at this stage to administer fresh ruminal contents to assist in rehabilitation of the ruminal flora.

Attention has already been drawn to the initial regulation of water intake. After this period drinking should not be restricted and forced drenching should be resorted to in order to soften the ruminal contents.

On the whole animals seem to do best when left in a small paddock, where food, water and protection are provided.

Infections, such septic metritis or mastitis, are often complicating factors and may even be the primary cause of severe illness. Early and vigorous treatment should be instituted in these cases.

Course and Prognosis

Transport tetany is a serious disease. Many affected animals are lost in spite of treatment, especially if they are in an advanced state of pregnancy. Treatment seems to be more successful, if abortion or parturition has taken place.

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COBALT IN RELATION TO RUMINANT NUTRITION IN SOUTH AFRICA

C. C. Wessels*

Introduction: Standards of Cobalt Deficiency

The recognition of the part the trace element cobalt plays in animal nutrition has occurred only within comparatively recent years. There are, however, references going back about 150 years of pining ruminants in certain defined areas all over the world, and we now know that the cause of this so-called pining is, in fact, a deficiency of cobalt.

The earliest known records in print are those of Robert Fraser[1] published in 1794, and of James Hogg[2] in 1807. Fraser, apparently anticipating our present ideas of overcoming pine, recommended a drench of soil from healthy areas, mixed with water, as a cure, which was widely practised in certain areas of Scotland.

The rôle cobalt plays in the health of the ruminant animal is now well known and since the discovery in 1948 that vitamin B_{12} contains cobalt,[3,4] a great deal of study has been carried out on the relationship between this vitamin and cobalt deficiency in ruminants. Unlike the monogastric species of animals, which procure their vitamin B_{12} requirements through their food supplies, the situation in the case of ruminants is rather a different and unique one, in that cobalt is required by the bacterial flora of the rumeno-reticular sac for the manufacture of vitamin B_{12}. This vitamin is synthesized by various bacteria and fungi.

The ruminant's vitamin B_{12} requirements are relatively high: liver stores of healthy adults are approximately double that of non-ruminants. It is possible that their peculiar metabolism, involving utilisation of fatty acids, may necessitate higher vitamin B_{12} concentrations but this requires further research. Cobalt deficiency is in effect a vitamin B_{12} deficiency.

Over the last two years preliminary field experiments with cobalt, carried out over practically the entire Union, have disclosed some very interesting and informative results.

In order to have the optimum effect of cobalt on the micro-organisms, it must be present in the rumeno-reticular sac at all times, and as other methods cannot provide this assurance, the cobalt bullet** was used. This novel method originated from the well-known fact that metallic foreign bodies will remain in the ruminant's fore-stomachs for long periods if accidentally swallowed, eventually becoming completely eroded if they do not lead to trauma. Experiments were conducted with pure metallic cobalt,[5] but it was found that although the metal gave up sufficient

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cobalt when immersed in distilled water, little, if any, was released in the anaerobic reducing medium of the rumen. Further research by the same workers showed that pellets consisting of cobaltic oxide and china clay compressed and baked at 800 to 1,000°C., released adequate cobalt in the environment of the rumen, and the rate of release could be influenced by variations in the firing process. The rate of release of cobalt from the pellets, however, is also influenced by the pH and the oxidation-reduction potential of the rumen contents. The mixture of cobalt oxide and clay, after compression and firing, becomes extremely hard but still sufficiently porous for the pellets to take up 6 per cent of their weight when immersed in water.

The retention rate of the bullets have been studied by means of fluoroscopy and by post mortem examinations; they can remain in the forestomachs for very long periods, depending a great deal on the type of grazing.

Extensive experiments have proved beyond doubt that these cobalt pellets or bullets are able to provide sufficient cobalt to meet the requirements of sheep.

The composition of the present cobalt bullet is cobalt oxide 90.0%, ball clay 4.0%, sodium silicate 6.0%, with a S.G. of 4.0. For sheep the bullet weighs 5 gm. and for cattle it weighs 20 gm.

Field trials with flocks on cobalt deficient pastures demonstrated the long-term effectiveness of treatment with cobalt bullets, a response at least equal to drenching three times weekly with the equivalent of 1 mgm. of cobalt per day being obtained.[5]

In South Africa experimental field trials were undertaken and planned as follows.

In the case of sheep, where possible and as far as practicable under field conditions, they were divided equally into groups of the same breeds, ages and sexes; they were all weighed and identified individually by means of numbered eartags. Half of the numbers was dosed once only with the cobalt bullets or pellets and their counterparts were left untreated to serve as controls. For the rest, the animals under test were kept under the same conditions in regard to feeding, anthelmintic treatment, etc. The sheep were then re-weighed at varying intervals and the treated ones compared with the untreated ones, using their weights, general condition and symptoms of disease as criteria.

In the case of cattle, matched pairs or groups of young growing animals were, as far as possible, always selected and weighed. Where scales were not available, a weigh-band was used, using the same band and applying the same tension in every case. It should be noted that extensive practical tests with the band have shown the percentage of error to be very small and, for practical purposes, this method is reliable when applied correctly.

In all cases a specially designed inexpensive plastic gun of two different sizes, delivering the bullet within the oesophagus, was used. Correct administration is of utmost importance.

This undertaking was done in an endeavour to determine the following wherever possible.

1. Deficient areas and the degree of deficiency.
2. Whether cobalt could bring about improvement in areas not necessarily deficient.
3. Whether cobalt could have any adverse effects on animals.
4. The effect on quality and quantity of wool.

From the above it is obvious that such work is lengthy and time-consuming and will still take several years before final completion is reached. However, it is felt that some of the observations and findings after two years are so important that their publication is justified.

At the outset it must be emphasized that, depending on the degree of lack of cobalt in ruminant animals, they are just able to maintain health or they start declining in condition. Only if the lack of cobalt is severe, do the animals show more marked symptoms of anaemia and extreme poverty.

In South Africa, it has become apparent from the author's experimental findings that if sheep, after treatment from three months onwards, show on an average a live weight increase from 3 *to* 5 *lbs. per sheep* when compared to their controls, they can be considered to have suffered from *subacute cobalt deficiency*. From clinical examinations it has become very evident in the controls that growth becomes retarded and signs of unthriftiness appear. Similarly, increases of *over* 5 *lbs. per sheep* in the case of treated sheep against controls, indicate *acute deficiency*; the controls reveal clinical symptoms of emaciation, anaemia and sometimes definite pining. Improvements, three months or more after treatment, from 1 *to* 3 *lbs. per sheep* as against controls cannot be seen with the naked eye, especially if the sheep carry several months' wool. Such sheep, in the absence of organ analysis, cannot be diagnosed as suffering from a cobalt deficiency, but usually their general improvement can be judged after slaughter, when their carcases fetch better grades than their controls. In support of the finding on animals falling in this category, viz., an improvement without necessarily a deficiency, the author quotes: "Cobalt also appears to be a requirement for the proper functioning of rumen micro-organisms. Therefore, its use as a therapeutic agent in correcting disturbances of the rumen, such as inappetance, digestive type of acetonaemia and bloat, may well be justified *even though an adequate supply of cobalt is present in the ration.*"[6] Undoubtedly, the grazing conditions in South Africa, especially during certain seasons, could lead to such improper functioning of the rumen micro-organisms.

Weight gains of *less than* 1 *lb. per sheep* as against their controls are considered as *negative*.

Similarly, in the case of young growing cattle of about 300 lbs., an average live weight increase, in those treated upwards of three months, of 20 *to* 40 *lbs. per beast* over their controls, can be considered as indication

of *subacute cobalt deficiency* and *over* 40 *lbs.* as *acute cobalt deficiency.* Although cattle gaining from 7 to 20 lbs. after treatment over controls, cannot be justifiably diagnosed as having suffered from cobalt insufficiency, especially in the absence of liver biopsies, yet their general *improvement* in health and nutrition shows that they have benefited by the treatment. This finding, as in the case of sheep stated previously, may be based on the fact that the correction of certain forms of rumen dysfunction and metabolic disorders can be attributed to the therapeutic use of cobalt even in the presence of the element in the feed.

As there are no sharp lines of demarcation between these stages, and because the one can merge into the other over different periods, one hundred per cent accurate standards cannot be laid down. However, after extensive investigations, the author formulated a standard as shown in the following table:—

The Average Live Weight Gain per Animal in lbs. over Untreated Controls 3 months or longer after treatment.

Cobalt Status of Soil	Sheep	Cattle	Cobalt Status of Animal
Sufficient	▷1	▷7	Negative
Sufficient	1–3	7–20	Improvement Only
Marginally Deficient	3–5	20–40	Subacute Deficiency.
Deficient	◁5	◁40	Acute Deficiency

Survey of Cobalt Deficiency in South and South West Africa

About 25 years ago, as a result of the findings of research workers in New Zealand, Australia and the United Kingdom on cobalt in relation to animal health, our attention in South Africa was drawn to the South Western Districts of the Cape, where sheep were affected in a similar manner. Soon afterwards this condition was also shown to be due to cobalt deficiency. In the late 1950's, as a result of cobalt deficiency symptoms in sheep reported by farmers, a few more isolated spots were picked up along the coastal belt near Port Elizabeth in the East[7] and Saldanha in the West.

Apart from this coastal strip, and even here confined only to certain parts extending inland for about 15 miles, nothing more is known of the cobalt status further away inland nor in the rest of the Union. However, from time to time reports are received from farmers indicating symptoms in ruminants suggestive of cobalt deficiency.

Up till the present, for various reasons, one cannot depend on the diagnosis or incidence of insufficiencies solely on analyses of animal organs, soil or vegetation. In fact, it can even happen that there is a sufficiency of cobalt in the soil and yet the animals may suffer from an insufficiency. The reasons and factors for this cannot be explained here, but they are bound up in the chemical interactions between different elements, complicated by botanical and meteorological influences.

Moreover, the degree of incidence and severity of the deficiency can vary in the same area from year to year. According to Marston,[8] in Australia in the same area, over a period of 10 years, there was a complete range from severe mortality in lambs in some years to no symptoms in several years. Along the coastal belt of the South Western Districts this finding is well-known to the local farmers.

Furthermore, the unpredictable distribution of this disease is well-known in some areas of Scotland, where cobalt deficient granitic soils may produce cobalt deficiency symptoms while, within 100 yards, sheep may be cured by pasturing on whinstone soils. The author has found, after experimental dosing of cobalt to sheep on a cobalt deficient farm, marked improvement of treated animals over controls. Later, when moving them to an adjoining farm, the controls slowly started to increase in weight. After some months, when these animals were returned to the original farm, the controls again slowly started to deteriorate compared to the treated group. In other words, the cobalt status of the soil can vary from one locality to another, even from one farm to another next door and even from one place to another on the same farm.

In spite of these facts, one still hears of statements, sometimes even from responsible authorities, that a particular area is not cobalt deficient, without feeding tests having been conducted. It is a well-known fact that the only reliable method of determining cobalt, or, for that matter, most of the trace element insufficiencies, is by means of actual feeding tests *in loco*, using controls with subsequent weights or other findings recorded.

Throughout these experiments, for the sake of brevity, the symbol A/B denotes A over B, where A refers to treated animals and B control animals. Thus A/B + 5 lbs. signifies the average gain of treated animals is 5 lbs. per animal over controls.

Because of the lack of space, the farms regarded under these tests as negative, i.e. where no response to treatment was shown, have not been listed in the following tables. Furthermore, protocols can be obtained on request from the author.

Cape (Southern)

As this area, especially the coastal belt, is regarded to be cobalt deficient, only a limited number of field tests were conducted mainly for other purposes rather than to establish the incidence. However, the trials confirmed the existence of cobalt deficiency as follows:—

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Bredasdorp	9		1.600	7
Bredasdorp	9		3.475	5
Malmesbury	37		1.021	6
Malmesbury		11	7.333	6
Somerset West		2	22.000	10
Stellenbosch		4	81.000	6
Vredenburg	59		1.982	5
Bredasdorp	35		3.872	5
Malmesbury	30		3.266	4

In the above area altogether 10 farms, comprising a total of 199 sheep and 17 cattle, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
10	Sufficient	Adequate
40	Sufficient	Improvement Only
40	Marginally Deficient	Subacute Deficiency
10	Deficient	Acute Deficiency

Thus on 90% of the farms the treated animals improved over their controls, whereas on 10% the response was negative.

ORANGE FREE STATE

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Philippolis	18		1.475	4
Bloemfontein	20		3.650	9
Bethulie	17		1.278	8
Bethulie	20		5.300	4
Brandfort	15		10.000	15
Dealesville	39		2.049	3
De Wetsdorp	32		1.444	9
Edenburg	39		2.010	9
Excelsior	28		2.714	3
Fauresmith	31		4.069	8
Fouriesburg	13		2.190	7
Fouriesburg	25		2.436	7
Jacobsdal	20		3.650	3
Jagersfontein	20		3.650	8
Koffiefontein	37		4.335	4
Ladybrand	37		4.209	9
Philippolis	56		1.078	8
Rouxville	35		1.734	10
Smithfield	33		3.661	7
Springfontein	5		6.000	9
Trompsburg	34		2.769	9
Vredefort	25		2.995	6
Zastron	37		3.522	8
Ficksburg		6	26.333	8
Luckhoff	26		1.905	8
Zastron	18		1.889	8

In the above area altogether 38 farms, comprising, 1124 sheep and 6 cattle, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
31.6	Sufficient	Adequate
36.8	Sufficient	Improvement Only
23.7	Marginally Deficient	Subacute Deficiency
7.9	Deficient	Acute Deficiency

Thus, on 68.4% of the farms the treated animals improved over their controls, whereas on 31.6% the response was negative.

BORDER

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Alice	14		6.111	7
Cathcart	48		1.493	5
Queenstown		10	15.200	9
Komgha	25		1.583	13
Komgha	34		1.191	13
Komgha	32		1.200	13

In the above area altogether 12 farms, comprising 570 sheep and 29 cattle, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
50	Sufficient	Adequate
41.7	Sufficient	Improvement Only
—	Marginally Deficient	Subacute Deficiency
8.3	Deficient	Acute Deficiency

Thus, on 50% of the farms the treated animals improved over their controls whereas on 50% the response was negative.

NORTH EASTERN CAPE

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Aliwal North	98		1.025	3
Ugie		6	19.333	4

In the above area altogether 15 farms, comprising 817 sheep and 10 cattle, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
86.7	Sufficient	Adequate
13.3	Sufficient	Improvement Only
—	Marginally Deficient	Subacute Deficiency
—	Deficient	Acute Deficiency

Thus, on 13.3% of the farms the treated animals improved over their controls, whereas on 86.7% the response was negative.

EAST GRIQUALAND

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Franklin	100		1.560	6
Kokstad	27		2.003	6
Kokstad		5	28.333	18
Matatiele	97		1.365	6
New Amalfi	29		1.284	6
Umzimkulu		8	43.250	8

In the above area altogether 16 farms, comprising 665 sheep and 18 cattle, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
62.5	Sufficient	Adequate
25	Sufficient	Improvement Only
6.3	Marginally Deficient	Subacute Deficiency
6.2	Deficient	Acute Deficiency

Thus, on 37.5% of the farms the treated animals improved over their controls, whereas on 62.5% the response was negative.

NATAL

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Bergville	25		1.195	5
Estcourt		14	48.285	5
Richmond		17	43.527	13
Utrecht	34		9.531	12
Utrecht	29		1.519	3
Utrecht		10	10.400	3
Ladysmith		17	91.833	3

In the above area altogether 17 farms, comprising 634 sheep and 86 cattle, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
58.8	Sufficient	Adequate
17.7	Sufficient	Improvement Only
—	Marginally Deficient	Subacute Deficiency
23.5	Deficient	Acute Deficiency

Thus, on 41.2% of the farms the treated animals improved over their controls, whereas on 58.8% the response was negative.

KAROO

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Colesberg	40		1.775	6
Graaff Reinet	32		5.063	13
Hanover	40		1.725	6
Hanover	20		4.667	13
Middelburg	24		6.291	6
Murraysburg	38		1.842	7
Richmond	20		2.200	13
Richmond	33		1.862	7
Murraysburg	40		5.550	7

In the above area altogether 26 farms, comprising 908 sheep, were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
65.4	Sufficient	Adequate
19.2	Sufficient	Improvement only
3.9	Marginally Deficient	Subacute Deficiency
11.5	Deficient	Acute Deficiency

Thus, on 34.6% of the farms the treated animals improved over their controls, whereas on 65.4% the response was negative.

GRIQUALAND WEST

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Barkley West		4	23.000	8
Douglas	18		9.387	6
Koegas	38		1.050	16
Kuruman	17		2.944	14
Marydale	39		4.040	8
Prieska	19		4.000	16
Postmasburg	23		3.532	7

In the above area altogether 17 farms, comprising 770 sheep and 4 cattle were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
58.8	Sufficient	Adequate
11.8	Sufficient	Improvement only
23.5	Marginally Deficient	Subacute Deficiency
5.9	Deficient	Acute Deficiency

Thus, on 41.2% of the farms the treated animals improved over their controls, whereas on 58.8% the response was negative.

TRANSVAAL

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Delmas		6	52.334	7
Ermelo	37		2.551	6
Balfour		2	77.000	11
Holmdene		2	75.000	8
Heidelberg		4	35.500	18
Kempton Park		2	97.000	9
Johannesburg		10	61.300	16
Krugersdorp		2	127.000	7
Krugersdorp		5	55.000	16
Rustenburg		24	57.000	7
Volksrust	34		5.268	7
Volksrust	13		3.464	13
Volksrust		6	50.667	13
Vereeniging		6	60.334	7
Wakkerstroom	31		2.585	11
Wakkerstroom	10		5.180	13
Wakkerstroom		16	31.750	13
Bethal		2	36.000	3

In the above area altogether 25 farms, comprising 324 sheep and 97 cattle were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
28	Sufficient	Adequate
8	Sufficient	Improvement only
16	Marginally Deficient	Subacute Deficiency
48	Deficient	Acute Deficiency

Thus, on 72% of the farms the treated animals improved over their controls, whereas on 28% the response was negative.

Farm in District	No. of Sheep used	No. of Cattle used	A/B (lbs.)	Interval after Bullet Administration (months)
Omaruru		5	15.167	11
Abenab		18	15.000	11
Gobabis		54	27.495	9
Otavi		34	79.530	11

In the above area altogether 9 farms, comprising 69 sheep and 212 cattle were tested and show the following cobalt status:

% Farms	Cobalt Status of Soil	Cobalt Status of Animals
55.6	Sufficient	Adequate
22.2	Sufficient	Improvement only
11.1	Marginally Deficient	Subacute Deficiency
11.1	Deficient	Acute Deficiency

Thus, on 44.4% of the farms the treated animals improved over their controls, whereas on 55.6% the response was negative.

It is noteworthy from these tests that there is a definite relation between cobalt insufficiency and the types of grazing coupled with soil types on which the animals grazed.

It is generally accepted that shrubs with deep, penetrating roots can take up cobalt better from the subsoils than grasses can with their less penetrating roots. This is very well illustrated when comparing the Karoo area where, in general, on 65.4% of the farms under test the response to cobalt was completely negative as to 31.6% in the case of the Orange Free State. The Karoo is well known for its growth of Karoo bush, whereas the Orange Free State is well known for its grasslands, especially the central and south western areas.

It is also generally accepted that over centuries trace elements can become leached out, especially along certain mountain slopes. In these tests this finding is very well illustrated in the case of the mountainous areas of Southern Transvaal in districts like Volksrust and Wakkerstroom.

In the latter two districts the tests were carried out on farms in the mountains, the slopes of which carry predominantly sour grass. On the one farm, where the treated sheep show an improvement on an average of 5.268 lbs. per sheep over the untreated sheep, the cattle on this farm showed suspected clinical symptoms of cobalt deficiency in the form of emaciation and dull, staring, rough coats. These cattle were treated and 7 months afterwards they had improved beyond recognition. Similarly, on some of the other farms, especially along the Drakensberg range on the eastern side of the Orange Free State, there was clinical evidence of pining in the animals on veld showing outcrops of table mountain sandstone soil type usually associated with cobalt deficiency[7].

The grazing in the Griqualand West area is very mixed, partly grass and partly tall bushlands, consisting mostly of "rosyntjiebos". The soil types vary a great deal from very sandy loams to very rich limestone cover, which may be responsible for a fair percentage incidence of marginal deficiency of approximately 23%. There are also areas very rich in other minerals found at shallow levels such as manganese, asbestos and there are areas very rich in diamondiferous ground. It is significant that in such mineral-bearing grounds, the response to cobalt administration was negative, probably due to ancient volcanic upheavals when at the same time cobalt containing compounds could have been brought up to superficial levels. On the known Kimberley diamond mining areas, cobalt deficiency could not be established.

As in other parts of the world, where cobalt deficiency is associated with blown sea shell sands, the coastal belt of the southern Cape, known as "duineveld" and "strandveld", shows similar results, probably due partly to the "locking up" effect of the cobalt by the lime and partly due to leaching out of trace elements.

Summary of Cobalt Status in the Different Areas of the Union and S.W.A.

Areas Tested	No. of farms tested	No. of sheep tested	No. of cattle tested	% Adequate	% Improvement only	% Subacute Def.	% Acute Def.
Cape (Southern)	10	199	17	10	40	40	10
Orange Free State	38	1,124	6	31.6	36.8	23.7	7.9
Border	12	570	29	50	41.7	—	8.3
North Eastern Cape	15	817	10	86.7	13.3	—	—
East Griqualand	16	665	18	62.5	25	6.3	6.2
Natal	17	634	86	58.8	17.7	—	23.5
Karoo (North-Central)	26	908	—	65.4	19.2	3.9	11.5
Griqualand West	17	770	4	58.8	11.8	23.5	5.9
Transvaal (Central-South)	25	324	97	28	8	16	48
South West Africa	9	69	212	55.6	22.2	11.1	11.1
Total	185	6,080	478				
Average				49.2	23.2	13	14.6

Although, as stated earlier, there are marked variations in the incidence of cobalt insufficiencies in different areas, yet the above summary can serve, to some extent at least, to indicate the cobalt status in the most prominent areas within the Union, including Northern South West Africa. Thus, roughly speaking, there exists in the Union a degree of cobalt deficiency of approximately 27% but on approximately another 23% the animals derived some benefit, although no deficiency could be detected. In approximately 50% of the country under review there exists no cobalt deficiency at all, as could be ascertained by feeding tests.

Can cobalt bring about improvement in areas not necessarily deficient?

Under South African conditions, after very many tests have been carried out, the answer is in the affirmative. Apart from the fact that it is known that cobalt is necessary for the micro-organisms in the forestomachs to manufacture vitamin B_{12}, very little else is known about it in relation to other micro-organisms concerned with protein and carbohydrate digestion and fermentation, but such relations have been suggested by other workers. Whatever the phenomena connected with cobalt are, indications of its beneficial effect seem to be supported in these field tests.

In a large number of these trials the treated sheep had benefited over the untreated ones by less than 3 lbs. per sheep, so little that one can hardly ascribe it to a low grade type of sub-clinical deficiency, yet these animals maintained this benefit over their controls as proven by subsequent weighings for as long as eight months and longer. The same applies to cattle, where treated ones had benefited over controls by less than 20 lbs., and yet one could not make a justifiable diagnosis of a deficiency.

Adverse Effects of Cobalt

Toxic symptoms from the use of cobalt in anything approaching the usual therapeutic doses are never likely to be seen. Experiments have been conducted to determine toxic levels of cobalt salts and these have been shown to be far in excess of any dose rates likely to be employed therapeutically.

One-year-old wethers can tolerate up to 160 mg. of cobalt chloride per 100 lb. daily for at least eight weeks without harmful effects[9]. Dairy calves 6 to 10 weeks old tolerated up to 50 mg. of cobalt per 100 lbs. of body weight daily without harmful effects in the course of experiments continued for many weeks[10].

In not one of the trials in South Africa did the author come across any adverse effects by the bullet and there are very many thousands of animals which have been carrying these bullets for over two years in South Africa and for many years longer in other countries. Furthermore, many thousands of sheep and large numbers of cattle have been dosed by farmers themselves, and up till the present no justifiable complaint has been received for investigation. There are experimental sheep carrying half a dozen bullets each for many months without any untoward effects whatsoever. The author has carried out post mortem examinations on large numbers of animals at abattoirs when treated animals had been sent for slaughter, and after meticulous search the bullets had been recovered without the slightest sign of irritation in any part of the forestomachs. Fluoroscopic observation on the bullet whilst it is in a live animal indicates what little chance there is for the bullet to cause irritation. With the regular contractions of the forestomachs the bullet can be seen floating around in the food mass and rarely does it remain static in one spot. Furthermore, the lining membrane of the forestomachs consists of stratified epithelium; it is not lined by a sensitive mucous membrane like that of the abomasum, into which the bullet never enters.

Cobalt and Phalaris Staggers

When the young or actively growing stages of the grass *Phalaris tuberosa* constitute a relatively high proportion of the diet, it may give rise to a condition in sheep and cattle characterized by hyperexcitability, inco-ordination, muscle tremors, bobbing of the head, increased respiratory and heart rate, especially when the animals are driven or disturbed. The symptoms usually occur after more than two weeks' exposure to Phalaris, but sometimes after less[11]. Affected animals fall rapidly and have considerable difficulty in rising. Once the symptoms are well advanced, the condition is usually fatal. Occasionally, in long-standing cases, the muscle tremors and head movement may diminish and disappear. Histologically there is demyelination of the spinal cord and medulla oblongata and haemosiderosis of the kidney[12 13]. It has now been shown that the disease can be prevented by regular dosing with cobalt[14].

Two hypotheses[15] have been advanced to explain the protection by orally administered cobalt:

1. The increased cobalt concentration in the rumen favours the proliferation of micro-organisms which destroy the neurotoxic principle of phalaris.

2. The neurotoxic principle accumulates in sufficient concentration to induce the demyelination under sub-optimal conditions of cobalt intake, and hence in the presence of sub-optimal amounts of vitamin B_{12}. The provision of additional cobalt above the normal requirements ensures adequate vitamin B_{12} to meet the metabolic requirements and to detoxicate the neurotoxic substances.

The toxicity of phalaris probably varies according to its stage of growth and the terrain on which it grows. In certain areas the toxic principle responsible for the stagger syndrome is present in the leaves for almost the whole of the growing period. The symptoms are most likely when phalaris dominates the pasture and especially after the first seasonal rains, when the young shoots provide the only green available[16]. However, in many areas the grass provides a most valuable fodder and it is usually considered worth the risk of exposing sheep to the malady.

To date cobalt bullets are used regularly to prevent the disease in Australia.

In South Africa, although *Phalaris tuberosa* is cultivated and also causes staggers which can be prevented by the cobalt bullets, there is another more popular species of cross-bred phalaris grass known as Ronpha, which also causes staggers similar to that already described. Here again the cobalt bullet can prevent the onset of the symptoms.

Recently the author experienced an outbreak of staggers in cattle in a particular area in the Cape where cobalt deficiency is known to occur. About two years previously, the owner suffered severe losses from staggers in his sheep, and although at that time the disease was not diagnosed, he had dosed his flock of sheep with cobalt bullets because of being in a

deficient area. From time to time he retrieved bullets from slaughtered animals in this flock. Out of a total of 125 sheep slaughtered, the owner recovered 123 bullets, of which one was completely coated and half of the other was slightly coated. At the time when practically all his cattle, which had never been treated, developed staggers on his farm, only five sheep out of his whole flock revealed symptoms of staggers. Three of these showed staggers only in a mild degree, which improved on redosing, whereas the other two showed more severe symptoms. These sheep might have lost their bullets, or coating might have played a rôle in loss of efficiency. Of great significance in this case is that, where the animals grazed, the area was well covered with canary grass (*Phalaris minor*) and no doubt this was the cause of the staggers. The symptoms displayed by the cattle resemble those of Phalaris staggers in sheep.

The effect on wool

On a farm "X" in the South Western Districts of the Cape known to be cobalt deficient, two selected groups of merino sheep, each consisting of adult hamels and ewes, were chosen because they had been kept on this farm under identical conditions for some considerable time. The sheep were identified and wool samples taken from the same places behind the shoulders of each sheep. One group consisting of hamels and ewes was then dosed with cobalt bullets. The other group also consisting of hamels and ewes served as control.

Two months later all the ewes only, in both treated and control groups, were moved for mating purposes to an adjoining farm "Y". This movement was done because the owner knew that on the farm "Y" ewes, when served, will become pregnant, carry and nurse their lambs, whereas the original farm "X" was considered useless for lambing ewes. (At the time the author was not aware of this movement but only after 14 months he confirmed the owner's finding with feeding tests on farm "X" that it was cobalt deficient and farm "Y" was not cobalt deficient).

Shortly after sampling, all the animals were shorn and new fleeces were allowed to grow. When the latter growths were approximately the same length again, wool samples were again taken from the same places, that is, approximately 9 months after the experiment started.

In other words, in the case of all the hamels both lots of samples were taken from fleeces grown on the deficient farm "X", whereas in the case of the ewes only the first lot of samples was taken from fleeces grown on the deficient farm "X", but the second lot of samples was taken from fleeces grown on the non-deficient farm "Y".

A large number of these samples was then subjected to laboratory tests, viz. for fibre diameter determination, crimps per inch and for deficiency. The theoretical number of crimps per inch were calculated for varying fibre diameters according to the Duerdian scale[17]. In connection with the deficiency, the designation of the cause of steeliness rested upon a colour test with ninhydrin and to date its application has been

found satisfactory to differentiate between copper and cobalt deficiency. This test, which is based on the work of Kritzinger[18] on "weathering of wool", resulted from the finding that when normal wool is treated with ninhydrin, a blue colouration results; when wool from supposedly copper deficient animals is treated with ninhydrin, a fleeting glimpse of an initial orange-red colouration is observed, such red colour rapidly being masked by the formation of a blue colour; and that wool from supposedly cobalt deficient animals treated with ninhydrin, behaves in the same manner as normal wool, i.e. develops a blue colour[19]. In the absence of proven standards, this test is not a quantitive but more of a presumptive one.

The term "steely wool", as used in this study, means the loss of normal crimp from the wool fibre. In Afrikaans it is described as "wilde wol", meaning "wild wool", that is, the wool has lost its usual characteristic growth pattern with crimp formation and grows in a haphazard manner, having lost its normal and natural crimp, or the normal crimps have become replaced by very shallow waves, varying from only a few per inch to complete absence. In the case of copper deficiency, this straight wool assumes a lustre, the shine of which is characteristic and resembles that of light reflected from a steel object. In the case of cobalt deficiency the wool fibre also looses its normal crimp, the fleece becomes "fluffy" and the wool staples part easily and fall open. Often the fleece becomes tender and appears dull and lifeless[20].

In the treated group, sample B.T. denotes "before treatment" and refers to the sample taken on 2.9.58, and sample A.T. "after treatment" taken on 25.6.59. In the control group sample 1 refers to the sample taken on 2.9.58 and sample 2 to that taken on 25.6.59. It will be seen that both cobalt and copper deficiencies were encountered.

Hamels all the time on deficient pastures on Farm 'X'.

		Copper Deficient	Cobalt Deficient	% Correction
Treated Group	B.T.	6	6	75
(No. of Hamels used 12)	A.T.	2	1	
Control Group	1	4	2	
(No. of Hamels used 6)	2	4	1	17

Ewes first on Deficient Pasture on Farm 'X' and afterwards on Non-Deficient Pasture on Farm 'Y'.

		Copper Deficient	Cobalt Deficient	% Correction
Treated Group	B.T.*	8	1	
(No. of ewes used 9)	A.T.†	—	—	100
Control Group	1*	6	2	
(No. of ewes used 8)	2†	1	1	75

* Farm 'X'
† Farm 'Y'

The comparative situation is best seen in the above tables. Treatment of hamels continuously present on deficient pasture brought about a 75% correction whereas in the untreated controls there was only a 17% spontaneous correction. On the other hand, treatment of the ewes plus feeding on non-deficient pasture brought about a 100% correction, whereas in the untreated controls, feeding on non-deficient pasture only, there was a spontaneous correction of 75%; a difference of 25% in favour of the cobalt treatment.

Hamels Only: In Both Groups on Farm 'X'

	No. of Sheep	Average Fibre Diameter (Microns)		Average Theoretical Crimps/ Inch		Average Measured Crimps/ Inch	
		2.9.58	25.6.59	2.9.58	25.6.59	2.9.58	25.6.59
Corrected Fleeces.....	10	22.480	21.130	10.200	11.900	Steely	13.000
Non-Corrected Fleeces.....	8	21.637	21.950	11.000	10.250	Steely	Steely

There is an accepted standard of correlation between fibre diameter and theoretical crimps per inch[17], that is, the finer the fibre the more crimps per inch. The following can be seen from the above table when comparing the corrected wools of the hamels (in both groups) to the non-corrected wools of the hamels (in both groups).

(*a*) On an average in the corrected sheep the fibre diameter decreased by nearly 1.5 μ and the theoretical crimps increased by nearly 2 crimps per inch (statistically significant), whereas in the non-corrected sheep there was no change.

(*b*) In the same corrected sheep the measured crimps per inch, the fibre improved from "steeliness" (lack of crimp formation) to 13 crimps per inch or 66's, that is, under standard classification rules from XM (Cross Merino) to good Medium. In the non-corrected sheep the wool remained "steely".

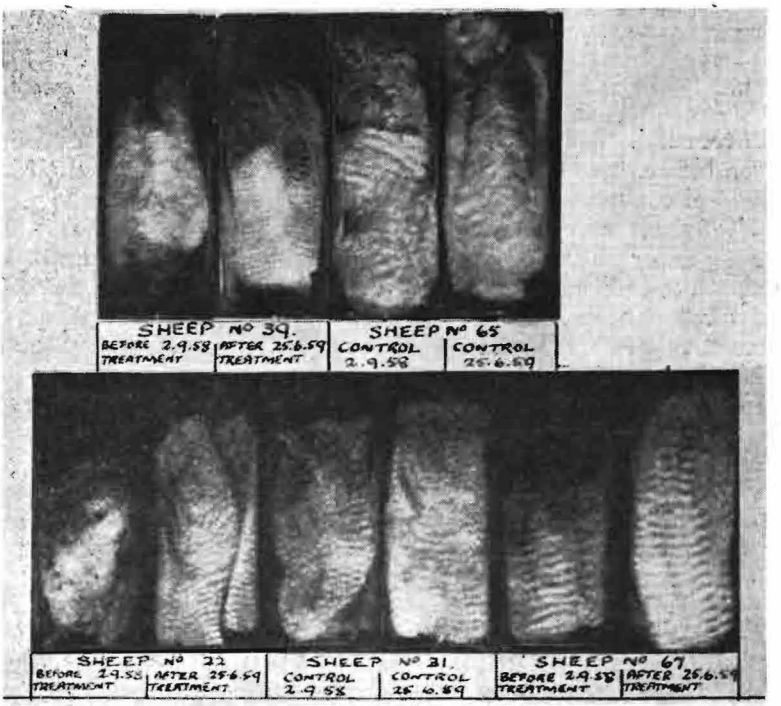
When a wool fibre varies in diameter, it is called untrue, which is caused by "atrophy"[21]. At certain points along the course of the fibre, there is a sudden contraction which is frequently sufficient to give the edge of the fibre a "notched" appearance, while in other cases there is a more gradual contraction as illustrated by the photographs hereunder.

Poor feeding and sickness are blamed for diameter variation or atrophy. Needless to say, trace element deficiencies of the types of copper and cobalt can contribute their share in this phenomenon. Unfortunately, no wool samples with a guaranteed 100% cobalt deficiency or copper deficiency are available in order to standardise the ninhydrin test and hence, in the absence of a reliable test, one must accept the possibility of a deficiency of these two elements playing a rôle in the causation of this lack of uniformity. It is even possible that in the absence of say, copper or vitamin B_{12}, the enzymes and precursors of proteins can be so affected

that the cell formation in structures of epidermal origin, including skin, wool, hair, hoofs, horn, etc., can still take place, but in a disorderly and continuous, haphazard manner like neoplastic growth, leading to thickening (hypertrophy as opposed to atrophy) of the wool fibres with actual increased weight of the fibre and perhaps of the other skin appendages.

It is well-known that the permanently rough, dull, staring coat of cobalt deficient cattle immediately responds to cobalt supplementation, the treated animals losing the rough coat and developing smooth, shining

coats full of lustre. In both cattle and sheep under treatment the author has witnessed this remarkable change, yet when the weights were compared with the controls, the differences were sometimes insignificant; sometimes the controls even showed a slight increase over the treated animals. Judging from the clinical improvement of the live animals and subsequent carcase gradings, there is not the slightest doubt about the beneficial effect of the cobalt supplementation, yet the question arises what contributed to the extra weight on the part of the controls however small. Is it possible that in such cases the absence of cobalt or copper could have lead to unabated abnormal cellular deposits of horny tissues, including hair and wool fibres[7]. The causes of these phenomena concerning copper and cobalt in animal nutrition need further investigations and researches into these aspects are justified.



The cause of straight or stringy wool (in South Africa termed "wild wool" or "steely wool") in copper deficiency has been fully discussed by Marston[22]; copper catalyses the formation of keratin, and this function is one of the first to be affected when copper supplies are short, which may account for the occurrence of affected wool among sheep which show no other sign of deficiency. Wool from copper deficient sheep in South Africa contained more sulphydril groups than normal wool, and its weak fibres were attributed to reduced formation of cystine linkages[23].

From the above photographs, which were taken before the wool samples were subjected to laboratory tests, the following can be clearly observed.

In sheep numbers 39 and 22, the wool samples were cobalt deficient before treatment and one can see the straight fibres as compared to the sample after treatment. This is confirmed by the analytical results, showing that there was a cobalt deficiency in both and that the fibre improved from steely to 18 measured crimps per inch, which falls in the category of fine wools of over 70's.

In sheep number 67, the wool sample was copper deficient before treatment, which is confirmed by the analytical result which showed that there was a copper deficiency and that the fibre improved from steely to 11 measured crimps per inch, thus falling in the category of a strong wool of 60's.

On the other hand, in the control group, sheep number 65, the steely wool in both samples, i.e. in the first and second growth, the sample shows greater deterioration, which is confirmed by the analytical result and which proves it to be cobalt deficient. The same applies to sheep number 31 which had a copper deficient wool.

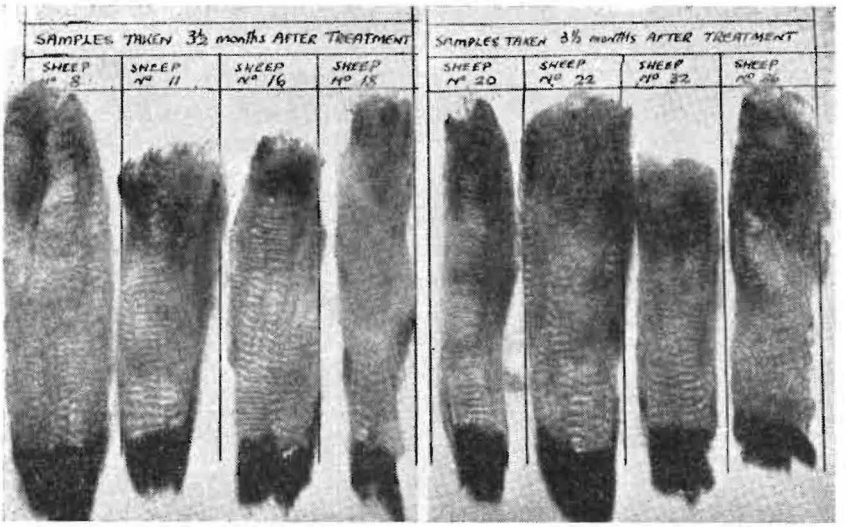
From these findings, what is of paramount importance and never proven before, is the fact that when cobalt is furnished by a controlled method of continuous liberation in the rumeno-reticular sac of sheep, it apparently not only corrects cobalt deficiency in the wool, but also advantageously affects copper utilisation. The interrelationships of one trace element and another, and of trace elements with macro-elements (and other nutrients) are still obscure and their complex interactions (stimulation and antagonism) as already shown for plants, may be the explanation, especially for the one already postulated, that cobalt increases the efficiency with which copper is utilised.

In another experiment a test was initiated on 20.5.59 on a farm near the Saldanha Coast, suspected to be cobalt deficient. The sheep were all merinos. In the past, symptoms of acute deficiency were not outstanding but a general description of the wool becoming "fluffy" and tending to fall open, resulting in a low yield, was the common complaint.

Thirty sheep with approximately 8 months' wool growth were selected, identified and weighed. Half was then dosed with the cobalt bullet. The following table shows the results:

	No. of Sheep	Ave. (lbs.) Wts. 20.5.59	Ave. (lbs.) Wts. 8.9.59	Ave. (lbs.) Gain per Sheep	A/B (lbs.)
Treated.....	15	70.000	79.600	9.600	+3.266
Controls.....	15	73.066	79.400	6.334	

It will be seen that on 8.9.59, i.e. after about $3\frac{1}{2}$ months, the treated group gained on an average of 3.266 lbs. per sheep over the controls, which, at this stage, is proof of cobalt deficiency of a marginal degree.



The above photographs are from samples of wool staples from the treated sheep in the above experiment. In the latter part of the growth nearest to the skin, corresponding to the length of time of retention of the bullet, a distinct improvement in substance due to a better crimp formation can be observed. The upper part, or earlier growth of the wool staple during which time there was an insufficiency of, presumably, cobalt, the substance is very poor, showing lack of definition and in some of them the wool fibres are distinctly steely and completely devoid of crimp formation.

In the majority of cases, especially that of sheep number 18, if the staple is held in an upright position between the tips of the fingers, the latter part of the growth retains its strength, whereas the upper part collapses completely and topples over because of lack of substance. In practice, this lack of support is the main concern of the wool producers in this area, because apart from the inferior quality due to lack of crimp, the wool on the sheep falls open, allowing free access to dust and other foreign matter. Other than this, merino sheep do very well in this area, especially with the recent pasture improvement practices advocated by the Department of Agriculture.

It has been shown in experiments with sheep[24] that the addition of cobalt in the diet can increase the wool production by 8% over untreated controls. The ideal method to establish wool gains from treated sheep over controls, would be to initiate an experiment at the time of shearing. Each animal is first weighed before shearing, then shorn and again weighed after shearing, thus establishing the actual wool yield and live weight separately. When the sheep is shorn again, usually 12 months later, the operation is repeated. In this way the true wool yields and live weight gains can be established and compared to the controls.

The following experiment was carried out in the Orange Free State and serves as an example:—

Table showing A/B in respect of wool and live weights in lbs.

	No. of Sheep Used	Wts. B.S.* 8.1.60	Wts. A.S.† 8.1.60	Wt. of Wool	Wts. B.S.* 2.12.60	Wts. A.S.† 2.12.60	Wt. of Wool	Increase Wool Wt. After 11 Months
Treated.....	44	3,812	3,415	397	3,844.5	3,389	455.5	58.5
Hamels A.....		Ave 86.636	Ave 77.613	Ave 9.023	Ave 87.375	Ave 77.022	Ave 10.352	Ave 1.329
Control.....	43	3,710	3,291.5	418.5	3,714.5	3,271.5	443	24.5
Hamels B.....		Ave 86.279	Ave 76.546	Ave 9.732	Ave 86.383	Ave 76.081	Ave 10.302	Ave 0.569

*B.S.: Before Shearing Overall i.e. Live Wt. + Wool A/B: +0.635 lbs.
†A.S.: After Shearing Live Wt. A/B: −0.126 lbs.
Wool A/B: +0.761 lbs.

As the total weight increase of treated sheep over controls over a period of 11 months was only 0.635 lbs. per sheep, this farm was listed as completely negative when tested, yet the treated sheep benefited by an extra $\frac{3}{4}$ lbs. wool per sheep, a most significent factor, especially when there was also an improvement of quality as compared to the controls. This improvement was confirmed by the owner as, during classification of these two groups, more "culls" were found amongst the controls.

In the following cases, the first weights were not taken at shearing time, nor thereafter again before and after shearing, yet the results are illuminating.

On a farm in the Orange Free State, the sheep were treated on 2.4.59 and shorn in October, 1959, which means that the wool only had the benefit of cobalt for 6 months. Thirty-seven sheep were used for this test.

Overall i.e. Live weight + wool	A/B: + 0.838 lbs.
Live wt.	A/B: + 0.365 lbs.
Wool	A/B: + 0.473 lbs.

The following farm in the South Western Districts of the Cape, the sheep were treated on 16.3.60 and shorn in August, 1960, which means that the wool only had the benefit of cobalt for 5 months. In this test 55 sheep were used.

Overall i.e. Live weight + wool	A/B: + 2.499 lbs.
Live wt.	A/B: + 2.357 lbs.
Wool	A/B: + 0.142 lbs.

The following farm in Natal, the sheep were treated on 20.11.59 and shorn in November, 1960, which means that the wool had the cobalt benefit for full 12 months. Thirty-four sheep were used in this test.

Overall i.e. Live wt. + wool	A/B: + 9.471 lbs.
Live wt.	A/B: + 6.647 lbs.
Wool	A/B: + 2.824 lbs.

From the above field trials the beneficial effect of a continuous supply of cobalt on both quality and quantity is apparent.

If a certain percentage of bullets had not been lost and a certain percentage had not become coated, the beneficial effects would have been still more conclusive. A later improved formulation of the cobalt bullet of heavier weight, in which iron instead of porcelain is used with the cobalt for better retention, and dosing the animal simultaneously with a specially made steel grinder grub screw to prevent coating, will lead to even more beneficial effects.

Summary and Conclusions

In accordance with weight gains and symptomatology, certain standards for the establishment of cobalt deficiency can be applied.

According to these standards, it is reasonable to conclude that in South Africa, after extensive controlled field tests on the cobalt bullet, out of 185 farms tested involving 6,080 sheep and 479 cattle, there was no deficiency on approximately 50%, whilst on approximately 50% cobalt supplementation could benefit ruminant nutrition. The incidence of deficiency is shown to depend on different pasture and soil types.

The cobalt bullet is of invaluable aid for the prevention of phalaris staggers caused by various species of phalaris grasses.

The presence of the cobalt bullet in the forestomachs of sheep and cattle for periods upwards of 1 to 2 years in thousands of animals, has disclosed no adverse effects of any nature whatsoever.

Cobalt administration in the form of the heavy bullet intended to remain in the rumeno-reticular sac for a long period so as to allow for a regulated, continuous liberation of the element, not only corrects cobalt deficiency in the system, but also eliminates the symptoms of cobalt, and in many instances also copper, deficiency in the wool itself.

It is suggested that insufficiencies of cobalt and copper can cause atrophy of the wool fibre leading to the so-called "notching" of the fibre, tending to bring about the lack of uniformity in fibre diameter and hence the disturbance of correlation between fibre diameter and measured crimps per inch. On the other hand, it is also possible that through the lack of copper and cobalt, there may be disturbed keratinisation and epidermal cell formation leading to unabated, irregular deposition of such cells, not unlike neoplastic growth, and so causing thickening of the wool fibre with increased weight. This may even apply to other epidermal structures.

In one particular controlled experiment with adult hamels continuously on a deficient farm, 75% of cobalt and copper deficient wools was corrected with treatment as against only 17% spontaneous correction

in the controls. In the case of ewes with deficiency, but then moved to a non-deficient farm, the treated ewes showed a 100% correction as against a 75% spontaneous correction. These findings seem to support the reliability of the ninhydrin test.

Findings in these tests also prove that correction by cobalt treatment of the lack of crimp formation in merino wool restores substance, leading to closer packing of the staples, thus eliminating the entry of foreign material and bringing about better scoured wool weights.

In 4 field experiments with a total of 213 sheep used, greased wool yields showed significant improvements even in cases where live weight gains could not support a diagnosis of cobalt deficiency.

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RESPIRATORY DISEASES OF FOWLS

*L. Abrams

INTRODUCTION

In the past all the respiratory diseases of fowls were referred to as roup—a vague, unspecific term. Actually there are a number of separate and distinct infectious diseases which affect the respiratory system of fowls, viz. infectious bronchitis (I.B.); infectious laryngotracheitis (I.L.T.); three forms of Newcastle disease (N.C.D.): the velogenic, mesogenic and lentogenic forms; chronic respiratory disease (C.R.D.); and infectious coryza (I.C.). Avitaminosis A can sometimes cause lesions of the respiratory tract but is as rare in its occurrence as aspergillosis, or brooder house pneumonia. Although psittacosis is known to occur in South Africa, its significance in the poultry industry has not yet been assessed. A constant vigilance will have to be maintained to determine the rôle played by this disease in the respiratory complex of poultry.

Some of these diseases occur with atypical manifestations. The classical description of infectious bronchitis, for instance, differs vastly from the form encountered in South Africa, where infectious bronchitis at present is a serious disease in the broiler industry.

The diseases are found singly or in combination with others, e.g., infectious bronchitis has been encountered on its own and has also been found in conjunction with chronic respiratory disease, which in turn has been found uncomplicated by any other disease.

The intensification of the broiler industry, complicated by bad housing and ventilation, and the incorrect use of deep litter with resultant ammonia irritation, especially of the eyes, has undoubtedly brought many of these diseases to the fore. In some instances vaccination with fowl pox vaccine has also helped to stimulate latent respiratory diseases. This problem has largely been overcome by the manufacture of a pox vaccine made from a pigeon strain, which produces a milder reaction, and provides an adequate immunity for use in the broiler industry.

It is sometimes extremely difficult to arrive at a diagnosis of these respiratory diseases, especially in adult birds, but usually a tentative diagnosis can be made on the history, symptomatology and post mortem lesions which are observed in affected chickens. A definite diagnosis can only be made by means of virus or bacterial isolation, or serological tests, for which purpose the correct specimens should be collected.

A separate description of each disease as it occurs, or has occurred, in South Africa will be given as a guide to the profession.

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Infectious Bronchitis

Infectious bronchitis is a highly infectious disease of poultry caused by a virus and has an incubation period of 24 to 96 hours. The disease spreads very rapidly and has a very high morbidity. Unlike the high mortality caused by virulent strains, the strain of virus encountered in South Africa causes a variable, low mortality in chicks and negligible losses in adult birds.

The effects of infectious bronchitis are mainly encountered in broiler plants where there is a continuous weekly or bi-weekly introduction of susceptible chickens. These new introductions help to perpetuate the disease in the flock. Chickens hatched from parent stock, immune to the disease following an infection or vaccination, have a passive immunity lasting ten to fourteen days, after which they become fully susceptible.

In poultry establishments where breeding occurs for short periods during the year, the disease often escapes detection and is not perpetuated, because the infection is not egg-transmitted and there are no carriers of the disease. In such cases re-introduction of the infection is necessary to initiate another outbreak of the disease in susceptible birds.

In broilers the disease is complicated by the invasion of the serous membranes of the air sacs, the pericardium, the liver and the bronchi by bacteria, mainly *E. coli*, and other Gram negative bacteria. This resembles the condition described in the literature as coli septicaemia.

In addition to the death of birds, the main effect of this disease is the inconsistent or unprofitable weight gains shown by many young birds with resultant economic loss. The main economic effect of the disease in adult birds is a dramatic drop in egg production when the disease is introduced into a susceptible flock.

Transmission

The rate of transmission is extremely rapid. Infectious bronchitis is transmitted by infected droplets and by secretions and excreta. It is not unlikely that the condition is air-borne from one farm to another, as it has been found that several farms in close proximity to each other have become infected in a short space of time. There is a possibility that the virus is excreted with the faeces and can thus be transmitted mechanically on the clothing and footwear of workers. The virus could conceivably be spread as an aerosol from closed environment houses with extraction fans, and thus infect other houses on the premises.

Infectious bronchitis is not egg-transmitted and there are no carriers after recovery from infection.

Symptoms

Broilers: In chickens with a passive immunity the symptoms will be seen from fourteen days onwards, but in chickens without passive immunity they may appear at any time after hatching. In South Africa

the disease is characterized by mild respiratory symptoms, such as gaping and moist râles. A wheezing, gurgling noise is heard, especially at night or in the early morning when the birds are at rest; very rarely a slight nasal discharge may be encountered, since bronchitis is mainly a disease of the lower respiratory tract. Older chickens may show an irregular pattern of growth in addition to the respiratory symptoms, which are often not detected, unless the chickens are observed carefully. The owner usually complains of poor growth amongst his birds from five to six weeks of age onwards. At this stage the chickens develop a chronic diarrhoea, which gives the birds the appearance of those suffering from coccidiosis. A number of birds have vent gleet and the bedding or dropping boards in batteries are wet. A small percentage of birds shows twisted heads due to a bacterial infection of the cranial air spaces via the Eustachian tube. The heads are bent downwards and backwards and sometimes sideways.

In *adult birds* the combs become cyanotic; an odd bird may show respiratory symptoms such as wheezing, which is heard mainly at night. The main effect of the disease is the precipitous drop in egg production. On recovery, mis-shapen or malformed eggs, as described in the literature, have not been observed as yet.

The usual course of the disease in adults is one to two weeks, depending on the size of the plant and the degree of isolation of various houses or batteries within the plant.

Hens may undergo a partial or complete moult, depending on the time of the year the disease appears. If the disease occurs during the flush laying period, a partial neck moult can be expected, with production returning to normal within four to six weeks. If, on the other hand, the disease occurs during the immediate pre-moulting season, the return to normal egg production will be delayed until the birds have undergone a complete moult. Pullets may be delayed in coming into egg production.

Post Mortem Lesions

Chicks: In very early cases only a mild tracheitis and a few petechial haemorrhages in the trachea may be observed, but generally the autopsy findings are negative.

In the more advanced cases the birds are emaciated and caseous plugs may be found in the bronchii. The most striking lesion is a thickening of the serous membranes of the air sacs; in some of the advanced cases they are filled with caseated pus. The thoracic and abdominal air sacs are chiefly affected. A pericarditis and myocarditis, pleuritis and perihepatitis are present as a rule. Splenitis, pneumonia and peritonitis may sometimes be seen. The absence of rhinitis and sinusitis is a characteristic of this condition. In small percentages of birds pus will be found in the spongy bone of the skull. A sub-acute enteritis is observed in the more seriously affected birds.

In *adult birds* the post mortem findings are usually negative. Sometimes birds suffering from the acute form of the disease may show a tracheitis. Aerocystitis is also encountered occasionally.

Diagnosis

In *adult birds* a tentative diagnosis of infectious bronchitis can be made from the history. A dramatic fall in egg production, associated with blue combs, the absence of any definite symptoms and negligible mortality, are indications of infection with this disease. In broilers, a history of poor growth and poor weight gains, the respiratory symptoms and the typical post mortem will strengthen one's suspicion of infectious bronchitis.

Suspected infectious bronchitis should be confirmed by isolation of the virus or by means of the serum-virus neutralization test. Tracheas from early cases can be submitted in 50% glycerine for virus isolation.

For the serological tests acute and convalescent phase sera are required. About 8–10 ml. of blood should be collected from a few fowls during the early phase of the outbreak and again fourteen to twenty one days later. In the case of broilers it is not always possible to obtain acute phase serum. In such instances blood should be collected from the oldest broilers on the farm. Serum should be decanted into sterile bottles and 200 units of penicillin and 200 micrograms of streptomycin per ml. should be added to control bacterial contamination.

Control

As this disease is not egg-transmitted, the rearing of chickens in complete isolation is a practical approach. The isolation of the chickens from other infected chickens must be rigorously enforced. If this is not done, any attempt to eradicate infectious bronchitis by these means is doomed to failure. All houses, which previously contained infected chickens, should be fumigated or washed with 2% formalin and be kept free of chickens for a minimum period of a month. The weekly intake of chicks must be curtailed for four to six weeks if separate premises cannot be provided. This naturally affects the continued marketing of broilers, but by curtailing the intake of susceptible chickens and eliminating infection by thorough disinfection of all the premises, the cycle of transmission of the virus is broken.

Commercial vaccines against infectious bronchitis are used in some countries but such vaccines are not yet available in South Africa.

Treatment

There is no treatment for infectious bronchitis. However, the secondary bacterial infection may be controlled with Furazolidone (.011%) in the mash. Furazolidone will only be of value if administered to chicks from the time they are one day old until they are seven weeks of age, when the birds will have recovered from the effects of the initial infectious bronchitis infection. Furazolidone is of no value in cases where the secondary infection is advanced.

INFECTIOUS LARYNGOTRACHEITIS (I.L.T.)

This is an infectious disease of fowls caused by a virus with an incubation period of five to ten days. The disease does not spread as rapidly as infectious bronchitis or Newcastle disease and this accounts for the less precipitous drop in egg production encountered with outbreaks of infectious laryngotracheitis.

The distribution of infectious laryngotracheitis in South Africa still has to be assessed; so far it has been found on a limited scale as an entity on its own.

The disease is transmitted by contact with infected droplets and secretions.

The natural route of infection is via the respiratory tract. Although the disease is not transmitted through the egg, recovered birds may remain carriers of the virus and this perpetuates the disease in a flock whenever susceptible birds are introduced.

SYMPTOMS

The most outstanding symptoms of infectious laryngotracheitis as observed in South Africa, are cyanosis of the comb, gasping, with the neck characteristically extended, moist râles, sneezing, coughing, wheezing and shaking of the head. Lachrymation and rhinitis are also sometimes encountered. Occasionally blood stained mucus is expelled during coughing. In some cases a collection of caseous material in the larynx causes the bird to die of asphyxiation. A drop in egg production occurs, which returns to normal within five to ten weeks, depending on the time of the year that the birds become infected.

A mild form of the disease can occur without any marked respiratory symptoms. Even in the mild form, there is a considerable drop in egg production. In broilers, the disease produces symptoms not unlike those of infectious bronchitis, with secondary bacterial infection as the main cause of debility. Mortality can be high in a virulent outbreak, but, in the type so far encountered in South Africa, there has been a very low mortality in adult birds.

POST MORTEM LESIONS

Recently infected birds show a haemorrhagic laryngo-tracheitis. The lumen of the trachea contains a bloody mucus or, in more advanced cases, a yellow, caseous exudate with little or no blood. No other lesions are encountered as a rule.

DIAGNOSIS

The history, the symptoms and post mortem lesions are taken into account. The haemorrhagic laryngo-tracheitis is an important factor in making a diagnosis of infectious laryngo-tracheitis. The diagnosis is confirmed by virus isolation and serum-virus neutralization tests. Tracheas

can be examined histologically for intra-nuclear inclusion bodies in the epithelial cells; only tracheas from birds in the early stage of the disease are suitable for histopathological examination, as desquamation of the epithelium takes place in older cases.

Treatment

There is no treatment for infectious laryngotracheitis.

Control

Day old chickens should be raised in complete isolation as outlined in infectious bronchitis. If an outbreak of the disease occurs, it is essential that recovered fowls should be slaughtered to eliminate carriers of the virus before the new hens, which have been raised in isolation, are introduced. Houses or batteries, where infection has taken place, should be thoroughly cleaned and disinfected and should be left vacant for not less than a month. In countries where the disease occurs on wide scale birds are vaccinated. The vaccine is applied to the cloaca.

Newcastle Disease

There are three types of Newcastle disease: the velogenic form (virulent form), the mesogenic form (a less virulent form) and the lentogenic form (a mild form). The velogenic form is associated with a high mortality, whereas the lentogenic form is associated with high morbidity and low mortality.

The various types of Newcastle disease are caused by strains of virus which differ in virulence but are immunologically identical. The natural routes of infection are via the respiratory and alimentary tracts. The disease can be transmitted either by exudates and excreta of infected birds or it can be air-borne. Various wild birds can also act as carriers of the disease. Traffic in infected, live birds spreads the disease. Newcastle disease is not transmitted through the egg, but there is the possibility of an incubator infection.

Symptoms

Velogenic form: The disease appears suddenly and spreads with alarming rapidity. The disease is characterized by respiratory symptoms such as gaping, sneezing, coughing and a high-pitched, distressed cry. The combs are cyanotic. There is a tremendous drop in egg production, with the production of soft-shelled eggs. A green diarrhoea, nervous symptoms and lameness are encountered. Affected fowls usually die within a few days and the mortality is usually over 90%. The disease runs its course in about ten days, depending on the degree of isolation within the flock.

In *the mesogenic form* the mortality rate is lower and varies from twenty to fifty per cent. It is characterized by respiratory symptoms and a drop in egg production. Nervous symptoms are rarely seen.

The *lentogenic form* is characterized by a sudden drop in egg production, cyanotic combs and mild respiratory symptoms in a few birds. Some of the fowls have a slight nasal discharge and make wheezing noises, especially when listened to at night. The mortality in adult fowls is negligible and the symptoms are often so mild as to escape detection.

In chickens the most common symptoms are gaping, gasping and coughing. The chicks are listless, huddle together and make peculiar chirping sounds. The mortality in very young chicks may be high in all three forms of the disease.

Nervous symptoms are found in the velogenic form but are absent in the lentogenic form. In the lentogenic form recovered birds are debilitated, as it follows the same course as is found in infectious bronchitis. Some birds exhibit an opacity of the eye.

Post Mortem Lesions

Velogenic form: Haemorrhages in the proventriculus and a tracheitis are constant lesions.

Mesogenic form: Haemorrhages occur in the proventriculus, varying with the virulence of the strain involved.

Lentogenic form: In this form there are no haemorrhages in the proventriculus, but a tracheitis is found in the very early cases and in chickens. If secondary bacterial infection has occurred in chickens, the post mortem may appear very similar to that of infectious bronchitis.

Diagnosis

In the velogenic and mesogenic forms of the disease, the typical symptoms, post mortem changes and high mortality are sufficient to justify a tentative diagnosis of Newcastle disease. However, diagnosis of the lentogenic form is sometimes difficult and any suspicion of Newcastle disease should be confirmed by virus isolation and haemogglutination-inhibition or serum-virus neutralization tests. Specimens should be collected as for infectious bronchitis.

Control

Newcastle disease is a scheduled disease in South Africa. In an outbreak of the velogenic type, the whole infected flock should be slaughtered out and birds in the immediate vicinity vaccinated. The other forms are controlled by the raising of chickens in isolation as described for infectious bronchitis.

Chronic Respiratory Disease

Although the disease has been eliminated in many large breeding, commercial egg and broiler plants, it is still unfortunately very prevalent in South Africa. It is to be regretted that there are still many poultry men who have made little or no effort to eradicate the disease, despite the success that has been attained in eradicating the disease on other farms.

Chronic respiratory disease is caused by *Mycoplasma gallisepticum*—a pleuro-pneumonia-like organism—and is associated with secondary bacterial infection during its course, Gram negative bacteria being the predominant flora. A virus has been incriminated as a complicating factor in the aetiology of chronic respiratory disease, but there is still a great deal of doubt about its significance. Chronic respiratory disease does occur as a disease *per se*, or is found complicated by infectious bronchitis, lentogenic Newcastle disease or *Haemophilus* infection. Vaccination for chicken pox, poor housing and ventilation and other faults in management can all act as a stimulant to a latent infection of chronic respiratory disease. The incubation period of chronic respiratory disease is from ten to thirty days and this accounts for the fact that the disease is rarely seen in chickens before they are four weeks old.

Transmission

Chronic respiratory disease is egg-transmitted but not every egg is infected. Young hens, that have recently become infected, lay a higher percentage of infected eggs, while older carrier hens lay very few infected eggs. Thus, in controlling the disease, only the eggs from older birds should be used for breeding purposes. Chronic respiratory disease is usually transmitted by contact with nasal discharges, exudates and excreta of infected birds. Recovered birds remain carriers and are thus able to perpetuate the disease in a flock.

Symptoms

Chickens: The disease is usually seen in chickens from four to twelve weeks of age and is characterized by poor growth, a nasal discharge, swollen sinuses, a discharge from the eyes, and gasping. There is an unpleasant smell if the birds are kept in poorly ventilated rooms. There is usually a history of a gradual decline in weight gains. The chickens are usually very emaciated and always have a dirty appearance. The mortality in broilers varies from 5 to 15%.

Adults: In an active outbreak of chronic respiratory disease there is a drop in egg production and poor hatchability of the eggs. Fowls show nasal discharge, swollen eyes, gaping and some birds die of asphyxiation due to the accumulation of caseous material in the pharynx. Although a large number of birds recovers from the disease, an outbreak is always followed by a lowered egg production and a large percentage of unproductive, emaciated birds. Many of the recovered birds do not show any symptoms and appear healthy.

Post Mortem Lesions

Rhinitis, sinusitis, conjunctivitis, caseous material on the palate, tracheitis, aerocystitis and emaciation are the most important lesions.

DIAGNOSIS

A history of poor weight gains and the symptoms in broilers, and poor egg production and hatchability, and the symptoms in adult birds are important factors to consider. The diagnosis is confirmed by doing the agglutination test on plasma, using a *Mycoplasma* antigen. The oldest broilers should preferably be bled for the agglutination test. Cultures can be made to isolate the organism.

CONTROL

Treatment with antibiotics is of limited value in an early outbreak. They merely control the secondary bacteria until reasonable slaughter weights can be obtained but have no effect on *Mycoplasma gallisepticum*. In a well-established outbreak antibiotics are of little value.

Control is based on the fact that *M. gallisepticum* does not survive for long outside the bird. Premises and equipment left vacant for a month are free of the organisms.

Total depopulation of the flock is a very effective but drastic and expensive approach in controlling chronic respiratory disease. Once the premises have been rested for a month, day-old chickens from a PPLO-free flock should be used for repopulating the farm.

A system of gradual depopulation is the one most commonly advocated. The advantage of this system is that a broiler producer does not go out of production for any length of time. In a commercial laying flock, all day-old chickens from a PPLO-free farm are raised in complete isolation. Provision for a separate feed room should be made and the attendants should have no contact with any of the infected birds. When the young pullets are four months old, 10% of them should be subjected to the agglutination test. If they are found to be negative, then all the old (infected) hens should be slaughtered, the premises rested for a month and the new sexually mature hens introduced. Three months later 10% of the birds should be re-tested.

A breeder, who wishes to maintain his own blood lines, should hatch chickens from eggs obtained from old hens and it is preferable to hatch for a limited period only, e.g. eight hatches, so as to minimize the possibility of using infected eggs. These chickens should be raised in isolation and the same procedure followed as stated above.

In the case of broiler production no chickens should be introduced for four weeks, thus enabling the brooder houses to be depopulated and thoroughly cleaned. If the farmer is able to provide premises and brooders away from the existing broiler plant, he can continue raising chickens. The break in the intake of chickens will enable the farmer to rest every set of houses or batteries for a month. All precautions should be taken to keep every rested portion isolated from the infected houses or batteries.

This system of gradual depopulation gives gratifying results when all the necessary precautions are taken. It is essential that repopulation only takes place with chicks obtained from PPLO-free flocks.

Breeding flocks that have been certified free of the disease have remained so for five years. These flocks have been maintained as closed flocks or have introduced chicks only from PPLO-free farms.

Infectious Coryza

This is a respiratory disease of fowls caused by *Haemophilus gallinarum*, has an incubation period of two to four days, and runs a course of ten to fourteen days.

Transmission

The disease is acquired from sick or recovered birds, and the infection is spread by contact and by air-borne infected droplets. The disease spreads rapidly through a flock, depending on the degree of isolation of the houses within the flock.

Symptoms

In most cases of infectious coryza there is a nasal discharge, oedema of the face, conjunctivitis and sneezing. The wattles are nearly always swollen in the males and sometimes in the hens. There is a drop in egg production and a loss of weight in broilers.

Post Mortem Lesions

A catarrhal inflamation of the mucous membranes of the nasal passages and sinuses, conjunctivitis and sub-cutaneous oedema of the face and wattles are observed. In older cases, complicated by secondary bacteria, caseous material can be found in the sinuses and nasal passages.

Diagnosis

The swollen face and rhinitis are very characteristic symptoms of the disease. Isolation of the bacteria can be attempted to confirm the outbreak.

Treatment

Infectious coryza responds very well to the sulpha drugs (sulphadimidine and sulphathiazole), which are added to the drinking water. In order to prevent the spread of the disease, it is advisable to medicate the water of houses adjoining the infected ones for several days.

Control

It is preferable to slaughter the birds from infected houses, since they can remain carriers of the disease after recovery. However, it may sometimes be necessary to keep these fowls until new birds, which have been raised in isolation, can be introduced. After the infected or recovered birds are disposed of, the houses should be disinfected and kept vacant for a month. Only day-old chicks should be bought for replacement purposes.

Differential Diagnosis

The differential diagnosis of these conditions is somewhat complicated. However, if certain distinguishing features are taken into account and are coupled with the correct use of reliable diagnostic procedures, an accurate diagnosis can be made.

As an aid to the practitioner, these features have been summarized in the accompanying table.

	I.B.	I.L.T.	N.C.D.	C.R.D.	I.C.
Incubation period	24–96 hours	5–10 days	1–3 days	10–30 days	1–5 days
Rate of spread	Very rapid. Chickens affected with secondary bact. seen at 4–6 weeks	Rapid	Very rapid	Slow	Rapid
Mortality	Low	Variable	Very high or low, depending on strain	5–10% in broilers; high percentage culls in adults	Low
Effect on egg production	Precipitous fall	Fall but less dramatic	Dramatic fall	Gradual lowered egg production	Fairly rapid fall.
Weight gains	Markedly reduced	When encountered in broilers reduces wt. gains	Lentogenic — reduces wt. gains. Velogenic — high mortality	Marked reduction in wt. gains	Little effect, as treatment is possible
Clinical Symptoms	Adults — blue combs, sneezing, gaping. Chickens — gaping, rales, *rarely a nasal discharge*	Blue combs, wheezing, lacrymation	High mortality, nervous symptoms, gasping or almost symptomless drop in egg production	Nasal discharge, swollen faces, lacrymation, debility, bad odour, gaping	Facial oedema, slight nasal discharge.
Port Mortem	Adults—negative. Chickens—caseous material in bronchi, aerocystitis, pericarditis, emaciation	Haemorrhagic tracheitis, blood stained tracheal mucous	Haemorrhages in proventriculus, tracheitis. Lentogenic form—P.M. almost negative	Emaciation, rhinitis, sinusitis, conjunctivitis, aerocystitis	Facial oedema and caseous exudate in sinuses
Diagnostic aids	Serum-virus neutralization, virus isolation	Serum-virus neutralization, virus isolation. Inclusion bodies	H.I. test, serum-virus neutralization, virus isolation	Agglutination test, Isolation of mycoplasma	Isolation of haemophilus.
Optimum time of specimen collection	Broilers—oldest broilers available. Hens—3 weeks after outbreak	3 Weeks after outbreak	Serum for H.I. 5 days or longer after outbreak	10 Weeks or upwards or adult hens	Bacteriological isolation of organisms in acute outbreak
Carrier state after recovery	No carriers after 4 weeks	Carrier state	No carriers	Carriers	Carriers
Treatment	Furazolidone for secondary bacteria. No treatment for adults	No treatment	No treatment	Anti-biotics of limited value for secondary bacterial inf., until slaughter weights are obtained or flock is depopulated	Sulpha drugs
Vaccination	Vaccine available	Vaccine available	Vaccination only to control a velogenic outbreak	No vaccine	No vaccine

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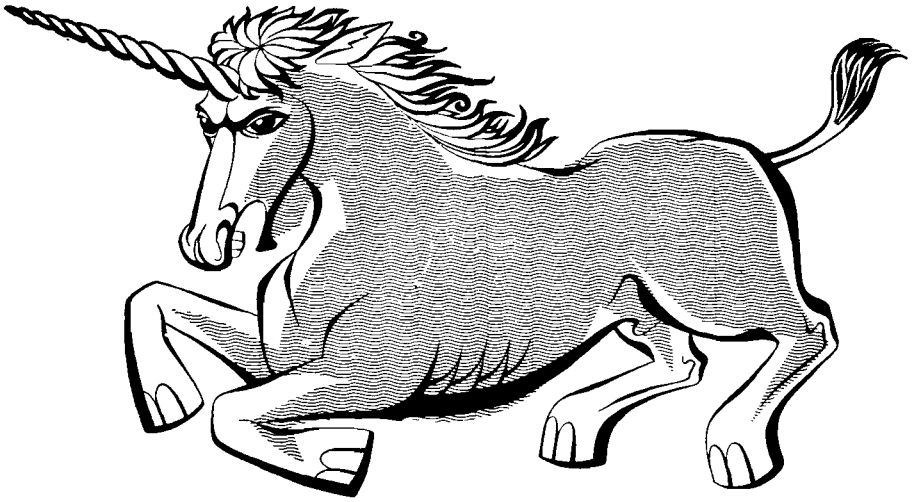

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T. H. WHITE *"The Book of Beasts"*

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Obituary

Nicolas Theart van der Linde

Dr. N. T. van der Linde, well-known colleague and energetic member of the profession, died suddenly at his home in Bloemfontein on 29th April, 1961. He was 52 years of age.

Theart van der Linde was born in the Griquatown area and qualified in 1931. He immediately joined the State Service where he served for 28 years, leaving last year to enter private practice at Bloemfontein. He was transferred to the Free State in 1946 and in 1954 was promoted to Senior State Veterinarian. He served in a number of Foot and Mouth Disease Outbreaks and did sterling work during the early days of Rift Valley Fever, a disease he himself contracted whilst investigating an outbreak. He lectured at the Glen College of Agriculture for many years. He served at Grahamstown and many other parts of the Union. He was an excellent veterinary clinician and the farmers of the Free State will miss his cheerful manner and sound advice and approach to their many problems.

He leaves a widow, a son who is presently studying in London and a daughter at Rhodes University. To them we express our deepest sympathy in their very sad loss.

Obituary

Dr. A. C. Kirkpatrick

Andrew Clements Kirkpatrick attended the Dublin Veterinary College and obtained his M.R.C.V.S. in July, 1910. He was employed in the Union Division of Veterinary Service from 1910 to 1920, when he joined the staff of the Johannesburg City Council, becoming Assistant Director of the Abattoir and Livestock Market Department in 1921, and Director in 1939. He retired from this post in February 1948. He was Veterinary Surgeon to four Racing Clubs in Johannesburg and the East Rand from May 1947 until April 1960, when arthritis of the hip joint, from which he had suffered for many years, made it impossible for him to continue. From there his health deteriorated steadily until his death in Boksburg on 2nd April, 1961.

Dr. Kirkpatrick played an active part in the formation of the S.A.V.M.A., and was its Secretary from 1921 to 1930. He was an Elected Member of Council from 1934 to 1948 and an Hon. Life Vice-President from 1949. He seldom missed a meeting of Council or of the Association's Annual Congress.

Dr. Kirkpatrick's other great interest was the Witwatersrand Agricultural Society. He became a member in 1928 and in the same year was appointed to the Central Council and to the Cattle Committee, of which he was the Chairman from 1948 until his resignation in 1960. He was elected Vice-President of the Society in 1947 and Life Vice-President in 1953.

Dr. Kirkpatrick started the cattle feeding scheme at Delta Farm in 1938, with a few oxen bought on the Newtown Livestock Market. In 1940 he travelled to John Todd's farm in Northern Transvaal to purchase 25 Angus heifers and a bull, which nucleus was then used to start the existing 3,500 cattle feeding and breeding herd at the City Engineer's sewage disposal farm "Olifantsvlei" about 12 miles south of the City. This is a unique undertaking not adopted by any other municipality.

Careful and thorough in all he did, loyal and reliable, firm yet always pleasant and friendly, Dr. Kirkpatrick had the respect and affection of all with whom he was associated or who worked with him or for him. Making light of his own ill-health, he did a lot to help and cheer friends who were ill or in trouble. He enjoyed the simple pleasures of life and liked nothing more than to joke with friends over a drink, while smoking one of his many cigars, and this he continued to do almost to the very last, even though he knew the end was near—and that is how his friends will like to think of him, and how he would like to be remembered.

To his sons we express our deepest sympathy in their sad bereavement.

G.P.

PUBLIC RELATION SERVICE

News of Members

Promotions: Congratulations to Drs. Meeser, Mansvelt, Belonje, Kluge, Weiss, de Boom, and Schulz on their promotion to the post of Sub-Director of Veterinary Services; to Dr. Edwards on his promotion to Assistant Director, and to Dr. Lambrechts on his promotion to Deputy Director (Field).

Private Overseas Trip

Dr. Cyril Flight left by air on 11th May, 1961, for New York. He will spend a month in the U.S.A., 3 months in England and will return via various cities in Europe.

Appointments of Permanent Secretary to the Association

Dr. Diesel has now been appointed permanent Secretary to the Association with commencement of duty Aug. 1st, 1961. The Association has acquired offices on the second floor of the Transvaal Agricultural Union Buildings, 279 Struben Street, Pretoria. Telephone 2-6232.

Director of Veterinary Services to visit Turkey and the Rhodesian Federation prior to Retirement

Dr. Alexander leaves for Turkey during June where he will attend a meeting on emerging diseases at Ankara on 19th–24th June. The meeting has been convened by F.A.O. and Dr. Alexander has been invited to attend as Consultant—a function which called on him to prepare the working papers dealing with these diseases. An emerging disease is one previously believed to be confined to specific areas e.g. Africa, but which has shown a tendency to spread throughout the world, e.g. Bluetongue to Portugal and Spain; Horsesickness to the Near East; Lumpy Skin Disease to other parts.

From July 17th–26th Dr. Alexander will attend the 10th Annual Meeting of I.B.A.H. and the 7th Annual Meeting of I.A.C.A.H. which will be held at Livingstone. Dr. Alexander retires on July 28th, 1961. On retirement he proposes to remain in Pretoria and to devote his time to committing to paper unpublished results on virus research undertaken by him over the last decade. We wish him "Bon Voyage", happy landing and every success in his subsequent retirement.

NEW PREPARATIONS AND APPLIANCES OFFERED BY FIRMS TRADING IN PHARMACEUTICALS AND INSTRUMENTS

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These palatable granules have been designed to meet the need for a balanced mineral-vitamin supplement in cats and dogs. They contain in each gram—

Ferrous Fumerate, 11.15 mg.
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Prime indications for the use of I.C.D. Granules are essential mineral deficiencies in small animals, osteodystrophic conditions, unthriftiness, rickets or those conditions where adequate and sustained mineral supplementation is necessary to prevent "stunted" growth.

During pregnancy and lactation I.C.D. granules will supply the dam with added mineral intake to enable her to rear the litter without depleting her own system unnecessarily.

Packing: 2-oz. Cannister and 1-lb. tins.

"FERSAMAL VETERINARY GRANULES"

The need for an easily assimilable, effective oral haematinic for large animals has long been felt and the introduction of a "Ferrous Fumarate" granule with a palatable flavour has met with general approval by practicising veterinarians.

Ferrous Fumerate is an established iron tonic with no toxic or side effects, and possesses a specific effect on the haemopoetic system by supplying essential iron for the regeneration of Red Blood Corpuscles.

In large animals where anaemia is present as the result of destruction of the Red Blood Corpuscles or following secondary depletion due to internal parasitism, Fersamal granules are indicated to supply essential iron. The granules are easy to administer and are readily accepted by both cattle and horses.

COMPOSITION

3.5 grams Fersamal Veterinary Granules provide approximately 0.6 grams ferrous iron.

Packing: 8 oz. Cannister.

DAPSETYN INTRAMAMMARY OINTMENT

Dapsetyn has been formulated to deal with Staphylococcal and resistant forms of bovine mastitis and contains in each tube 0.15 gm. Chloramphenicol (Alficetyn) plus 0.3 gm. of dapsone.

In combination these drugs exert a synergistic action against a number of pathogenic organisms inflicted in the causation of bovine mastitis. In particular Dapsetyn is especially active against.

Staphylococcus Type B.
Resistant Strains of Streptococcus agalactiae, dysgalactiae and uberis.
Coliform organisms.
Corynebactuim pyogenes.

Chloramphenicol (Alficetyn) has not been used in intramammary preparations in South Africa until now, but overseas it has given outstanding results in the treatment of mastitis due to the organisms mentioned above.

Packing: Boxes of 12 tubes.

STREPTOPEN FOAMING PESSARIES

The great majority of the commonly encountered pathogenic organisms in animal practice can be dealt with effectively by a combination of penicillin and streptomycin.

Streptopen Foaming Pessaries contain 0.5 mega units of procaine penicillin plus 0.5 gm. of Streptomycin as sulphate in a mildly effervescent base.

Thorough dispersal of both these drugs can be achieved in the endometrial lining without risk of toxicity or damage.

Streptopen Foaming Pessaries are indicated in the prevention and treatment of infection in the genital tract; following parturition or dystokia they control sepsis and make the manual removal of foetal membranes an easy task as well as controlling odour.

Streptopen Foaming Pessaries are packed in tins of 6 and 12.

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AGRO-CHEM (PTY.) LIMITED WISHES TO ANNOUNCE THE FOLLOWING NEW DRUGS FOR VETERINARY USE:

NEGUVON A: This vermicide is to be used for SHEEP only. It is of course, not a new drug but has now to be used in accordance with amended recommendations for sheep only.

DYLOX: Vermicide for CATTLE. Contains a purified organophosphate. Highly effective against WIREWORM (*Haemonchus placei*) and NODULAR WORM (*Oesophagostomum radiatum*) and also effectively controls INTESTINAL BANKRUPT WORM (*Cooperia* spp.) STOMACH BANKRUPT WORM (*Trichostrongylus axei*) and BROWN STOMACH WORM (*Ostertagia* spp.)

Available as a wettable powder; it is safe, effective, most economical; no prestimulation necessary. *Packing*: 5 lb. lithographed tins.

DYLOX FLEAPOWDER: Highly effective against fleas on *dogs* and *cats*. Contains 2.5% of an organo-phosphate as active ingredient. Completely overcomes the problem of flea resistance to other chemicals. Extremely safe.

Packing: 4 oz. dusting tins.

BAYER 2353: New cestocide group for the control of TAPEWORMS in young ruminants, dogs and cats. Exceptionally successful as a taeniacide in human beings. Highly effective in young ruminants, dogs and cats.

VERSLAG VAN UITBREKINGS VAN GEPROKLAMEERDE VEESIEKTES.

REPORT OF OUTBREAKS OF NOTIFIABLE STOCK DISEASES.

Vir die Kwartaal geëindig 31 *Mei* 1961.
For the Quarter ended 31*st May* 1961.

Siekte Disease	Distrik District	Getal uitbreke Number of outbreaks
Bek- en Klouseer	Potgietersrus, T.	3
Foot and Mouth Disease	Waterberg, T.	12
Brandsiekte	Carolina, T.	1
Sheep Scab	Ermelo, T.	1
	Umvoti, N.	1
	Carolina, T.	2
Gonderiose/Gonderiosis	Dundee, N.	1
Milde Bees	Piet Retief T	3
Benign bovine	Weenen, N.	1
	Lower Umfolozi, N.	5
	Umzinto, N.	2
	Umtata, K.	1
	Eshowe, N.	1
	Msinga, N.	4
	Carolina, T.	1
	New Hanover, N.	1
Gonderiose/Gonderiosis	Hlabisa, N.	33
Kwaadaardig bees	Barberton T	2
Malignant bovine		
Gonderiose/Gonderioses	—	—
Kwaadaardig Buffel		
Malignant Syncerine		
Hondsdolheid	Fauresmith, O.	Meerkat (1)
Rabies	Winburg, O.	Meerkat (1)
	Koppies, O.	Meerkat (1)
	Marico, T.	Bees (1)
	Letaba, T.	(1)
	Lichtenburg, T.	Kat (1)
	Vryburg, K.	Hond: bees (2)
	Brandfort, O.	Meerkat (1)
	Kuruman, K.	Kat (1)
	Wesselsbron, O.	Bees (1)
	Klerksdorp, T.	Kat (1)
	Bloemfontein, O.	Dassie: Meerkat (2)
	Hopetown, K.	Bees (1)
	Kimberley, K.	Meerkat (1)
	Bultfontein, O.	Hond (1)
	Bloemhof, T.	Bees (1)
	Clocolan, O.	Hond (1)
Hoendertifus	Estcourt, N.	1
Fowl typhoid	Ventersdorp, T.	1

Siekte Disease	Distrik District	Getal uitbreke Number of outbreaks
Johne se Siekte/..... Johne's Disease	—	—
Knopvelsiekte..... Lumpy Skin Disease	Marico T..... Mahlabatini N..... Piet Retief, T..... Pretoria, T..... Vryburg, K.....	1 1 1 1 1
Lugpypontsteking..... Laryngo-tracheïtis.....	Wynberg, K.....	1
Miltsiekte..... Anthrax	Lichtenburg, T..... Babanango, N..... Hoopstad, O..... Msinga, N..... Bloemfontein, O..... Dundee, N..... Estcourt, N..... Mahlabatini, N..... Heilbron, O..... Nqutu, N..... Entonjaneni, N..... Bergville, N.....	1 1 2 1 2 2 1 10 2 1 11 1
Slapsiekte..... Dourine	Kuruman K.....	1
Skrufte, Bok..... Mange, Goat.....	Hlabisa, N..... Ubombo, N..... Nongoma, N..... Ingwavuma, N..... Kingwilliamstown, K..... Middeldrift, K..... Witzieshoek, O..... Kentani, K.....	1 1 1 1 1 2 1 1
Skurfte, Perd..... Mange, Equine.....	—	—
Skurfte, Vark..... Mange, Porcine.....	Nongoma N.....	1
Tuberkulose..... Tuberculosis	Bredasdorp, K..... Potchefstroom, T..... Klerksdorp, T..... Ventersdorp, T..... Piet Retief, T..... Wepener O..... Inanda, N..... Kroonstad, O..... Bloemfontein, O.....	Hoender (1) Bees (1) Bees (4) Bees (2) Bees (3) Hoender (1) Bees (1) Bees (1) Bees (1)

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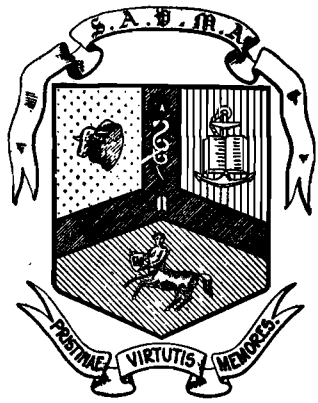

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TOXOPLASMOSIS IN DOGS IN SOUTH AFRICA: SEVEN CASE REPORTS

J. D. Smit

Department of Pathology Onderstepoort

INTRODUCTION

Since the identification of Toxoplasma as a cause of disease in mammals in North Africa more than 50 years ago, this organism has been demonstrated in a variety of animals, including man, in almost all parts of the world. *Toxoplasma gondii* is unusual in so far that it has no host specificity: apparently it will infect mammals, birds and even cold-blooded animals.

Amongst our domesticated animals, toxoplasmosis is only of importance as a cause of serious mortality in dogs and cats. It is usually a chronic disease but acute outbreaks may occur in fully susceptible kennels. Cole *et al.*[1] describe what are probably uncomplicated outbreaks of toxoplasmosis in two large kennels. In many of the reports of canine toxoplasmosis the finding of the parasite may have been incidental. Toxoplasmosis was often a complication of distemper or any other debilitating disease. Campbell *et al.*[2] recorded 16 cases of toxoplasmosis in 268 dogs affected with distemper; in only six of these was the disease regarded as extensive. Hartley[3] reported a series of six cases in New Zealand; in at least four the disease could be regarded as general. Of special interest is the congenital form of toxoplasmosis, which is of greatest importance in man. Feldman and Miller[4] assume that the congenital disease results when a non-immune pregnant woman happens to acquire an inapparent infection. The resultant parasitaemia permits toxoplasma to set up a nidus in the placenta from which infection of the foetus follows. Only one abortion occurs and subsequent pregnancies will be normal. The congenital disease has been reported in the dog by Olafson and Monlux[5] and by Chamberlain *et al.*[6], and in the pig by Cole *et al.*[1], Farrell *et al.*[7], Sanger and Cole[8] and by Momberg-Jorgensen.[9] It has also been described in cattle by Sanger *et al.*[10] In Australia and in New Zealand Smith considers it a major cause of abortion in ewes[11 12]. Toxoplasmosis has been encountered in the dog in South Africa by Schulz and Malherbe,[13] as well as in a jackal from the Pretoria National Zoological Gardens and in fowls, but these cases were never published. The present series of seven cases are therefore the first to be reported in this country.

The lesions in toxoplasmosis may vary considerably, depending on the acuteness of the infection and the immunity of the host. The interactions between host and microbe, starting with the generalised acute infection, are traced through partial states of immunity to the chronic

infection, which may or may not be symptomatic.[14] Descriptions of the pathological-anatomical changes emphasise the occurrence of focal, often miliary, inflammatory processes and necrosis in the various organs, especially in the lymph nodes.[15] Enlargement of the lymph nodes is a frequent and important diagnostic finding according to Siim.[16] In our series we can fully endorse the latter statement.

In the seven cases to be described three were of an acute nature, three chronic and one was most probably an incidental finding as a complication to babesiasis. In the acute form, the lung lesions were responsible for the most pronounced symptoms and were the immediate cause of death. Laboured breathing, especially expiratory, was a very characteristic symptom and of great diagnostic importance. In the chronic cases, lymphatic tissue was involved most frequently and hence most suitable for diagnostic purposes.

Case Reports

Case No. 1

This 18 month old Dobermann dog was presented at post mortem. The history was that the dog had been off colour for a few days and had died rather unexpectedly. At post mortem the outstanding lesions were a focal fibrinous pneumonia, generalised lymphadenopathy, splenomegaly and some evidence of anaemia.

Histologically, the lungs showed focal fibrinous pneumonia with a marked surrounding reticulo-endothelial reaction. Numerous free and intracytoplasmic toxoplasma organisms were present in the periphery of the foci. The lymph nodes and spleen showed a severe reactive hyperplasia with a marked increase in macrophages. Toxoplasma organisms frequently occurred in the macrophages. No pseudocysts were observed.

Case No 2

A crossbred Dobermann pup of about one month old was the next case to be diagnosed. It was one of a litter of five. Two litter mates had died a week previously, one was dead on presentation and one (Case No. 3) was ill. This particular pup (No. 2) was presented in a comatose state and died soon afterwards. The post mortem showed an emaciated carcass with slight splenomegaly and tumor hepatis. Unfortunately a detailed post mortem was not carried out and material for histological examination was only collected from the liver. Histologically, the liver showed slight fatty degeneration and a severe periarteritis with a marked leucocytic cell infiltration. Monocytes and some polymorphs were the essential cells involved. A careful examination revealed a few toxoplasma organisms in the cytoplasm of the macrophages.

Case No. 3

A crossbred Dobermann pup of about one month old, litter mate of case No. 2, was the third case encountered. This pup showed a slight elevation of temperature and slight conjunctivitis. The outstanding

symptoms may be summarised as extreme dehydration, tucked up and painful abdomen and continuous yelping. It seemed to recover somewhat after antibiotic treatment but was returned a few days later in a dehydrated and emaciated condition. It was kept alive for a few days with electrolyte fluids but died, showing the severe abdominal pains and making yelping noises. The post mortem revealed an emaciated carcass with a marked splenomegaly and evidence of nephrosis. On closer examination the spleen had numerous dull grey foci about 1–2 mm. in diameter. Histologically the most important lesions were found in the spleen. The whole architecture of the spleen was disturbed: the white and red pulpa had a uniform appearance with a marked increase in reticulo-endothelial cells and a reduction of the lymphoid tissue. Numerous foci of necrosis were present throughout the parenchyma. In the periphery of these foci pseudocysts of toxoplasma were frequently observed. Some single forms of the parasite were also seen.

Case No. 4

The next case was a Dobermann bitch about 1 year old and in good condition. She was the mother of cases 2 and 3. Clinically she appeared to be in perfect health. Euthanasia was performed and on post mortem the oesophagus showed a granulomatous growth as a sequelae to *Spirocerca lupi* infestation. The lungs were emphysematous and several firm nodules occurred throughout the substance. The bronchial lymph nodes were enlarged and red in colour. There was a marked splenomegaly and on section the malpighian bodies were very prominent. Tumor hepatis was also present. Ulceration of the duodenum was observed. Histological examination of the spleen revealed a marked reactive hyperplasia with very distinct malpighian bodies. In the red pulpa the reticulo-endothelial cells were prominent. Haemosiderosis was another feature noticed. Large numbers of intracytoplasmic toxoplasma organisms as well as pseudocysts were present. The lymph nodes showed congestion, oedema, haemosiderosis and a reactive hyperplasia. A fair number of pseudocysts and intracytoplasmic toxoplasma organisms were present. There was slight glycogen and fatty infiltration of the liver, with perivascular round cell infiltration, especially in Glisson's capsule. No significant lesion was present in any of the other organs.

Case No. 5

A ten month old German Shepherd bitch was presented at the Outpatients' Clinic, with a history that she had been ill for some weeks and had no appetite. She was treated for worms and allowed to return home. After a week she was brought back and admitted as a suspected case of distemper. She died the next day. An autopsy was performed and revealed a marked splenomegaly, general congestion, anaemia and a catarrhal enteritis. Histologically, the outstanding lesion was the presence of very large numbers of protozoal organisms in the red cells of most organs. These organisms were identified by the section Protozoology as probably being babesias. Unfortunately no blood or spleen smears were available for confirmation of this diagnosis. The spleen had a uniform

appearance with loss of the normal architecture. The malpighian bodies were indistinct and the red pulpa showed a marked reactive hyperplasia with large numbers of reticulo-endothelial cells. Haemosiderosis was present. A few pseudocysts of toxoplasma were found. The liver showed a marked congestion, centrilobular necrosis, fat infiltration, bile stasis and haemosiderosis. Apart from a general congestion and the presence of numerous babesia-like organisms, no significant lesion was found in the other organs. The toxoplasma infection was most probably an incidental finding in this case.

Case No. 6

This six-weeks old nondescript female pup was sent in by a private practitioner for autopsy. The history was very vague. The pup had been ill for some time, without showing any definite symptoms. It was emaciated and had not responded to treatment. The post mortem findings were very inconclusive. These included general congestion, ascites, oedema of the lungs, generalised lymphadenopathy and a mild catarrhal enteritis. Histologically, the outstanding lesions were confined to the lymphoid tissues. A reactive hyperplasia had resulted in the loss of the normal splenic architecture. Large numbers of intracellular and pseudocyst forms of toxoplasma were present. The lymph nodes revealed a focal necrosis, reactive hyperplasia and large numbers of toxoplasma organisms. The lungs were severely congested and early phases of a fibrinous pneumonia were seen. Large numbers of leucocytes, especially monocytes, were present in the alveolar walls and in the alveoli. A slight fatty degeneration and congestion were observed in the liver.

Case No. 7

A crossbred Bull Mastiff dog of about 6 months old was presented to the medicine clinic. The dog was in a good condition and the history was that he had been normal 24 hours before. The whole symptom complex can be described as a collapsed animal in irreversible medical shock; the dog died a few hours after admission. The outstanding symptom was labouring of respiration, particularly of the expiratory phase. The gross post mortem picture consisted of generalised hyperaemia with petechial haemorrhages on the mucous membranes, hydropericardium, hydrothorax, generalised lymphadenopathy, splenomegaly, tumor hepatis and a mucocatarrhal enteritis. The outstanding lesion was a focal pneumonia and vicarious emphysema. The lungs were partially collapsed and had a mottled appearance, due to the presence of light red, raised and dark red, slightly dull, sunken areas.

Histological examination of the lungs revealed an extensive focal, acute fibrinous pneumonia with compensatory emphysema. A marked leucocyte infiltration, especially of monocytes, was evident and oedema was severe. Large numbers of intracytoplasmic and free toxoplasma organisms were present. In the lymph nodes there were extensive areas of coagulative necrosis; some nodes showed a severe congestion and oedema. The lymphoid tissue had a washed-out appearance. The

reticulo-endothelial cells were very prominent and large numbers of intracytoplasmic toxoplasma organisms were observed. In the spleen, a focal coagulative necrosis with loss of the general architecture was evident; there was a marked reactive hyperplasia with increase in R.E. cells but depletion of lymphoid tissue. Large numbers of toxoplasma organisms were present. A focal coagulative necrosis was also seen in the liver, and a perivascular cell infiltration in the surrounding areas. Toxoplasma organisms occurred in the monocytes and in liver parenchyma cells. The other organs did not show any significant lesion.

Discussion

The first of the seven cases described, occurred in 1955 and the other six from October 1960 to February 1961. The incidence of the disease, therefore, appeared to be fairly high. Considering the previous cases encountered in South Africa, one is not sure whether the recent increase is real or apparent. Although no special effort was made to look for cases, toxoplasmosis has recently been kept in mind in the examination of routine cases. The distribution of the infection in this country is also uncertain. All the cases originated from the Pretoria area, but no attempt has been made to look for cases in other areas where the disease may be just as prevalent.

The differential diagnosis is another interesting aspect of the disease. It certainly falls in the "distemper complex." Recently four cases of suspected toxoplasmosis were submitted by a Pretoria practitioner. The ultimate diagnoses made in three of these cases were: toxoplasmosis, rickettsiases and infectious canine hepatitis respectively; one case was not diagnosed. These diseases should therefore be considered in the differential diagnoses. To this one should add distemper, atypical cases of babesiasis and, recently, histoplasmosis.

In all cases of toxoplasmosis the diagnosis was only made at post mortem or on histological examination, but if biopsies of lymph nodes and/or spleen were made a fair percentage of cases could be diagnosed clinically.

The symptom complex can vary considerably, depending to a very large extent on the chronicity of the disease. In general it may be said that, in the acute form of the disease, the respiratory symptoms are the outstanding feature. In particular one should pay attention to the forced expiratory breathing. In more chronic cases the enlargement of the lymph nodes and spleen may be of the greatest diagnostic value. In the chronic congenital form the chorioretinitis is a very important diagnostic point. The eye appears normal on cursory examination, but on closer inspection it has a dull bluish-grey appearance, sometimes with a red ring round it. The lesion is commonly seen in cats. In young puppies a typical description of toxoplasmosis may be a pup with indefinite symptoms, an undulant fever, poor appetite, tendency towards emaciation and no response to antibiotic treatment.

Nervours symptoms are often stressed, especially in the human literature, but in the present series no true evidence of nervous symptoms was observed. Abortion is another important feature of the disease.[11, 12].

The position in South Africa in this regard is unknown. The possibility of toxoplasmosis as a cause of abortion in sheep and goats will have to be borne in mind but it is unlikely to prove a major factor.

SUMMARY

A brief review of the literature on Toxoplasmosis is given. The essential pathological lesions are mentioned. Seven cases of Toxoplasmosis in dogs in South Africa are described. The incidence is apparently high in the Pretoria area. The differential diagnosis includes the usual "distemper complex": distemper, biliary fever, rubarth's disease, *Rickettsia canis* and histoplasmosis. In acute cases the respiratory symptoms predominate and in the chronic form a reactive hyperplasia of the lymphoid tissue is the outstanding feature of the disease.

ACKNOWLEDGMENTS

The author wishes to express his thanks to the Director of Veterinary Services for permission to report these cases. I would also like to thank Prof. van der Walt of the Medicine Department and Dr. Chris Craig for cases submitted for autopsy.

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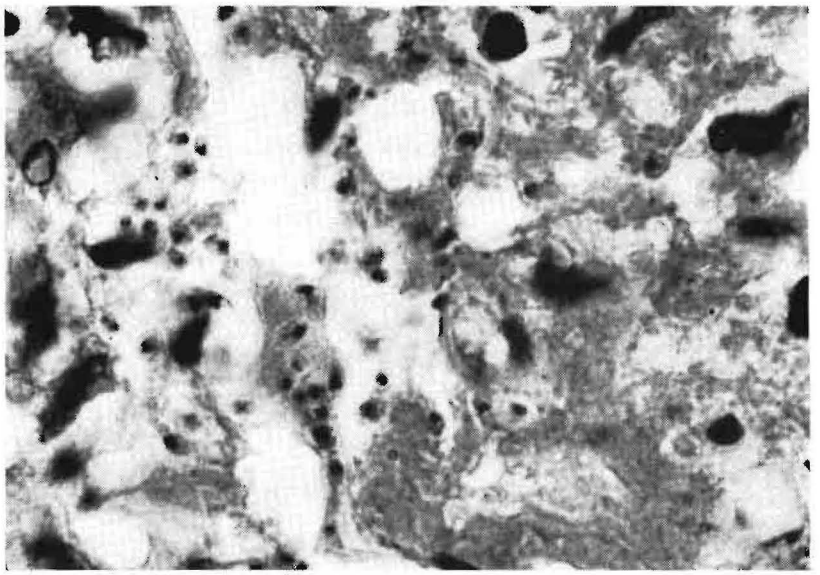

FIG. I. A.—Section through lung showing focal fibrinous pneumonia and large number of intracytoplasmic organisms.

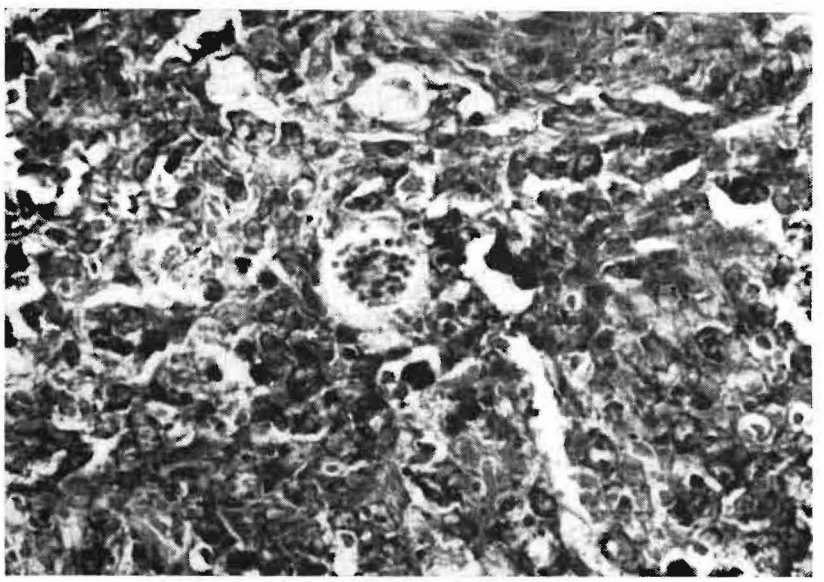

FIG. I. B.—Section through spleen showing pseudocyst. Note reactive hyperplasia of R.E. cells surrounding the pseudocyst.

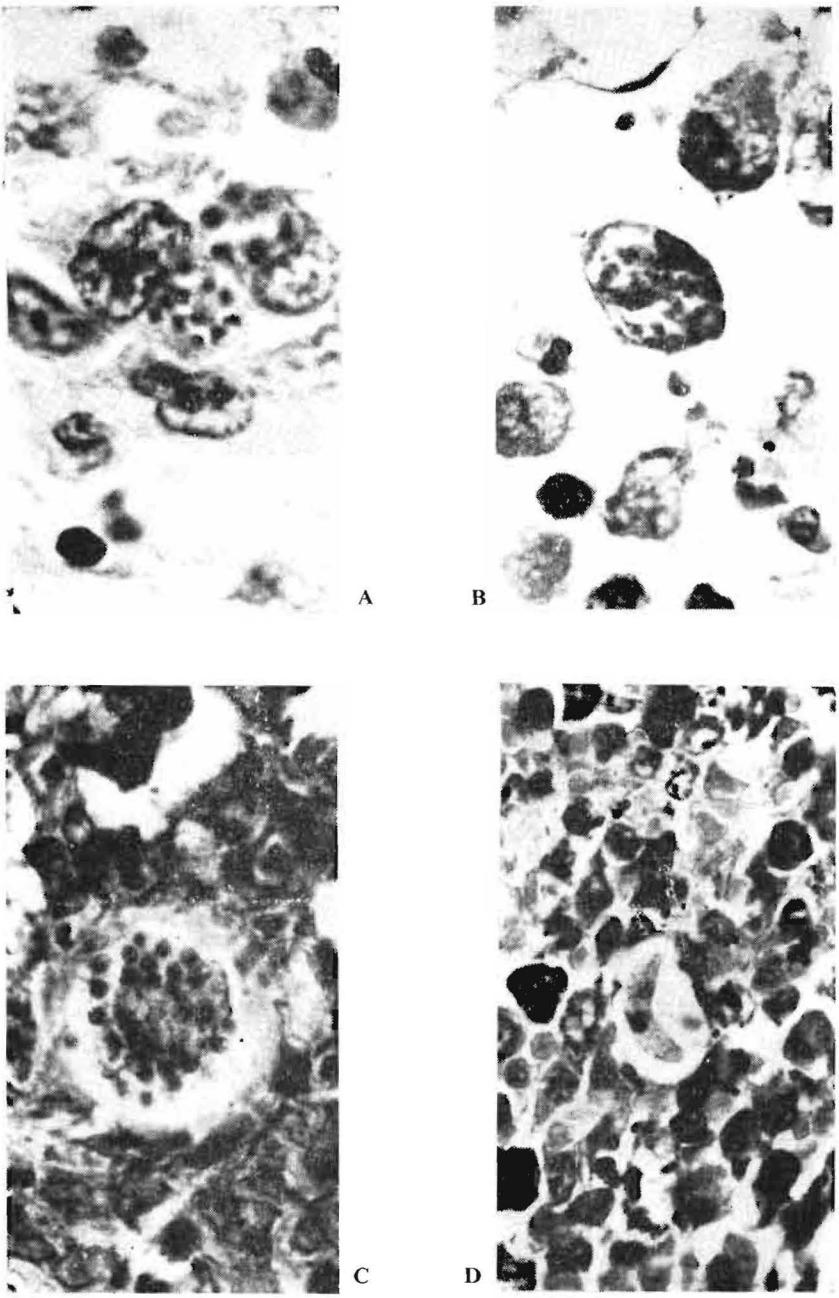

FIG. II.—Sections of spleen showing various phases of the parasite: A. Macrophages with number of intracytoplasmic organisms. B. Degenerating macrophage with large number of organisms. Probably a phase in the development of pseudocyst. C. Pseudocyst with R.E. cell reaction. D. Large single form of parasite in a pseudocyst.

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ISONIAZID ADMINISTRATION AND BLOOD LEVEL IN CATTLE

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INTRODUCTION

The chemotherapy of tuberculosis consists of the administration of chemical substances with a specific curative effect on the disease. Most of these agents are effective in remarkably low concentrations. The degree of benefit is dependent upon two main factors, the drug-parasite interaction and the drug-host relationships. Contrary to other bacterial infections tuberculosis is a chronic disease, where proliferative and exudative stages follow each other or appear at the same time. The destructive nature of the disease, with its frequently large necrotic caseous masses and barriers of fibrotic tissue, cavity and abscess walls, demands drugs with great diffusibility and low capacity for inactivation by the biochemical environment of the lesion. The walls of fibrotic tissue generally have a well defined capillary supply and will therefore not prevent the drug from passing through. The penetration of the caseous or semicalceous necrotic lesions will depend on diffusion only. In case of oral administration there are other possible antagonists like the diet, the pH, bacteria and enzymes of the intestinal tract. Further there is the intracellular location of most tubercle bacilli and the fact that the bacilli can subsist at such low level of metabolic activity that they are indifferent to the effect of the drug. Most of the drugs are ineffective against bacteria which are not multiplying.

Further the action of the drugs is limited to the period of their administration. The value of tuberculostatic drugs is limited by another decisive factor—bacillary resistance which can develop against all antituberculous drugs in different degrees. As regards the origin of the resistant variants the greater part of the evidence indicates that a natural selection of spontaneously emerging mutants is taking place. The larger the number of bacilli subjected to the drug's action the bigger the chance for the occurence of resistant mutants will be.

The qualifications which effective drugs for tuberculosis should have may be listed as follows:

(*a*) Strong tuberculostatic action combined with low toxicity. It must possess a selective toxicity for tubercle bacilli in a range where it is well tolerated by the patient.

(*b*) It should produce the favourable effect within a reasonable period of time.

(*c*) Sufficient diffusibility into pathological structures.

(*d*) Ease of administration.

(*e*) Suitability for long term treatment.

(*f*) Low capacity to stimulate allergic drug sensitivity.

(*g*) No or limited neutralisation or interaction by body proteins.

(*h*) Destruction or conversion into inactive forms as well as excretion through the kidney should not occur at a rapid rate.

(*i*) The therapy should interfere as little as possible with the bodies own immunological forces.

(*j*) Low costs in the case of cattle treatment.

At present these requirements are best fulfilled by isoniazid. A large body of medical opinion has accumulated recommending it as the best available drug administered by itself for mass treatment of humans. There is also the extraordinary characteristic of isoniazid resistant variants of M. tuberculosis var. bovis to have a very low degree of virulence to laboratory animals, goats and cattle.[17] Rapid uniform distribution of isoniazid in body fluids and tissue was observed by utilising radioactivity in tracer techniques.[3, 11] The concentration of tagged Na^1 and Br^1 was the same in the centre of cavities as in the surrounding lung tissue. The carbon[14] labelled isoniazid also diffused readily into the interior of caseous lesions.

Significance of the blood level

The clinical evaluation of antimicrobial agents is generally based on the determination of its level in the blood plasma and its excretion. Many investigators regard the blood level as sufficiently representative for the total body concentration while others stress the importance of the affinity of drugs to certain organs. Blood supply is a decissive factor in penetration. The distribution, metabolic fate and excretion of isoniazid has been well studied in humans and experimental animals. The dependance of the therapeutic result on the blood level in the human patient has been debated in the literature and today a frequent demand is to adjust the dosage of the drug so that its concentration in serum attains bacteriostatic levels. It is well established that the blood levels of isoniazid and the rate of inactivation vary significantly between different human subjects and races but remain constant in the same individual for long periods.[1, 12] Peak levels of 2–5 mcg/ml are reached two hours after ingestion, and a patient is called a rapid inactivator if his blood level is below 0.4 mcg/ml six hours after an oral dose of 4–5 mg/kg. Isoniazid determinations have also been conducted on monkeys, dogs, rabbits, guinea pigs and rats, and it has been shown that the pattern of metabolism varies in different animal species.[8, 9, 13, 14, 19, 23] Investigations on cattle have only been mentioned by Freerksen[7] who found very low blood levels and concluded that treatment could not be considered in cattle.

Scope of present investigation

The absence of any published data as to the rate of absorption, metabolism and blood lecel of isoniazid in cattle made it necessary to

study these matters in connection with large scale field trials on the use of the drug in the control of bovine tuberculosis.[15] The experiments described in this paper as well as the field trials were all based on oral administration of the drug because any other route is entirely impractical. Since it is gradually becoming clear that the use of 4–5 mg/kg isoniazid is by no means adequate to deal with tubercle bacilli in many human patients, the lowest dosages applied to cattle were 10 mg/kg bodyweight. Because of the differences in the metabolic fate of the drug in various animal species it was felt necessary to establish the blood level after varying dosing methods. It was feared that isoniazid might be converted to inactive forms by the microflora in the rumen of cattle or by the various fermentation processes in that organ. Predosing of sodium bicarbonate was therefore applied in two trials in order to close the oesophageal groove. This was done immediately prior to the treatment by dosing 60 ml of a 10% sodium bicarbonate solution.

Another aim of the present study was to compare the two principle methods of determining concentrations of isoniazid in biological substances, viz. chemical proceedures and microbiological assays. Both the chemical and the radioactivity procedures have been blamed for measuring conjugated and bacteriostatically inactive as well as free active isoniazid.[2, 4, 6, 20] The biological methods depend on the inhibition of growth of isoniazid sensitive mycobacteria.

Methods and material

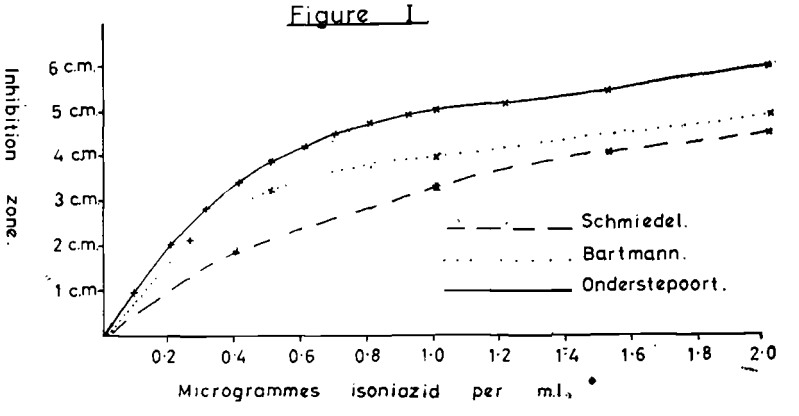
Six 4 year old Friesland cattle, 8 adult Jersey cattle and 6 suckling calves of different breeds, free of diseases, were selected, weighed and kept in a stable during the experiment. The adult cattle were fed on hay and green lucern and water ad lib. Dosing was done in the crushpen or in the stable with pure cristalline isoniazid obtained from Farbenfabriken Bayer A. G., Leverkusen. After various time intervals as indicated in the following tables blood was collected from the V. jugalaris in 100 ml bottles and stored in an incubator (37°C) for 45 minutes. The clot was then loosened from the glass surface, centrifuged for 15 minutes at 2,500 r.p.m. and the serum decanted into a sterile glass container. The time intervals between bleeding and the beginning of the tests was about 70 minutes. The chemical tests were carried out with blood from the Friesland cattle or the calves and the biological tests with blood from the Jersey cattle. Otherwise all procedures as regards feed, dosing and serum production were the same.

For the chemical determinations a modification of Short's technique was employed, which has been described by the authors in a previous paper.[16] The procedures with serum are essentially the same with the exception that the mixture of equal parts of serum, distilled water, saturated Ba $(OH)_2$ and Zn SO_4 solution (9%) is heated for $2\frac{1}{2}$ minutes in boiling water and immediately after that put into cold water (15°C) for 15 minutes.

A vertical diffusion sensitivity test developed by Tinne and Henderson[22] and adopted by Schmiedel[20], Bartmann and Massmann[2] for measuring active isoniazid was used for the microbiological determinations. It

s as follows: The highly isoniazid sensitive strain of M. tuberculosis var. hominis H 37 Ra is the test. organism. The usual amount of L.–J. medium is poured into test tubes (160 × 16 mm) and solidified as slopes in the usual manner. Young culture mass of the test strain is ground under sterile precautions and suspended at the rate of 1 mg/ml buffer. The medium is evenly inocculated with one drop of this suspension. The standard solution or the serum to be assayed is then added to the tubes at the base of the slope, closed with cotton wool, sealed off with paraffin wax and then incubated. The test is based on the diffusion of the isoniazid molecules from the liquid into the culture medium and upwards into the slope. The test organisms can only grow at a certain distance from the level of the liquid. The inhibition is proportional to the concentration of the drug. The length of the inhibition zone is a logarithmic function of the isoniazid concentration. The lower limit of growth is clearly visible horizontally and reproducible under the same conditions. The method permits measurements in a range from 0.1 to 2.0 mcg per ml. Where higher amounts than 2.0 mcg/ml are expected saline dilutions of serum (1:2 and 1:3) are made. Several standard series are prepared by adding different amounts of isoniazid to drug-free serum. The readings are done on the 12th and sixteenth day with a calliper or a ruler with millimeter device. Figure 1 shows a comparison of the standard curves of Schmiedel, Bartmann et al., and Onderstepoort, to indicate the similarity of the results.

Figure 1



Results

Five different experiments were carried out by applying 20 mg isoniazid (INH) per kilo bodyweight in various dosing methods to cows and calves. Two more test series were then done with administration of 10 mg/kg INH using the dosing method which was found most suitable in the previous tests. The results of the chemical determinations of isoniazid in the serum of cattle are presented in table 1–3 and figure 2.

TABLE 1

Isoniazid level in serum after administration of 20 mg./kg. b.w.

	Dosing of powder with spoon			Water solution by dosing syringe		
	Time elapsed between dosing and bleeding					
Cow	6 hours	17 hours	24 hours	6 hours	17 hours	24 hours
	mcg/ml	mcg/ml	mcg/ml	mcg/ml	mcg/ml	mcg/ml
1	1.90	1.74	0.70	2.12	1.24	1.02
2	—	2.46	0.80	1.82	2.84	1.04
3	2.56	2.32	0.88	1.94	1.24	1.04
4	1.80	1.74	0.78	1.68	—	0.86
5	1.98	2.18	0.94	1.60	0	0.60
6	2.10	2.80	1.32	2.36	0.74	1.16
Mean INH.....	2.10	2.21	0.90	1.92	1.21	0.95

TABLE 2

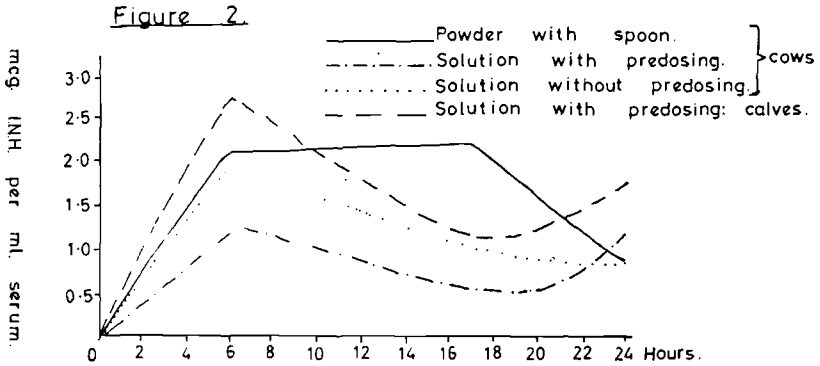
Isoniazid level in serum after dosing of 20 mg/kg b.w.

	Water solution after premedication ($NaHCO_3$)			Communal feeding of concentrate	
	Time elapsed between dosing and bleeding				
Cow	6 hours	17 hours	24 hours	17 hours	24 hours
	mcg/ml	mcg/ml	mcg/ml	mcg/ml	mcg/ml
1	0.82	0.60	0.82	—	—
2	1.50	0.86	1.60	1.60	0.64
3	0.94	0.32	1.60	4.00	1.00
4	1.42	0.48	0.90	3.20	0.60
5	0.72	0.70	0.94	6.00	1.88
6	1.88	0.36	1.70	0.78	0.54
Mean INH	1.21	0.55	1.26	2.48	0.80

TABLE 3

Isoniazid level in serum of calves dosed with 20 mg/kg b.w. in water solution after premedication of sodium bicarbonate

Calf	Time elapsed between dosing and bleeding		
	6 hours	17 hours	24 hours
	mcg/ml	mcg/ml	mcg/ml
1	0.98	0.86	1.54
2	2.81	0.08	3.04
3	4.45	2.00	0.88
4	3.47	1.46	3.52
5	2.43	1.20	1.24
6	2.15	0.76	1.06
Mean INH	2.71	1.18	1.85



Bloodlevel after different dosing methods, 20 mg isoniazid per kilo b.w.

Having determined serum concentrations after dosages of 20 mg/kg b.w. experiments were conducted with the application of 10 mg/kg as used in the therapeutic field trials.

TABLE 4

Determination of isoniazid in serum of adult cattle after administration of 10 mg/kg b.w.

(*a*) Microbiological estimation

Cow	2 hrs	4 hrs	6 hrs	8 hrs	10 hrs	12 hrs	14 hrs	16 hrs	18 hrs	20 hrs	22 hrs	24 hrs
1	1.5	1.2	1.2	1.7	0.7	0.6	0.4	0.2	0.2	0.3	0.15	0.1
2	1.6	2.0	1.5	1.4	1.2	1.0	0.6	0.4	0.3	0.3	0.2	0.1
3	1.2	1.0	1.2	0.8	0.5	0.6	0.5	0.2	0.2	0.3	0.2	0.15
4	1.0	0.9	1.1	0.7	0.6	0.6	0.3	0.3	0.2	0.2	0.2	0.15
5	1.2	2.0	1.1	0.7	0.6	0.7	0.5	0.2	0.3	0.2	0.2	0.2
6	1.0	0.5	1.0	1.0	0.7	0.8	0.6	0.4	0.3	0.2	0.15	0.15
7	1.2	2.0	1.2	1.0	1.5	1.2	0.7	0.7	0.4	0.2	0.15	0.15
8	0.7	0.8	—	0.7	0.7	0.7	0.5	0.2	0.2	0.2	0.1	0.15
Mean	1.2	1.3	1.2	0.9	0.8	0.78	0.5	0.3	0.25	0.25	0.17	0.14

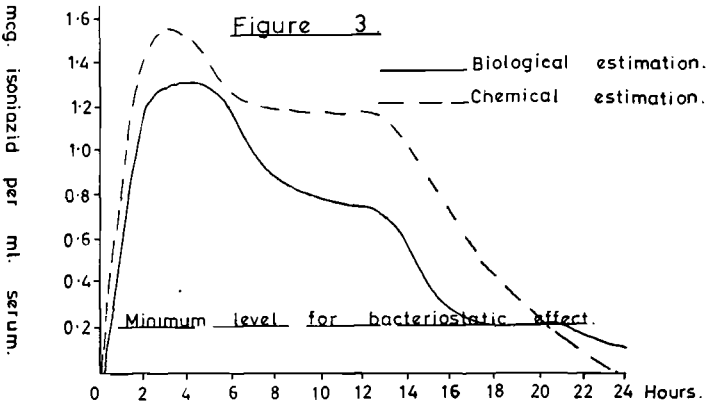
N.B.—All figures represent micrograms isoniazid per milliliter serum.

(*b*) Chemical estimation

Cow	3 hours	6 hours	12 hours	17 hours	24 hours
	mcg/ml	mcg/ml	mcg/ml	mcg/ml	mcg/ml
1	1.44	0.70	0.76	0.42	0
2	1.68	—	1.14	0.70	0
3	2.40	0.72	1.32	0.50	0
4	1.76	1.56	1.22	0.60	0
5	1.08	1.91	1.38	—	—
6	0.98	1.42	1.41	—	0
Mean INH	1.56	1.26	1.20	0.55	0

It was found that pure isoniazid powder is sometimes blown out of the mouth during dosing; therefore all drug administration was done by dosing syringe or bottle. The water solution was prepared immediately prior to dosing.

The average results of both the chemical and the biological isoniazid determinations are compared in figure 3.



Discussion

Considerable blood levels were attained with both dosages in all animals and with all administration methods. The levels of isoniazid, as a function of time following an oral dose, varied significantly between calves and adults and between individuals. Assessing the value of the different dosing methods it can be stated that administration of pure powder per os definitely resulted in the highest average blood level. The isoniazid watersolution gave similar levels after six and 24 hours but the seventeen hours values were distinctly lower than with the first method. Premedication of sodium bicarbonate given to close the oesophageal groove produced significantly lower serum levels in adult cattle which might be explained by the differences in the digestive processes in the forestomachs of ruminants in contrast to the abomasum and intestines. This dosing method resulted in a rise of the isoniazid level at the 24 hours value in both adults and calves to which an explanation cannot be given. Of great practical importance is the finding that the microflora of the rumen does not seem to have any adverse effect on isoniazid and that a relatively constant bloodlevel is achieved by a single dose once a day. The explanation appears to lie in the fact that great amounts of food and fluid are kept in the stomachs of ruminants for long periods and that the absorption of fluid by the walls of the stomachs is much slower than in human beings or carnivores the blood level of which show high peaks and a rapid decline. For the same reason, viz. the quick absorption of fluids in the alimentary tract of calves these showed considerably higher 6 hour peaks than the adults.

The mixing of isoniazid powder into rations in communal throughs produced great variations in blood levels obviously as a result of differences in the amount of concentrate taken in. Administration of the drug in communual water troughs and feeding places is therefore not advisable.

Consideration of the results obtained with dosages of 10 mg/kg b.w. makes it apparent that this dosage is not much inferior to the dose of 20 mg/kg b.w. A bacteriostatically effective bloodlevel is attained for a period of 21 hours with 10 mg/kg and doubling the dose would only extend this period for 3 hours till the next dose is given. In fact a 50% increase of the general dose to 15 mg/kg b.w. failed to produce a clearly better therapeutic result in a field trial with 23 tuberculous cattle as compared with the results of treatment with 10 mg/kg b.w.

The problem in evaluating the dosages and blood levels is to determine what concentration is bacteriostatically effective and during what portion of the 24 hour period must the drug maintain effective concentrations. The length of intervals between such periods should depend on the generation time of the bacteria. The minimum concentration of isoniazid in vitro to inhibit tubercle bacilli is reported to be 0.015 mcg/ml, 0.02 mcg/ml or 0.025 mcg/ml.[5],[10],[21] In vivo concentrations above 0.5 mcg/ml are generally accepted as a state of complete bacteriostasis. For humans it is recommended that the dosage be adjusted so as to achieve serum levels of 3.2 mcg/ml at 2 hours and 0.8 mcg/ml at six hours after ingestion.[18] It is very probable, however, that a serum level of 0.2 mcg/ml is also sufficient to stop multiplication of tubercle bacilli as field strains of M. tuberculosis var. bovis are completely inhibited by this concentration in culture media and growth in the diffusion test method is retarded up to height of 2 cm above the surface of such serum.

By dosing 10 mg/kg daily for many months the extraordinary state will develop of an animal so permeated by the drug suppressing the multiplication of the tubercle bacilli that it is a totally unsatisfactory host to the organisms. The greatest proportion of the bacillary population is killed in a short time but the therapy is wanting in two ways. Although isoniazid permeates readily through the bacterial cell membrane and has great penetrant action in casesous lesion it will only achieve adequate concentrations in the lumen of lung cavities and lymphnode absecesses if well-vascularized tissue encircles their walls. Secondly bacilli which are in a state of complete rest, the dorment or latent state, can escape its action. Further the whole complex of defence mechanisms plays an important role in the elimination of the infection. Two problems arise: how long should tuberculous cattle be treated and how effective is this in preventing future relapses. The results of bacteriological studies on 145 treated tuberculous cattle suggest that the minimum period of continuous treatment should be eight months.[17] This can also be regarded as the optimum period in most cases from an economical point of view. In this respect it is of interest to note that for human patients nine months is generally recommended as the minimum period of treatment.

Experience in the field has shown that the easiest method of treatment is to mix the isoniazid powder into the rations where separate feeding

troughs for cows are in use. Dosing of cattle under pure ranching conditions is more difficult because the animals have to be dosed in the crushpen with dosing guns or dosing syringes. Under the circumstances the best way is to estimate the live weight of all the cattle to be treated, weigh the total amount of drug required per day and prepare a water solution with a measured quantity of water. Both dosing methods may be combined on the same farm. Cows in milk receive the drug as pure powder mixed with the ration and dry and young stock are dosed with a water solution in the crushpen.

Accumulation of the drug in normal tissue has not been observed,[19] the meat will be free of active isoniazid 36 hours after the last dose was given.

The effect of long-term treatment with isoniazid on the immunological response of cattle needs to be studied further. There is a rapid reduction in the size of the antigenic stimulus provided by the bacterial population, but there are also definite symptoms of mobilisation of the host defence mechanisms. The disappearance of tuberculin allergy in the majority of cases indicates a suppression of antibody formation.

Comparing the results of the biological method for isionazid determination with those of the chemical method it is evident that the chemical assay was constantly measuring higher quantities than could be confirmed biologically. This is due to the interference of derivates of isoniazid in the chemical test which are ineffective tuberculostatically. The chemical assay failed to detect amounts of 0.1 to 0.2 mcg/ml in the serum collected 24 hours after ingestion.

Summary

(1) General problems of chemotherapy of tuberculosis, requirements for effective tuberculostatic drugs and the significance of the bloodlevel are discussed.

(2) Experimental evidence has been produced to prove that oral administration of isoniazid to cattle produces bacteriostatically effective blood levels for a considerable length of time.

(3) A daily dosage of 10 mg/kg b.w. isoniazid per os for a period of 8 months is recommended.

(4) The best methods of administration are the mixing of the pure powder into the ration or the dosing of a water solution once daily. Premedication with sodium bicarbonate solution is not suitable.

(5) A microbiological assay method for the determination of free active isoniazid in serum is described.

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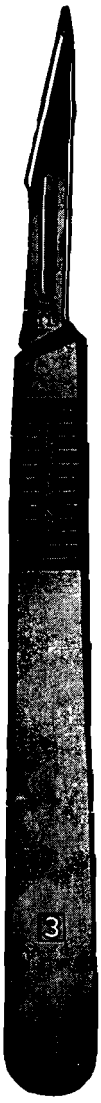

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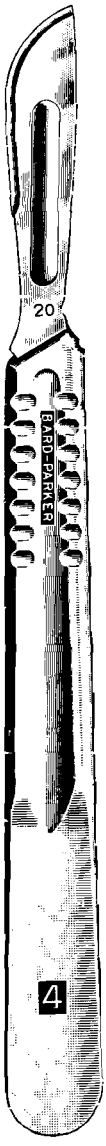

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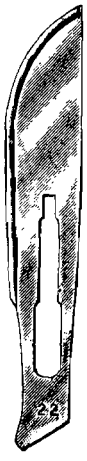

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COMPARISON OF EFFICACY OF DIFFERENT TETRACYCLINE ANTIBIOTICS AND DIFFERENT FORMULATIONS OF THESE ANTIBIOTICS IN THE TREATMENT OF HEARTWATER. I: COMPARISON OF FIVE TETRACYCLINE FORMULATIONS IN THE TREATMENT OF HEARTWATER IN SHEEP

J. D. H. Poole P.O. Box 7552 Johannesburg

(*Received for publication, 9th August*, 1961)

Experimental Method

A flock of sheep belonging to a farmer in the Grahamstown area was used for this experiment. The flock consisted of 590 Merino-type sheep of different ages and sizes, including some three- to six-week old lambs. Part of the flock consisted of sheep newly introduced from a non-heartwater area and part consisted of sheep which had been on the farm for two years.

The whole flock was infected intravenously with heartwater blood supplied by the State Veterinary Department in Grahamstown, on the 28th of April, 1961. The strain was that which is now exclusively used for immunisation purposes in this area, i.e. the Ball-3 strain.

Temperatures

Rectal temperatures were taken and recorded on the 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, 17th and 20th days after infection. The minimum rectal temperatures, at which treatment was carried out, were as follows:—

Warm sunny days	7 a.m. to 10 a.m.	104°F.
	10 a.m. to 11.30 a.m.	104.5°F.
Cold and/or overcast days		104°F.

Occasional double checks on individual sheep indicated that high atmospheric temperatures increased the average normal rectal temperature of sheep; under these conditions the higher minimum rectal temperature was used.

Experimental Groups

Group 1—Chlortetracycline Hydrochloride Injectable Suspension in Oil.
Group 2—Chlortetracycline Bisulphate Soluble Powder (Experimental Formulation based on chlortetracycline bisulphate Formulation A). Completely Soluble.
Group 3—Chlortetracycline Hydrochloride Powder (Tinted).
Group 4—Tetracycline Soluble Tablets.
Group 5—Tetracycline Soluble Powder.
Group 6—Oxytetracycline Soluble Powder.

Allotment of Sheep to Experimental Groups

Only those sheep which had temperatures over the minima mentioned above were allotted to experimental groups each day. To ensure that sufficient numbers were obtained in Groups 3 to 6, all reactions on the 8th day were allotted to these four groups only. On the 9th day Group 2 was included, and on the 11th day Group 1 was included. Coloured plastic ear tags with numbers were used for identification purposes.

As the sheep reacted, they were allotted to each of the groups in turn, so that younger and older sheep as well as long and short-woolled sheep were distributed at random throughout the groups.

Sheep reacting after the 12th day of infection were not included in experimental groups. Those included in the experiment numbered 321 and there were about 70 late reactors which were treated but not included in the experiment.

Treatment

Treatment was carried out solely by the intramuscular route for the following reasons:

(1) Intravenous injections on large numbers of sheep[3]would be time consuming and impracticable under field conditions.

(2) With certain of the formulations, in particular the chlortetracycline formulations, experience seems to indicate that intravenous injection has no clinical advantage over intramuscular injection in the treatment of heartwater.

(3) Formulas with oil vehicles cannot be used intravenously.

Dosage

A standard dose of approximately 2 mg° per pound body weight was used for all antibiotic preparations. Since the animals were not weighed, dosage in all cases was approximate. The majority of sheep received a total of 200 mg at each injection. This provided an approximate dose of 2 mg. per pound of body weight but not more than 200 mg. per day. Repeat injections were given whenever the temperature was above the minimum, regardless of whether an injection had been given on the previous day or not.

The various tablet and powder formulations were mixed with distilled water to attain a concentration of 200 mg. active ingredient per 5 ml. of final solution. The chlortetracycline suspension in oil contained 25 mg. per ml. which necessitated a volume of 8 ml. per injection.

Results and Discussion

Clinical Efficacy

The number of treatments at this dosage level required to reduce the temperature below the prescribed minima, was the criterion used to judge efficacy.

Table I lists the different treatments in order of efficacy and gives the number of sheep in each group, the total treatments required, and the average number of treatments required per sheep. In evaluating the clinical efficacy of the different formulations under test, it was assumed that the actual day on which the reaction occurred should have no effect on the response to the antibiotic.

TABLE 1

Group	Treatments (In order of efficacy)	Number of Sheep in Group	Total Treatments Required	Average Number of Treatments per Sheep*
1	Chlortetracycline hydrochloride suspension in oil....	32	35	1.09
2	Chlortetracycline Bisulphate solublle powder.....	30	54	1·8
3	Chlortetracycline hydrochloride powder.....	51	101	1.98
4	Tetracycline soluble tablets..	71	154	2.17
5	Tetracycline soluble powder	71	165	2.32
6	Oxytetracycline soluble powder	66	166	2.52

NOTE:
For brevity of reporting, the actual temperature charts of individual sheep in the experiment, are not included in this report. However, they will be made available to interested readers on request to the writer.

Statistical Analysis

At the 1% *level:* The difference between treatment 1 and all others was significant. The results in Groups 2, 3 and 4 were significantly better than those in Group 6.

At the 5% *level:* The difference between Group 2 and Group 4 was significant.

TABLE 2

Per cent of sheep requiring 1, 2, 3, 4 and 5 treatments respectively

Group	Treatment	Number of Treatments				
		1	2	3	4	5
1	Chlortetracycline suspension in oil.....	% 90.6	% 9.4	% 0	% 0	% 0
2	Chlortetracycline Bisulphate powder.....	40	40	20	0	0
3	Chlortetracycline Hydrochloride powder.....	35.4	37.5	21.5	5.5	0
4	Tetracycline tablets....	21.1	38	30	10	1.4
5	Tetracycline powder....	31	40.8	1.4	5.6	4.2
6	Oxytetracycline powder	22.7	25.5	28.8	18.1	3

From Table II it can be seen that one injection per sheep with chlortetracycline suspension in oil was sufficient for the majority (90.6%) of cases. Two injections of the preparations used in groups 2 and 3 may have possibly also sufficed in the majority (73.80%) of cases. In this connection it would be interesting to carry out another experiment with the three best preparations and give only the prescribed one or two injections (say on the 10th and 12th day), and observe the results. It would be most useful to establish whether one could make a standard recommendation to inject once or twice on prescribed days after infection and so do away with the necessity for taking temperatures.

Ease of Application

The chlortetracycline suspension in oil was the easiest of the six preparations to use, as no mixing is required. One drawback of the chlortetracycline hydrochloride powder is that only small quantities can be made up at a time, otherwise, it crystallises on standing. All the other preparations proved to be completely soluble at the concentrations required and did not crystallise on standing.

Pain and Irritation at Site of Injection

All the preparations except chlortetracycline suspension in oil caused considerable pain on injection. The most irritant was chlortetracycline hydrochloride powder which caused considerable lameness in some animals. The lameness usually was no longer noticeable after one or two days, but in a few cases lasted for as long as 10 days. The other powder formulations also caused lameness but not of such long duration. No lameness or swelling at the site of the injection was caused by chlortetracycline suspension in oil in spite of the larger volume which had to be injected (8 ml.)

Cost of Treatment

The cost per 200 mg. dose of each preparation in South Africa as well as the average cost per sheep in this experiment is given in the following table.

TABLE 3

Drug	Cost per 200 mgm Dose	Approximate Average Cost per Sheep in this Experiment
Chlortetracycline suspension in oil.....	33c	36c
Chlortetracycline bisulphate powder.....	10c	18c
Chlortetracycline hydrochloride powder....	10c	20c
Tetracycline tablets	40c	86.8c
Tetracycline powder.....	10c	23c
Oxytetracycline powder	10c	25c

SUMMARY

Five hundred and ninety Merino sheep were infected with heartwater blood, and the subsequent reactors were treated with six different formulations of different tetracycline antibiotics at 2 mg. per pound body weight. According to the average number of treatments required per sheep to bring body temperature back to normal, these formulations were placed in the following order of efficacy—

(1) Chlortetracycline Hydrochloride Suspension in Oil.
(2) Chlortetracycline Bisulphate Soluble Powder.
(3) Chlortetracycline Hydrochloride Powder.
(4) Tetracycline Hydrochloride Soluble Tablets.
(5) Tetracycline Hydrochloride Soluble Powder.
(6) Oxytetracycline Hydrochloride Soluble Powder.

ACKNOWLEDGEMENTS

The co-operation of the following people made this experiment possible—Dr. L. W. Rossiter, Senior State Veterinarian, Grahamstown; Mr. O'Neill and Mr. Kramer of the State Veterinary Office, Grahamstown; Mr. A. Pike, owner of the sheep; Mr. A. W. P. Coleby, who carried out the statistical analysis of the results; Mr. E. Holmden, who assisted in carrying out the experiment. The writer wishes to thank these gentlemen for their valuable help.

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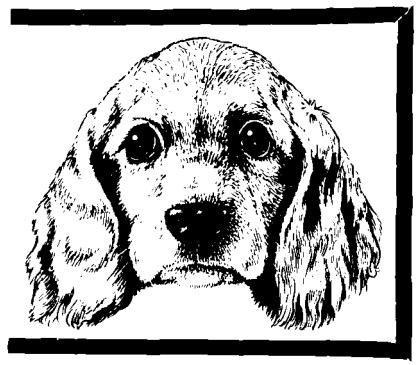

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TRIALS WITH BAYER 2353* AND OTHER DRUGS AS CESTOCIDES FOR RUMINANTS

S. Stampa & H. J. J. Terblanche
Veterinary advisors to Agro-chem. (Pty.) Ltd., P.O. Box 1366, Johannesburg.

Received for publication, July 1961

INTRODUCTION

Information on a tapeworm anthelmintic of remarkable efficacy and low toxicity has recently become available. This cestocide is Bayer 2353, which is chemically N-(2′ chlor 4-nitrophenyl)-5-chlorsalicylamid ((1) Gönnert & Schraufstätter, 60 (2) Hecht & Gloxhuber, 60 & (3) Strüfe & Gönnert, 60). Trials on *Hymenolepis diminuta* of rats by Hecht & Gloxuber at a dosage rate of 100–200 mg/kg proved highly effective. Furthermore, dosage rates of 1,000 mg/kg in rats and rabbits caused a temporary weakness only, but no mortalities. They also report a trial in which 10 rats were dosed at 2,500 mg/kg daily for 30 days with no mortalities.

The common tapeworms of ruminants in Southern Africa are *Moniezia expansa*, *Moniezia benedeni*, *Thysaniezia giardi* and *Stilesia hepatica*. The latter is only found in sheep, where all age groups can become infested. The other species are seldom found in adult stock in which they appear to cause less harm than in young animals.

Field trials with Bayer 2353 were carried out in various areas in South Africa on ruminants infested with one or more of the above species. In addition Hexachlorophene and Neguvon "A" were also included in some trials for comparative purposes.

MATERIALS AND METHODS

(1) Infested stock were dosed at various dosage rates with Bayer 2353. The efficacy was compared with undosed controls by faecal examinations at varying intervals after dosing.

(2) Results were confirmed by post morten at intervals varying from 5–7 days after treatment.

(3) To ensure the safe use of Bayer 2353 under various conditions, areas with different systems of animal management, climate, grazing, etc. were used for trials.

(4) Toxicity trials were undertaken.

(5) The severity of infestation and the rate of expulsion of tapeworms was established.

* Trade name: LINTEX—available to the profession only.

RESULTS

Most trials were conducted on stock infested with Moniezia spp. and Thysaniezia spp. The results are summarised in Table I.

TABLE I

ANIMALS INFESTED WITH MONIEZIA, THYSANIEZIA AND AVITELLINA

Infestation	*Livestock Treated*		Dosage rate and formulation	*Examination after Treatment*		
	Species	Age and weight		Period in days	Post mortem	Faecal examination
A. Moniezia Thysaniezia	5 merino lambs 5 merino lambs	2–3 months 28–38 lbs. do	59–80 mg/kg—in tablet form Controls treated with Neguvon A: 50–70 mg/kg	5 5	5 neg. 3 pos.	5 neg. 2 pos. 3 neg.
B. Moniezia**....	6 merino lambs 6 merino lambs	3–4 months 10½–27 lbs. do	50 mg/kg of a 5% suspension in water Untreated controls	7 7	2 neg.** 4 pos.** not killed	 5 pos. 1 neg.
C. Moniezia Thysaniezia	6 merino lambs 6 merino lambs	4 months 33–51 lbs. do	50 mg/kg as a 5% suspension in water Untreated controls	7 7	6 neg. 5 pos. 1 neg.	6 neg. 6 pos.
D. Moniezia.....	6 merino lambs	4 months 30–40 lbs.	1 gram each in tablet form	7	6 neg.	—
E. Avitellina Thysaniezia	4 Dorper lambs 3 merino lambs	5 months 36–47 lbs. 6–7 months 27–48 lbs.	55–57 mg/kg as a 10% suspension in water do	5 5	4 neg. 3 neg.	4 neg. 3 neg.
F. Thysaniezia Moniezia	61 Angora kids	6–8 months 35–50 lbs.	1.25 gram each of a 75% dry wettable powder (= 55–80 mg/kg)	16	not slaughtered	30 samples taken at random: all neg.
G. Moniezia.....	1 calf	3 months 92 lbs.	1.9 gram of a dry wettable powder (45 mg/kg)	5	pos.	positive
H. Moniezia.....	1 calf	3 months 80 lbs.	1.8 gram of a dry wettable powder (48.5 mg/kg)	6	neg.	negative
I. Moniezia.....	2 calves	3–5 months 94–132 lbs.	50 mg/kg of a 10% suspension in water	7	2 neg.	2 neg.
J. Moniezia.....	1 calf	3 months 80 lbs.	76 mg/kg of a 25% suspension in oil	2	neg.	negative
K. Avitellina Moniezia	1 calf	4 months 98 lbs.	50 mg/kg of a dry wettable powder	21	—	negative
L. Thysaniezia....	1 cow	1,200 lbs.	50 mg/kg of a dry wettable powder mixed with concentrate	weekly for 4 months	—	negative
M. Moniezia.....	5 Jersey calves	6–9 months 112–186 lbs.	96–159 mg/kg of a 20% suspension in water	3	—	5 neg.

A & D = Edmunton, C.P.
B = Grahamstown, C.P.
C = Middelburg, C.P.
E = Hekpoort, Tvl.
F = Kranzdrift, C.P.
G. H, I, J, K, L = Eastern Province
M = Pretoria, Tvl.

** *Experiment B:* At a dosage rate of 50 mg/kg, the 2 larger lambs in this group (26 & 27 lbs.) reeeived approximately 0.6 grams active ingredient Bayer 2353—effective. The smaller lambs received proportionately less, i.e. approximately .25 grams active ingredient Bayer 2353—not effective. In very small lambs, therefore, a dosage rate of 50 mg/kg is insufficient.

TOXICITY TRIALS WITH BAYER 2353

Lambs, calves and Angora kids were subjected to heavy overdosing with this cestocide. The results are shown in Table II, and clearly indicate the safety of this drug even at a dosage rate of 10 times the therapeutic dose.

TABLE 2

The effects of overdosing Bayer 2353 or dosing animals with Entiritis

Animal Species	Weight	Dosage Rate	Result
2 lambs	21–33 lbs.	100 mg/kg.	No ill effects
4 calves	79–169 lbs.	110–158 mg/kg	do
2 calves	54–71 lbs.	250 mg/kg	do
9 lambs	15–34 lb	250 mg/kg	do
5 Angora kids	20–31 lb	250 mg/kg	do
5 lambs	17–28 lb	500 mg/kg	do
5 Angora kids	17–28 lb	500 mg/kg	do
2 emaciated calves with Enteritis	90 & 94 lb	45 & 76 mg/kg	Died 2 & 4 days resp. after treatment

A flock of 360 lambs, 8–10 months of age, running on *Amblyomma hebraeum* infested veld, was given 55–70 mg/kg. of this drug. One lamb died 24 hours after treatment. Heartwater was diagnosed on post mortem as the cause of death. The rest showed no ill effects.

ESTABLISHMENT OF THE SEVERITY OF INFESTATION AND THE RATE OF EXPULSION OF TAPEWORMS AFTER TREATMENT WITH BAYER 2353

In this trial 8 Dorper and Merino lambs, excreting *Avitellina* and *Thysaniezia* segments in their droppings, were dung-bagged for 3 days after treatment. Dung collection was undertaken once daily, and the tapeworms (and segments) separated and cleansed by repeated washing. The volume of cestodes excreted was determined by displacement of water in a measured cylinder. Three lambs with no segments in their droppings were also treated and kept as controls for comparison.

The dosage rate of all lambs was 55 mg/kg. Seven animals were killed for post-mortem 3 days after treatment as part of the efficacy trials.

RESULT

It was found that these lambs excreted a total volume of tapeworms, which varied from 3 c.c. to 41.5 c.c. per lamb. The largest quantities were found in the first dung collections (24 hours after treatment). Forty-eight hours after treatment only a few segments could be isolated from the dung, and no segments at all were found during the dung examination, carried out 72 hours after treatment.

TRIALS WITH BAYER 2353, HEXACHLOROPHENE AND NEGUVON A AGAINST STILESIA HEPATICA

Thirty animals infested with *Stilesia hepatica* were divided into three groups, and dosed with Bayer 2353, Hexachlorophene and Neguvon A respectively. Different dosage levels were used. Post mortem examinations, five to twenty-one days after treatment, proved all three drugs to be ineffective even at dosage rates twice the therapeutic dose.

Neguvon A removed gastro-intestinal cestodes from 4 out of 6 sheep at a dosage rate of 60 mg/kg. but was much less effective at lower dosage levels.

Discussion

Bayer 2353, whether used in the form of dry powder, tablet, suspension in water or suspension in oil, proved to be highly effective against the common gastro-intestinal cestodes of ruminants at a dosage rate of 50 mg/kg. In very young lambs a dose of less than 0.6 grams active ingredient proved to be ineffective. A minimum dose of 1 gram active ingredient in lambs proved to be highly effective. It was not effective at 45 mg/kg.

This substance is ineffective against *Stilesia hepatica* even at four times normal dosage levels. At a dosage rate ten times the therapeutic dose, the toxic margin was not reached. An animal, presumably with latent heartwater, died after dosing with this material. Whether the drug is indirectly responsible for the mortality seems rather unlikely, although it is possible. Emaciated calves with Enteritis and diarrhoea died after dosing. Whether these calves would have died irrespective of Bayer 2353 dosing, is not known but very likely. The elimination of Cestodes from the digestive tract was complete 48 hours after treatment irrespective of the degree of infestation.

Summary

(1) Apart from very young lambs, Bayer 2353 at 50 mg/kg dosage eliminated *Moniezia*, *Thysaniezia* and *Avitellina spp.* from infested stock.

(2) The minimum dose for very young lambs was 1 gram active ingredient irrespective of their live weight. Thereafter 50 mg/kg. proved effective.

(3) Dosage rates of ten times the therapeutic dose showed no evidence of toxicity in lambs, kids and calves.

(4) Gastro-intestinal cestodes were eliminated within 48 hours after treatment.

(5) Hexachlorophene and B 2353 were ineffective against *Stilesia hepatica.*

(6) Neguvon A at a dosage rate of less than 60 mg/kg was ineffective against gastro-intestinal cestodes.

ACKNOWLEDGMENT

Thanks are conveyed to Dr. R. K. Reinecke, chief of the Department of Helminthology, Onderstepoort, for assistance rendered in many respects, including the lay-out of this paper.

The many farmers, who assisted and made their farms and animals available for field trials, are thanked very cordially.

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A SUGGESTED ROLE FOR COPPER IN THE ARSENIC RESISTANCE OF THE BLUE TICK, *BOOPHILUS DECOLORATUS* KOCH

J. S. Harrinton P.O. Box 1038, Johannesburg

(*Received for publication 25th May* 1961

INTRODUCTION

The existence of arsenic resistance in the blue tick in certain regions of South Africa has been known for some 20 years (du Toit, Graf and Bekker, 1941),[3] and within a short period of time the arsenic-resistant tick has been found subsequently in a narrow coastal belt stretching from the Eastern Cape to Natal although in inland areas the tick is still sensitive to arsenic.[1, 22] The development and the mechanism of this resistance in the blue tick are well covered in two interesting reviews by Whitehead.[20, 21]

The affinity of arsenicals for sulphydryl groups, first suggested by Paul Ehrlich, and later well supported by the work of Voegtlin, Dyer and Leonard[17], Fink[6], and Forgash,[7, 8] provided a working hypothesis for a study of the association of sulphydryl compounds with the arsenic resistance of the blue tick. Thompson and Johnston[16] had shown that embryos of the resistant strain (R) of the blue tick contain slightly more than twice as much sulphydryl groups (SH) as the sensitive strain (S). However, in a similar study on *Boophilus microplus* in Australia, Roulston and Schuntner found that they could not correlate arsenic resistance in this species with a greater relative abundance of SH groups in the R strain because no differences in levels could be found in embryos of the same age of both strains.[15]

Harington extended the work of Thompson and Johnston and showed that the levels of cystine-cysteine, reduced glutathione and total free sulphydryl in blue tick larvae of the R strain were significantly higher than those in the S strain.[9] Harington had already shown (unpublished) that the levels of free SH and reduced glutathione (GSH) in R strains of the blue tick were considerably depressed following the treatment of larvae with varying concentrations of arsenious oxide; this had already been shown to happen in *Periplaneta.*[7]

Three features which emerged from the work described above suggested that copper might be implicated in the development of resistance to arsenic by *B. decoloratus*, namely:

(*a*) The existence of the R strain in a coastal belt where copper deficiency in soils and pasture is well known.[13, 14]

(*b*) the establishment of higher levels of SH compounds in R strains than in S[16, 9]; and

(*c*) the role of copper in the oxidation catalysis of glutathione and other SH compounds.

A Proposed Role for Copper in the Development of Arsenic Resistance in the R Strains of the Blue Tick

The increased levels of SH compounds found in the R strain gave rise to the possibility that the redox equilibrium of such compounds had been adjusted in this strain to allow a reduced state to predominate in cellular processes, in other words, for example, that the redox equation for reduced glutathione (GSH),

$$2\ GSH \rightleftharpoons GSSG + 2H,$$

tended towards the left, thus allowing a greater production of GSH for the detoxification of arsenic. As this favoured the livelihood of the tick, this adjusted equilibrium would probably be maintained.

Materials and Methods

An experiment was therefore carried out to test the ability of extracts of R and S strains to dehydrogenate GSH, that is, the ability of the extracts to work from left to right in the above equation.

The method used was a modification of that of Kun and Abood.[10] Tick larvae of R and S strains (0.6 gms) or more, depending on the enzyme content, were homogenized in 10 mls. of ice-cold 0.1 M phosphate buffer (pH 7.4). The homogenate was used directly for duplicate estimations of glutathione dehydrogenase activity.

Into the main part of a Thunberg tube were pipetted:
1 ml. phosphate buffer,
1 ml. tick homogenate (R and S in separate tubes).
Into the side-arm were pipetted:
1 ml. substrate (reduced glutathione, M/50, in water),
1 ml. of freshly-prepared 2, 3, 5 triphenyltetrazolium chloride solution, (TTC), 0.001 M.

After the contents of the tubes were mixed by careful shaking, the tubes were incubated at 38°C. for one hour when 1 ml. of 20% trichloroacetic acid was added to each (to stop the reaction), and then 5 mls. toluene (to extract the triphenylformazan). The tubes were vigorously shaken and the contents centrifuged, after which the clear supernatant was drawn off for colorimetric reading at 480 mμ.

A blank of normal homogenate from both strains, heated to 100°C. for 5 minutes, produced no formazan. A calibration curve was obtained by reducing TTC with sodium hydrosulphite as described by Kun and Abood.[10]

Results

Dehydrogenase activity of R and S strains with reduced glutathione as substrate

No. of determinations	Strain of tick	Amount of Formazan produced (γ/ml)
1	Sensitive	29.5 = mean: 28.0
= 2	Sensitive	26.5 —
3	Resistant	7.0 = mean: 8.0
4	Resistant	9.0 —
5	Blank (S)	0.0
6	Blank (R)	0.0

On these figures, the S strain has 3.5 times the glutathione dehydrogenase activity of the R. In other words, it seems that the R strain, in addition to having two and a half times more GSH than the S strain, has this pool further safeguarded by having it 3.5 times less oxidised (dehydrogenated).[9] Also, it seems that the redox equilibrium for glutathione is indeed pushed over to the left (towards GSH) in the R strain, or conversely, to the right (towards GSSG) in the S strain.

The oxidation of reduced glutathione,

$$\underset{\text{(reduced)}}{2\ GSH} \longrightarrow \underset{\text{(oxidised)}}{GSSG} + 2H,$$

as in the case of other sulphydryl compounds such as cysteine and thioglycollic acid is catalysed by copper and curiously not nearly to the same degree by the other heavy metals which appear to be normal physiological components of tissues such as Fe, Mn, Ni or Zn.[19, 5, 4, 18] And in addition to this role for copper there are other indications of a physiological and pharmacological relationship between copper and glutathione.[18] It was therefore next considered whether a higher titre of this element would be detected in S strains of the blue tick when compared with the levels in R strains.

Preliminary spectrographic analyses of tick larvae and adults (with the ingested cattled blood removed) showed that the S strains possessed considerably higher levels of copper than did the R ones, and in a later study on the copper levels of the ingested cattle blood removed from the adult ticks, and of R and S cattle blood themselves, a marked predominance of copper in S material over R was found. The values obtained from these determinations are extremely tentative however and represent the results of a preliminary probe; for this reason they are not quoted in this paper.

Discussion

Whitehead has indicated that the development of resistant strains along the South African coastal belt might be due to the climatic conditions prevailing there.[20, 21] These could be expected to favour a high reproductive potential, which in turn would lead to more frequent treatment with insecticide. As a result of these two factors operating in

parallel, a more rapid selection of resistant-individuals could be expected. Although the present paper proposes the new factor of a relative copper deficiency in the coastal areas as being partly responsible for the development of resistance, the two suggestions support each other quite adequately.

The experiments described above were designed to investigate the hypothesis that a *relative* copper deficiency along the coastal zones of South Africa might give rise to a higher sulphydryl content in the ticks from those areas, thus conferring upon them a greater ability to detoxify arsenic, and allowing them to become resistant to this insecticide. But before this hypothesis can be regarded as acceptable, a number of supporting clauses should be tested:

(*a*) it is desirable that both components of the GSH—GSSG equilibrium in R and S ticks be measured and compared. The *total* glutathione content, that is, GSH + GSSG, should be found to be the same in both strains, but the components should differ. More GSH compared with GSSG must be found in the R strain total, and less in the S strain total. This aspect has not yet been investigated. It does assume of course, that total glutathione is constant for both tick strains, and this is not yet known.

(*b*) Chemical analyses for copper must be made (with stringent sampling techniques and statistical treatment) of the following materials:

(i) tick eggs and larvae of known age; R and S.

(ii) tick adults (freed of ingested blood); R and S.

(iii) host blood (from cattle in R and S areas).

(iv) pasture (from R and S areas).

(v) soil (from R and S areas).

None of the above analyses has yet been carried out under the conditions stipulated, and information on copper levels given in this paper must at best be regarded as being by nature tentative.

(*c*) the assumption is made that if lower levels of copper are found in R than in S strains, a higher titre of SH compounds should result.

On face value this should be correct, in view of the well-established role for copper in the oxidation of sulphydryl compounds, but it can be argued that as a catalyst, copper acts in trace amounts, and that even the low levels found in the resistant ticks should be sufficient to maintain an equilibrium no different from that found in the sensitive strain. But good supporting evidence that this need not be so is found in the work of Marston[11, 2] on the effects of copper deficiency in wool fibre. Marston found by histochemical techniques that a normal wool fibre contains SH groups extending over a distance of approximately 100 μ and that this sulphydryl area ceases quite abruptly in the fully-keratinized portion of the fibre. In a wool fibre from a sheep with a low copper status however, the sulphydryl zone extends for 1000 μ or more—practically the whole of the fibre reacting strongly. On dosing the deficient animal with copper, this greatly-increased zone of free SH groups retracts to its normal position within a few hours. As Marston reports, this evidence leaves little

doubt that copper is primarily responsible for catalyzing the oxidative closure of the thiol residues (SH) of the prekeratin fibrous protein to the disulphide (–SS–) linkages of keratin. The rate at which this reaction proceeds is a measure of the copper status of the sheep.

Burley studied the distribution of SH groups in wool from copper-deficient sheep by means of a specific SH reagent, and compared it with that in normal fibre after the same animals had been returned to normal copper status by supplementary feeding of copper sulphate.[2] He found a clear line of demarcation between "copper-deficient" and "normal zones". He showed by chemical analysis that the average concentration of SH groups was 26 micromoles per gm. in "copper-deficient wool" and 10 micromoles per gram in "normal" wool from the same staple. In other words, a deficiency in copper had increased the SH level some $2\frac{1}{2}$-fold.

These results should be seen in the light of Marston's remarks that whereas a blood level of 1 μgm. copper per ml. is a good average for man, laboratory animals and stock, a persistent level of 0.6 μgm. copper per ml. means a seriously—depleted status, and one above 1.3 μgm. copper per ml. signified that the animal has been, or is, in receipt of copper in considerable excess of its requirements[12]. A drop in level therefore, from 1 μgm. to 0.6 μgm. copper per ml. in blood can therefore be correlated with derangement of the SH—SS equilibrium in wool fibre.

Finally, an alternative and opposite hypothesis suggests itself, and this is that the copper levels in S cattle might be abnormally high, and those in R cattle normal, but in view of the reported copper deficiency in the coastal area homes of the R cattle, this seems hardly likely to hold water, and should clear decreases in copper levels in R situations be confirmed and established, it remains to be seen whether an increased copper intake in cattle in resistant areas would modify the resistance to arsenic of their tick parasites, and so reduce them to the susceptibility to arsenic found in sensitive strains.

Results on the copper-sulphydryl relationship in Australia where tick resistance to arsenic is well-established would be valuable, but the difficulty there is to find a resistant strain of *Boophilus microplus* which possesses demonstrably higher SH levels than those in sensitive strains.[15, 23] This has not yet been done and as far as the hypothesis proposed in this paper is concerned, the Australian data cannot yet be assimilated.

Summary

1. An hypothesis (based partly on theoretical and partly on practical information) is proposed that a *relative* copper deficiency might account for the arsenic-resistance of certain strains of the blue tick, *Boophilus decoloratus* found in coastal regions of South Africa.

2. Resistant strains of this tick have been shown to contain a higher level of sulphydryl compounds, and (in a preliminary analysis) lower levels of copper than do sensitive strains. The redox equilibrium for

glutathione in the tick is adjusted in the R strain to lead to a greater production of SH compounds, presumably for the purpose of arsenic detoxification.

3. There are sound biochemical explanations for these results because copper catalyses the oxidation of sulphydryl compounds. A low copper status in an animal or organism should therefore result in a greater level of sulphydryl compound. This association has been well established by several workers in studies on the wool fibre of sheep having normal and low copper levels, and should be applicable to tick relationships.

4. It is suggested that if the copper intake of cattle in resistant tick areas is increased the tick population might conceivably over a period, become sensitive to arsenic.

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TRIALS WITH BAYER L 13/59 (NEGUVON) FOR THE CONTROL OF FLEAS ON DOGS AND CATS

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Introduction

In the past, fleas were well controlled by BHC and other chlorinated hydrocarbons, used either in a bath or as a dusting powder and in breeding places. However, reports were received recently from several parts of South Africa that satisfactory results could no longer be obtained with these materials. We were able to confirm these reports as far as fleas (*Ctenocephalides canis*) found on dogs and cats in the city of Grahamstown are concerned. These could not be killed by a dusting powder containing 0.6% Lindane.

While searching for a suitable alternative, Neguvon (Bayer L 13/59) seemed to offer most advantages required in this field of pest control, as it has a very low toxicity to mammals and is not very stable in humid surroundings, thereby eliminating the danger of cumulative toxicity. Furthermore, it is virtually free from smell and does not burn or irritate mucous membranes when used in low concentrations.

Bolle[1] mentions the usefulness of Neguvon for flea control, but gives no details.

Experimental Procedure and Results

The Lowest Effective Rate

The lowest effective rate was established in a series of initial trials. Dogs, heavily infested with fleas, were treated and examined 30 minutes after treatment. Treatments were regarded as ineffective if any living fleas were found.

A dusting powder containing 2% active ingredient was completely effective in all cases, but a dusting powder containing only 1% active ingredient, was not effective.

It was decided to use a 2.5% Neguvon dusting powder in further trials, i.e. a concentration slightly higher than that which had been shown to be fully effective. This gave good control, even when small quantities were applied. No trials were carried out with washes, as the use of dusting powders is preferred by the public.

Residual Protection

As pets usually become reinfested by fleas, protection against such re-infestation is most desirable. The period of protection afforded by the treatment with a 2.5% Neguvon dust was studied by keeping dogs and cats of different breeds and sex exposed to reinfestation and by examining the animals at daily intervals after treatment. The results are given in Tables 1 and 2.

TABLE 1

Period of protection when all animals on the premises were treated

Breed	Length of Hair	Sex	Quantity Applied: (Gm.)	Protection (Days)
Dachshund	Very short	M	**	4
,, ...	,,	M	**	5
Schipperke	Short	M	3.0	19 PT
,, ...	,,	M	6.0	17
,, ...	,,	F	6.0	4
,, ...	,,	F	6.0	4 R
,, ...	,,	F	6.0	5 R
Alsatian	Medium	M	**	6
,, ...	,,	M	**	7 R
Terrier	,,	M	**	7
Crossbred	,,	M	**	7
Terrier	,,	M	7.5	6
,, ...	,,	M	9.0	12 R
,, ...	,,	F	6.0	8
,, ...	,,	F	6.0	7 R
,, ...	,,	F	6.0	4 R
Cat	,,	F	3.0	8
,, ...	,,	F	3.0	10 R
2 Cats	,,	M	3.0	10
2 Kittens	,,	M	1.0	10
,, ...	,,	F	1.0	5
Collie x Alsatian..	Long	M	12.0	2 †
,, ,, ..	,,	M	24.0	10 R
,, ,, ..	,,	M	24.0	7 R
Scot. Sheepdog..	,,	F	**	7
,, ,, ..	,,	F	**	9 PT

PT — premises also treated.
R — repetition with same animal.
† — one flea found on tail, which had not been treated.
** — animals were dusted at "normal rates" although exact quantities used were not accurately weighed out.

Reinfestation from other animals kept on the same premises may be a greater threat than reinfestation from the ground and bedding materials. The protection, afforded when only some of the animals kept on the premises are treated, was investigated in a further number of trials (see Table 2).

TABLE 2

Period of protection when only half the animals on the premises were treated

Breed	Length of Hair	Sex	Quantity Applied (Gm.)	Protection (Days)
Schipperke	Short	F	3.0	5
,, ...	,,	M	6.0	6
Corgi with.....	Long	Both	6.0 (2.0)	8 PT
suckling puppies..	,,	,,	6.0 (1.0)	11 PT

PT — Premises treated.

Toxicity

There was no case of acute poisoning by a single application nor by repeated treatments as specified in Table 1. Whether treatment repeated at daily intervals would lead to toxic effects, was investigated in four further trials.

Two female cats were each dusted with 3 g. Neguvon 2.5% dust for 30 successive days. No ill effects were observed.

Four kittens, 5 weeks old when the test started, were treated with 1 g. for 17 successive days. As there were no ill effects, the dosage was increased to 3.0 g. for 5 days. Definite toxic effects (listlessness and trembling of hind legs) became apparent on the fifth day. The treatment was interrupted for one day, and then continued with 1.5 g. per animal for another 6 days. There were no further ill effects: 1.5 g. of dust was already considerably more than what is usually applied to animals of this size. The dust was not removed shortly after application—as is frequently recommended in the case of cats—and licking was not interfered with.

One male Schipperke was treated for 40 days in succession with 3.0 g. dust. There were no ill effects.

One male Alsation aged 5 months, and one adult Spaniel, were dusted daily for 30 days. Six and three grams were applied respectively. There were no ill effects.

DISCUSSION

The 2.5% Neguvon dusting powder killed fleas on dogs and cats very effectively. The period of protection varied considerably, but in general, long-haired animals were protected for longer periods than short-haired ones. It should also be mentioned that the termination of protection is somewhat erratic. In two instances, for example, a single flea was found on the host and treatment was not repeated. However, on the next day, the animals were found to be free from fleas. This observation may indicate the existence of a partial protection before the complete breakdown of the protection.

Untreated animals and infested premises appear to be equally important as sources of reinfection.

The treatment of the bedding material with Neguvon, together with the treatment of the host, kept the latter free from fleas for longer periods than when the host only was treated. However, the results vary considerably. It is likely that other breeding places of fleas were accessible to the dogs in those experiments in which the treatment of the bedding material did not give long protection.

Normal quantities can be applied to dogs and cats of different ages for 30 successive days without danger. Toxic effects were observed in small kittens to which excessive quantities were applied for 5 days in succession. These symptoms were very obvious but not dangerous. This fact indicates that the material is extremely safe, as no pet owner would continue daily treatment once ill effects became obvious.

Summary

1. The existence of a BHC-resistant strain of *Ct. canis*, in the city of Grahamstown has been established.

2. Neguvon 2.5% dusting powder killed fleas of this strain effectively and protected dogs and cats for 2–19 days.

3. The protection was better when breeding places were treated as well as the animals.

4. The protection was also good if only some of the dogs on the premises were treated.

5. The material produced no ill effects on dogs and cats, when used on 30 successive days in reasonable quantities.

6. Excessive quantities, applied to young kittens at daily intervals, produced obvious but not dangerous ill effects.

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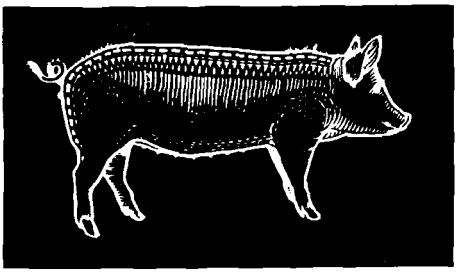

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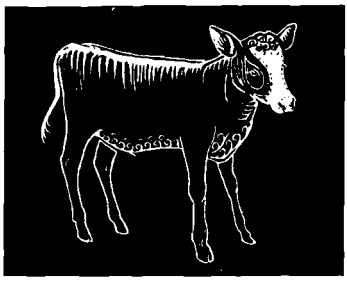

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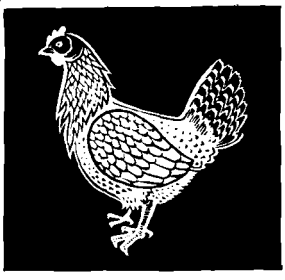

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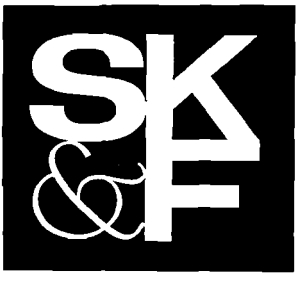

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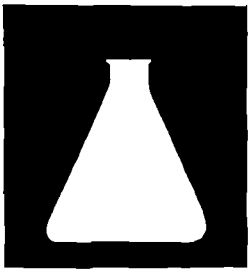

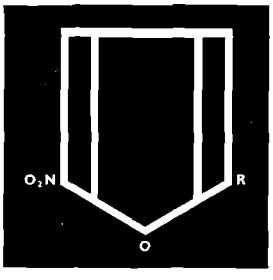

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THE NITROFURANS IN VETERINARY MEDICINE

A Review by

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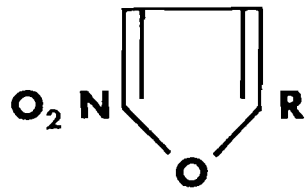
(*Received for publication*, 9 *August* 1961)

The nitrofurans were developed in the United States by the Norwich Pharmacal Co. during the Second World War, and were first reported to have marked antibacterial activity by Dodd & Stillman in 1944.[1]

Since then, over 500 nitrofurans have been synthesised and certain members of this group of antimicrobial agents are now widely used in both human and veterinary medicine. The nitrofurans are obtained initially from furfural, an agricultural by-product from corncobs, and oat husks. The addition of the nitro group (O_2N) to the 5 position of a furan nucleus has been shown to confer the antimicrobial activity.



The addition of various side chains to the 2 position of the furan ring largely controls the physiological performance and clinical use of the nitrofurans. This means that nitrofurans can, to some degree, be "tailor-made" to control certain specific types of diseases. For example, one nitrofuran derivative has been produced that is especially effective against enteric diseases, another against urinary tract infections and a third against fungi.

Characteristics

The nitrofurans as a group have certain uniform characteristics. They have a wide spectrum of activity against gram-positive and gram-negative bacteria, and in some cases against protozoa and fungi. They are bactericidal rather than bacteriostatic in action and there is little or no development of bacterial resistance even after continual use. Moreover, pathogenic organisms with natural or acquired resistance to antibiotics and sulphonamides remain completely sensitive to the nitrofurans. Some bacteria that are sensitive *in vitro* to various nitrofurans are shown in Table 1.

The nitrofurans are rapidly broken down by all body tissues except blood, and there is no build up in the animal body. The nitrofurans are not antagonised by organic compounds in pus, blood or faeces. They

are remarkably safe to use and even if normal doses are exceeded, any toxic effects are usually reversible and disappear on the withdrawal of the drug. There are no published reports of serious side effects at therapeutic dose rates. The fact that the nitrofurans remain stable indefinitely, unless exposed to excess heat or moisture, is of importance when they are used as feed additives. They are compatible with most vitamins, minerals and antibiotics when included in animal feedstuffs.

Mode of Action

The nitrofurans exert their action by their effect on the cell metabolism of bacteria, protozoa or fungi. Although the exact mechanism of antimicrobial action of the nitrofurans is not known, it differs from other agents and it has been suggested that they inhibit carbohydrate metabolism by blocking the acetylation of co-enzyme A at the pyruvate-citrate stage of the breakdown of glucose in the Krebs cycle.[2]

Veterinary Uses

Nitrofurazone

Nitrofurazone was the first nitrofuran compound to be synthesised. It's primary use in the human medical field is as a topical antibacterial agent. It has also been used in trypanosomal infections and in the treatment of testicular seminoma. Nitrofurazone has found a much wider application in veterinary medicine being used in poultry, pigs, cattle and small animals.

Coccidiosis

Nitrofurazone is used for the prevention and treatment of coccidiosis in poultry. Despite the advent of many new coccidiostats, nitrofurazone—or a combination of nitrofurazone and furazolidone (Bifuran)—is still widely used as a standard feed additive, particularly for replacement flocks. This widespread use is largely due to its relative cheapness, to its suitability for use in birds of all ages and to the fact that nitrofurazone readily allows the development of natural immunity.

Nitrofurazone has been shown to be effective in the prevention and treatment of caecal coccidiosis due to *Eimeria tenella*[3, 4, 5, 6, 7, 8] and of intestinal coccidiosis due to *E. necatrix*.[9, 10, 11] Nitrofurazone has also been shown to have some considerable effect against *E. maxima*[12] The use of "Bifuran" in the feed to give concentrations of 0.0055 per cent nitrofurazone and 0.0008 per cent furazolidone has been shown to be an improvement on nitrofurazone used alone as it stimulated growth slightly, and improved feed conversion.[11]

Nitrofurazone is equally effective against the two forms of coccidiosis in rabbits—liver coccidiosis caused by *E. stiedae*[13, 14] or intestinal coccidiosis caused by *E. perforans*[15] and *E. irresidua*.[15]

Many other coccidial infections in mammals respond to nitrofurazone therapy. Tarlatziz *et al* (1955)[16] reported nitrofurazone to be an effective agent in the treatment of coccidiosis in lambs and kids due to *E. faurei.* The dosage employed was 10 mg./kg. body weight daily for seven days. Deom and Mortelmans (1956)[17] also showed a complete clinical recovery in sheep and goats infected with *E. arloingi*, *E. parva* and *E. faurei* after the administration of nitrofurazone in the water. Shumard (1959)[18] treated experimental infections of six species of coccidia with nitrofurazone in the drinking water.

Fisher (1958)[19] successfully treated dogs suffering from non-specific diarrhoea and coccidiosis with nitrofurazone at an oral dosage of 3 mg./lb. body weight. Deom and Mortelmans (1954)[20] obtained excellent results with nitrofurazone in the treatment of coccidiosis in pigs due to *E. debliecki.*

Enteritis in Pigs

Nitrofurazone, or a combination of nitrofurazone and furazolidone, is being increasingly used for the prophylaxis or treatment of enteritis in pigs, particularly where Salmonella or *E.coli* organisms are involved. A number of studies demonstrate the value of nitrofurazone for swine paratyphoid due to *Salmonella cholerae-suis*[21, 22, 23]. More recent work underlines the use of nitrofurazone to control coliform enteritis or vibrionic dysentery. Roe (1959)[24] found nitrofurazone effective against enteritis and gut oedema where haemolytic *E. coli* was involved, particularly where treatment was based on sensitivity testing.

Skin Conditions

Nitrofurazone ointment or solution is a highly effective antibacterial agent for topical use in the treatment of wounds, burns, ulcers or eczema. De Camp (1949)[25] and Kaplan (1948)[26] reported the advantages of nitrofurazone as a topical agent in small animal practice. Knowles (1948)[27] described the use of nitrofurazone for otitis externa. The advantages of nitrofurazone for local therapy are: very wide range of antibacterial activity; no tissue toxicity; high degree of solubility and activity in tissue fluids and wound exindates and little or no development of bacterial drug-resistance.

Genital Infections

A combination of nitrofurazone and urea has been used in the treatment of retained placenta in cattle.[28] Nitrofurazone suppositories have proved useful in the treatment of genital infections in dogs and cattle.[29, 30]

Mastitis

Mires (1950)[31] reported successful results with intramammary injections of nitrofurazone under field conditions. Over 10,000 cows were treated and in 78% of cases with acute mastitis good results were obtained. Both Kakavs (1954)[32] and Smith (1959)[33] have shown the wide range *in vitro* activity of nitrofurazone against isolates from mastitis cases.

FURAZOLIDONE

Poultry Diseases

Furazolidone has proved of particular value to the poultry industry. This is largely due to its very wide range of antimicrobial activity and its suitability for routine inclusion in poultry feedstuffs. Furazolidone has been reported to be effective against Fown Typhoid (*Salm. gallinarum*) by numerous workers.[34, 35, 36, 37, 38] Many papers have also been published on the treatment of B.W.D. (*Salm. pullorum*) with furazolidone[39, 40] or avian paratyphoid (*Salm. typhi-murium*, *Salm. thompson*, etc.)[41, 42, 43, 44] Furazolidone has been shown to be a valuable adjunct to blood testing in the eradication of B.W.D. from breeding flocks.[45]

Furazolidone has been reported to be of value in the prevention or treatment of many other poultry diseases including Blackhead,[46, 47, 48, 49] Hexamatiasis,[50] Omphalitis,[51] Infectious Synovitis,[52] Infectious Hepatatis,[53] Bluecomb, Infectious Coryza and Coli Septicaemia[54]. Furazolidone has been demonstrated to have some considerable activity (77%) against coccidiosis due to *E. tenella* and *E. necatrix*.[12] This compound is also of use in the control of outbreaks of such respiratory diseases as C.R.D., Infectious Bronchitis and Infectious Sinusitis due to its marked action against secondary bacterial invaders, usually *E. coli*, that account for much of the mortality and morbidity in these diseases.[54, 55] Furazolidone is also widely used to control sub-clinical infections in broilers and laying flocks, with resultant increases in the productivity and efficiency of the birds.[56, 57, 58, 59] Furazolidone—being a nitrofuran—is of particular value for inclusion at low levels in poultry feeds because of the reduced danger of the development of bacterial resistance on sustained use.

Calf Paratyphoid

As a result of the excellent control obtained with furazolidone in the treatment of fowl typhoid, Henning (1954)[60] investigated the effect of the drug on a related infection—paratyphoid in calves due to *Salm. dublin*. He found that an oral dose of 1 gram of furazolidone daily for seven days brought about a complete cure. Four grams of the drug administered on each of two successive days provoked marked toxic symptoms, but was effective in bringing about a cure and the calves

recovered from the intoxication a few days after treatment was discontinued. Frik (1959)[61] artificially infected calves with *Salm. dublin* and *Salm. typhi-murium*. He found that furazolidone administered orally at 30 mg./kg. body weight daily for four days proved capable of completely curing acute infections.

Although furazolidone is the drug of choice for the treatment of Salmonella infections in calves, its effect is limited unless prompt treatment is undertaken. Most strains of *E. coli* have been shown to be sensitive *in vitro* to furazolidone, and this nitrofuran is also of value in the treatment of coliform bacterial scours.

Toxicity may occur on overdosage and is manifested by nervous symptoms such as hyperaesthesia, salivation, reflex irritability and a characteristic high stepping gait. These toxic symptoms usually cease on withdrawal of the drug.

Furaltadone

The nitrofurans as a group are not readily soluble in water and most are not appreciably absorbed from the gut. These are unfortunate disadvantages in veterinary practice where many infections are systemic and water medication is often imperative, especially in poultry.

Furaltodone ("Altafur") is a nitrofuran specifically designed for systemic use and which is relatively soluble in water. It is effective against most gram-negative and gram-positive bacteria. It has been shown to be particularly active against Staphylococcal bacteria, notably strains resistant to antibiotics and sulphonamides. In poultry, water medication with furaltadone is reported effective against *Salmonella typhi-murium*, *Salm. gallinarum* and *Salm. heidelberg*.[62] Furaltadone has also been used successfully as a feed, water or aerosol medication for the control of C.R.D.[63, 64] and Infectious Synovitis.[65] In the treatment of mastitis due to Staphylococcal bacteria, furaltadone has been reported 100% effective against *Staphylococcus aureus* and 84% effective against *Staph. albus*. No residue in the milk was detectable at 12, 24 or 48 hours after treatment.

Nitrofurantoin

Nitrofurantoin ("Furadantin") is a nitrofuran that is rapidly absorbed by the gut and excreted by the kidneys. It is very widely used in human and veterinary medicine for the treatment of urinary tract infections. It has proved particularly valuable in treating refractory infections, especially where resistance to other agents had developed.

Mosier and Coles (1958),[67] Fishler (1958)[68] and Pollock (1956)[69] report favourable results with nitrofurantoin in the treatment of urinary tract infections in small animals. Canine and equine tracheobronchitis also repond to treatment with nitrofurantoin.[70, 71, 72, 73]

Nifuraldezone

Nifuraldezone ("Furamazone")* is used in the treatment of cal enteritis and winter dysentery.[74, 75] It is a nitrofuran that is of particular value in the control of enteric infections because of a very low degree of absorption from the gut.

Nitrofurfuryl Methyl Ether

Nitrofurfuryl methyl ether ("Furospor")* is a topical fungicide used for the treatment of ringworm, sarcoptic mange, demodectic mange and similar conditions.[76, 77]

The Future of the Nitrofurans

It is apparent that the nitrofurans, either individually or as a group, have a wide range of antimicrobial activity. In fact, their antibacterial activity is of the extent, or greater, of most broad spectrum antibiotics. The development of drug resistant strains of bacteria is at present a major problem in human medicine and appears to be becoming a problem in veterinary therapy. The often indiscriminate use of antibiotics may well accentuate the situation. It is very noteworthy that no really significant development of bacterial resistance to the nitrofurans has been reported even after a number of years of continual use. The nitrofurans therefore will play an increasingly important role in veterinary medicine, particularly where the development of bacterial resistance precludes the use of other agents. The control of mastitis is one outstanding field where nitrofurans will prove progressively more useful in the future. Nitrofurans are of notable value in mastitis because of their low tissue toxicity, their wide range of action and their rapid breakdown in the body. Many nitrofurans are highly effective in mastitis yet are completely broken down and can be undetected in milk as little as 12 hours after treatment. Better control over many tropical and sub-tropical diseases, bacterial or protozoal, can be expected with the development of new nitrofurans with systemic action. Because of their basic chemical structure, the opportunities for synthesis of new nitrofurans are virtually limitless, and new nitrofurans can be especially designed to control specific diseases.

There can be little doubt that the nitrofuran group of chemotherapeutic agents will have an interesting future. They are one of the most efficient and versatile weapons in man's armoury in the widepsread battle against disease and in the struggle to produce more food for an ever-increasing world population.

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* Not available commercially in South Africa.

TABLE 1

Some bacteria reported to be sensitive to nitrofurans in vitro

Organism	Nitrofuran Compound				
	Nitro-furazone	Fura-zolidone	Nitro-furantoin	Furalta-done	Nifural-dezone
Aerobacter aerogenes.....	x	x	x	x	
Bacillus anthracis	x	x			
Bacillus subtilis	x	x		x	x
Clostridium histolyticum...	x	x		x	
Clostridium novyi	x	x		x	
Corynebacterium diphtheriae	x		x		
Corynebacterium pyogenes	x				
Escherichia coli	x	x	x	x	x
Pasteurella septica	x	x			
Salmonella cholerae-suis....	x	x	x		x
Salmonella dublin		x			
Salmonella gallinarum	x	x		x	
Salmonella paratyphi	x	x	x		x
Salmonella pullorum	x	x			
Salmonella schottmuelleri..	x	x	x		
Salmonella typhi-murium..	x	x	x	x	
Shigella dysenteriae.....	x	x	x		
Shigella paradysenteriae....		x			x
Staphylococcus albus	x	x	x	x	
Staphylococcus aureus	x	x	x	x	x
Streptococcus agalactiae....	x			x	
Streptococcus dysgalactiae..	x		x	x	
Streptococcus pyogenes....				x	
(Str. haemolyticus).....	x	x	x		x
Streptococcus uberis	x		x	x	
Vibrio cholerae		x			
Vibrio comma					x
Vibrio fetus	x	x			

N.B.—This table is based on actual reports of *in vitro* activity. Some of the nitrofuran compounds included may well be shown to be effective against a wider selection of bacteria as further reports become available. The activity of nitrofurans is not confined to bacteria. Some nitrofurans are also active against protozoa and fungi.

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SOME USES OF FURACIN SOLUBLE OINTMENT IN VETERINARY PRACTICE

Susanne Solomon White River, Transvaal

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Although this member of the nitrofuran group has been used extensively by veterinary practitioners both in the U.S.A. and the United Kingdom, it has not until very recently, been brought to the notice of the veterinary profession in South Africa. It has also been well established in medical practice for very many years, but as so often happens, the knowledge of this fact did not serve as an incentive to use it in dermatological and other cases where, as is now realised, it has become invaluable.

Its endless possibilities in every day practice was discovered quite by accident. While attending a mare some months ago the author happened to be carrying a tube of "Furacin" ointment, which she had been using on her son's "veld sores". This was on a Sunday when chemists don't usually like to be pulled out unless the case is urgent. The ointment was therefore left to be used topically, together with a prescription for an other ointment to be obtained the next day.

Twenty four hours later the client phoned to say that she had no wish to change the ointment, and that great improvement was evident. The mare was visited and the statement verified. Furacin was continued and within four days complete healing had taken place, both the owner and the author being equally impressed. (This case is quoted later).

By this coincidence the author's attention was drawn to Furacin. From this time on it was used widely, and although time has not permitted the collection of a vast number of cases, a few recent experiences are submitted in the hope that they will be of interest.

Case 1

A young mare, with foal at foot, became irritable and difficult to handle, and was not standing well when the foal sucked. The owner noticed that the udder was moist and hot to the touch.

On examination an advanced, moist, or "weeping eczema" of some day's standing was found, but from careful questioning of the owner and observation of the affected tissues, the primary cause for this condition could not be ascertained. The teats were spared, but the entire udder was covered with exudate, and on one side crusts had formed where the discharge had dried. The area was very inflamed posteriorly, probably where the animal had managed to alleviate the irritation by rubbing herself; here there were signs of secondary infection. The temperature of the mare was normal.

The udder was washed with G11 surgical soap solution and thoroughly dried. Furacin soluble ointment was applied liberally to the affected area, and worked into the skin, particularly where the softened scabs had left fissures. It was advised to spray the flanks of the mare with insect repellant, as the exudate was already attracting flies.

Treatment was continued daily for four days, the udder being washed and dried each time before application of the dressing. Forty-eight hours after the first treatment, there was a marked improvement of the condition. The animal was much less difficult to approach and allowed the foal to drink more placidly. On the third day the exudation had ceased, and on the fifth day treatment was discontinued.

There was no recurrence of the eczema.

Case 2

A young mare with foal, developed a similar condition to that described in Case 1. There was moist dermatitis of the udder surface but without swelling, perhaps because this case was seen before secondary infection could develop.

Furacin ointment was applied as before, after first cleaning with G11 soap solution. The ointment was applied daily for three days after which time healing was complete.

Case 3

A four year old stallion developed fetlock eczema (greasy heal), of the left fore limb, superimposed on infection following an injury two days previously. The eczema was acute and suppurative and was accompanied by heat, swelling and an offensive odour.

The area was clipped and cleansed with G11 soap solution (one teaspoon G11 to one cup of water). The crevice in the fetlock, which was about one and a half inches deep, was explored with swab-covered forceps in case any foreign body was lodged there. In this case only dirt was present. The fissure was cleaned as was the entire eczematious portion, and well dried. An application of Furacin dressing was then made, with particular attention to the crack into which the softening ointment penetrated. Over this strips of gauze were applied and the fetlock was then bandaged. Treatment was repeated daily in the above way. On the third day there was such improvement of the affected surface that the wound was not covered, but the ointment was applied for a further three days. After this time complete healing had taken place.

This case is of special interest as "greasy heal" is often so persistent. The unpleasant odour was absent after only 24 hours, when the exudate had practically dried up too.

Case 4

A three year old gelding very suddenly developed a small pustular skin eruption on the nose which spread to within about three inches of the eyes, and laterally onto the cheeks. Through rubbing, secondary infection had set in, The temperature of the horse was normal.

This condition was thought to be due to excess protein intake, and a change in the feed was made.

Furacin ointment was applied twice daily to the affected portion which was first washed with ordinary soap and water.

On the third day a marked improvement was evident; treatment was discontinued from the fifth day.

One month later there was a light recurrence, which was again dealt with in the same way.

Case 5

A white male bulldog, aged one year, was afflicted with an acute moist eczema, which had been unseccessfully treated, prior to examination. The part affected, beginning from behind the left shoulder, was a clearly defined area of approximately six by seven inches. It was painful and hot: a purulent green-yellow discharge oozing from the mat of hair and crusts. There was present a blood-tinged exudate on the periphery of the lesion, undoubtedly due to the continual scratching and rubbing of the tormented animal. The temperature was 104°F.

The area was cleansed and completely cleared of exudate, hair and debris. The surrounding strip, about two inches wide, was clipped so that any further spread could be more easily checked. Furacin was applied and rubbed well into the diseased part: 300,000 Units of Penicillin and 40 mg of Prednisolone were injected intramuscularly.

The dog was seen again twenty four hours later; the response to treatment being most gratifying. The temperature was normal, exuadation and heat had abated. There was no further spread of the eczema, and, according to the owner, the intense irritation had ceased. The raw, secondarily infected areas were showing considerable healing. Furacin was reapplied.

On the third day the skin surface was hardly eczematous at all. Treatment was continued until the 7th day, when healing was complete.

Case 6

A five month old crossbred Labrador puppy, was brought in with a severely infected tail stump. The animal was in considerable pain. On examination it was obvious that a crude amputation of the tail was responsible for the gangrenous condition. Temperature was 105°F.

A sedative was administered (Themalon) and the stump bathed with warm surgical soap solution. All necrotic tissue was removed. A gauze pad with Furacin dressing was applied to the stump and fixed into position with adhesive tape: 150,000 units of Penicillin were injected.

The dog was brought back after 24 hours. There was marked improvement, with less, or very little pain. The temperature was normal. The tail was again treated with Furacin and the dressing left in place until the fourth day. The resultant healing was spectacular. Bandaging was discontinued, the owner continuing to apply the ointment for two days.

Case 7

A one year old Alsation bitch had been suffering from ear infection for some months. When she was eventually brought in for treatment the condition was in an advanced state; the owner admitted having tried various remedies, and in the end was forced to seek professional advice.

The dog was in very poor condition. She was in great pain, and carried her head stiffly to the affected side, crying out whenever the ear was touched.

Pentothal Sodium had to be administered before a thorough examination could be made. There was a faetid odour from the right side, the hair on the sorrounding skin being matted by a foul brown discharge. A diagnosis of acute Otitis Externa was made.

Olive oil was applied to the external ear. Otoscopic examination revealed a swollen and inflamed meatus, with sensitive membranes which bled at the slightest touch. The temperature of the dog was normal.

Furacin ointment was melted and poured into the ear canal pressure applied at the base of the ear to ensure that it had penetrated along it's full length: 300,000 units of Penicillin were injected.

The bitch was seen on ten consecutive days. Each time the internal ear was cleansed and examined and treated with Fuarcin ointment. On the second day the examination could be carried out without sedative or anaesthetic, so great was the relief. The inflammation, exudate and swelling of the membranes had noticeably decreased.

On the fourth day she ceased shaking and rubbing her head.

On the sixth day the discharge was absent, and no trace of any odour remained.

On the eighth day there was an improvement of the animal's general condition, and the appetite had returned. The dog was discharged on the tenth day, and all treatment was stopped. Up to date there has been no recurrence.

General wound treatments

Without going into the details of each of the numerous cases treated with Furacin, it must be mentioned that the results are excellent, when used generally in wounds and sores.

For instance cat bite wounds, which form plaque-like abscesses of considerable dimensions, show wonderful response to Furacin dressing within 24 hours. In most cases anti-biotic therapy is not necessary. Necrotic tissue responds well to treatment and in the author's experience better than that obtained from the anti-biotic ointments used. This may be due partly to the fact that when Furacin ointment softens or is melted it penetrates every deep pocket and crack, thereby leaving no focus of infection. As its spectrum of antibacterial and antifungal activity is very wide, this usually means very quick resolution of infection. Another great advantage is that when a wound is dressed it may remain closed for one or two days without disadvantage. In country practice, when clients come a long way, and are often disinclined to dress wounds themselves, this is very helpful.

PHENOTHIAZINE POISONING IN A THOROUGHBRED RACING STABLE

H. G. Purchase 6 Rosebank Road, Johannesburg

(*Received for publication, 25th November*, 1960)

SUMMARY

The symptoms and treatment of 9 horses poisoned with phenothiazine are described. The case history and treatment of the horse affected most severely are dealt with in detail, this is followed by a short discussion.

INTRODUCTION

Phenothiazine is commonly used as a vermifuge in ruminants, horses and fowls. It was, until recently, considered to be the drug of choice for the treatment of strongyle infections in horses. The recommended method of administration is to give 5 gms. daily in the food for six consecutive days. Another practice is to follow this up with low level feeding of 1–2 gms. daily continuously, or 2 gms. daily for the first 20 days of each month. Although the therapeutic index is narrow, phenothiazine is usually considered to be safe when administered as described above.

CLINICAL REPORT

On this occasion nine thoroughbreds in one stable were given 25 gms. of a highly purified make of phenothiazine powder each in one dose. Six of them showed signs of poisoning to a greater or lesser degree.

The first symptoms occurred on the second day after administration when the horses showed pyrexia (to 103.5°F.), anorexia, dullness and lethargy, an accelerated pulse and respiration. As the poisoning progressed they developed anaemia, jaundice and dark red urine and they were all very constipated. Two of them also started staggering on about the 4th or 5th day.

Estimations of the haemoglobin concentrations of the blood were made: these fell from a normal reading of 15–17 gms. % (by this method) to about 7.5 gms. % in 18 days. During this time the horses only picked at their food and looked very ill. Soon after this they started eating again, showed a great improvement in general habits and the haemoglobin concentration started to rise.

One horse only remained severely depressed and had not eaten at all. By the 5th day the haemoglobin concentration had dropped to 8 gms. % and by the 14th day to 4 gms. %. Clinically there was a severe anaemia and jaundice.

Treatment

The treatment was to give 1 gm. of oxytetracycline on the first day followed by 3 million units of penicillin and 3 gms. of streptomycin for the next two days. This appeared to bring the temperatures down to normal. Vitamin B_{12} and iron were given twice weekly.

The one animal that failed to respond was admitted to hospital. On the 14th day a blood transfusion was started using blood collected in 100 c.c. of 3% sodium citrate per litre, as anticoagulant. The donor was a five year old horse brought in for destruction because of iliac thrombosis. Only one litre was given on this day due to lack of time. The heart rate was 48–50 beats per minute throughout and the respirations about 24 per minute whilst the blood was given at a steady rate of 120 drops per minute.

On the 15th day another 4 litres were given at ± 200 drops per minute. The heart rate increased to 58–60 per minute and remained constant except for a short period when the rate of administration of the blood was almost doubled. During this time the heart rate increased to 70 beats per minute but returned to 60 per minute a few minutes after decreasing the rate of flow On each occasion a blood sample was taken immediately before starting the transfusion.

On the 15th day the horse began to eat with relish and looked much brighter. A few days before the transfusion he started kicking the white-wash off the wall and eating the flakes that fell to the ground. This was considered to be some deficiency symptom, so when his appetite returned, ½ oz of calcium carbonate was given in the short feed twice daily. This apparently stopped the craving.

On the 22nd day after the transfusion had been completed, a blood sample was taken to see how much progress had been made At this stage the horse was eating very well and was so "full of himself" that he had to be given exercise The temperature was normal and nothing abnormal was found on clinical examination The blood sample, however, showed a fair number of *Babesia caballi* parasites The horse was then treated with 20 c c. of 5% euflavine and has not looked back since.

Discussion

It is interesting to note the continued haemolysis and jaundice long after one would expect that all the phenothiazine had been eliminated from the body. The clinical tests done, although rather simple, exemplified this.

On the 5th day the serum was dark red-orange in colour and thus the van den Bergh test was completely inaccurate. The colour was presumably due to a haemoglobinaemia, since it is doubtful whether it could have

been due to haemolysis in the sample bottle (dried oxalate was used) as the sample was fresh. No significant haemolysis had occurred in previous samples or has occurred since. It may, however, also have been partly due to the breakdown products of phenothiazine, which are red in colour.

The explanation for the strongly positive van den Bergh test on the 14th and 38th days is probably that the function of the liver to conjugate bilirubin was occurring normally but that there was a hepatocellular regurgitation icterus. This possibly was due to severe degeneration caused by the phenothiazine and anaemia in the first instance, and the piroplasms in the second. Even one litre of blood had a dramatic effect on the icterus, as is shown in the table and was also apparent clinically.

The response of the haemoglobin concentration and the Packed Cell Volume (P.C.V.) was disappointing even after 5 litres of blood had been transfused. The good effect of the Vitamin B_{12} and iron therapy can be seen in the Mean Corpuscular Haemoglobin Concentration (M.C.H.C.) which remained normal throughout.

The cause of the craving for the whitewash on the walls was suspected to be a calcium deficiency: it disappeared after the lime was added to the feed.

The appearance of piroplasms in the blood is very interesting, since the horse showed no symptoms at all. One can think of two explanations; firstly, that the parasites were transmitted from the donor to the partially immune or premune recipient and multiplied without actually causing clinical symptoms, or, secondly, that the parasitaemia was the early stage of a relapse. It was also noted that all the parasites seen were of the circular form. Only one pair of pear-shaped organisms was seen even after re-examination of the smears.

ACKNOWLEDGEMENTS

Thanks are due to Dr. F. J. D. Hempstead for the clinical handling of the case and to Dr. T. Adelaar and Prof. K. van der Walt for their advice.

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TABLE OF CLINICAL TESTS

Test Done	Day from the Day of Dosing the Phenothiazine						
	0	5	14	15	16	27	38
Haemoglobin Gm%	15	8	4	4.5	5.8	6.0	7.5
E.S.R. m.m/hr.	4	37	55	70	60	60	20
P.C.V. %	28	22	12	13	15	18	21
M.C.H.C.	35.5	35.5	33	34.6	38.1	33.3	35.7
Van Den Bergh Direct	—	?	++++	—	—	+	++++
Van Den Bergh Indirect	±	?	±	±	±	+	±
Zinc Sulphate Turbidity	±	±	±	±		+++	
Differential Count:							
Neutrophils %	58	76	64	69		49	53
Lymphocytes %	31	24	36	30		48	45
Eosinophils %	7	0	0	0		0	0
Monocytes %	4	0	0	1		3	2

NOTE.—The average figures obtained by our methods are included as day 0 above on the assumption that the blood picture of this horse was normal before the phenothiazine was given.

A LESION OF THE LEFT ATRIAL WALL OF THE HEART IN A DOG

Philip A. Boyazoglu Section Biochemistry (Nutrition) Onderstepoort

The Case was studied while the author was a final year student in the Faculty of Veterinary Science

(*Submitted for publication on 20th May* 1961)

History

An eighteen-month old non-descript bitch weighing 6.5 Kilograms was presented with a history of progressive listlessness, anorexia and always tending to take up a sitting position with the head extended. The breathing was laboured, and stairs, normally well within its capability, could not be negotiated. For several days before presentation the temperature was in the region of 101°F.

Status Praesens

Whenever possible the animal sat on her haunches with the head and neck extended. There was moderate, indeterminate dyspnoea, with prominent costal and abdominal breathing. Respirations were 68 per minute. Bronchial sounds were audible on auscultation. Percussion of the thorax revealed a dullness of the ventral area on both sides of the chest. The mucous membranes showed moderate cyanosis and dehydration was noticeable. The pulse was threadlike and indistinct. The cardiac impulse was present on the left between the fourth and fifth ribs.

Special Examinations

Haematological as well as liver and kidney function tests were essentially normal. Faeces examination revealed a few ancylostome eggs and there was slight albuminuria. The intradermal tuberculin test was negative as also a sputum smear for *M. tuberculosis.*

X-ray examinations after a barium meal showed no abnormality of the oesophagus, stomach or intestines. Chest X-rays showed both lungs much reduced in size and in a dorsal position.

Paracentesis yielded 100 ml. of watery straw-coloured fluid and four days later another 90 ml. were withdrawn. Subsequent to each paracentesis there was a marked improvement in respirations and the lungs were noticeably larger on X-ray examination. With a S.G. of 1.015 and no cellular elements present, the fluid was assumed to be a transudate.

Electrocardiographic examination showed normal ventricular function but auricular fibrillation.

Discussion of Findings

The accumulation of transudate in the thoracic cavity indicated obstruction of blood flow. The anterior and posterior venae cavae were ruled out as possible sites, because there was no evidence of venous congestion affecting the Vv. jugulares, nor of passive congestion of the liver and other abdominal organs; X-ray investigation did not reveal any lesion in the chest which could be responsible for such an obstruction. There were no symptoms suggesting such pathology as a dissecting aneurism or thrombus in, or obstructive pressure on the aorta or the Aa. pulmonales.

The fact that there was cyanosis and congestion of the lungs and that there was accumulation of transudate, was an indication that the origin was a passive congestion of the lungs with a probable interference occuring in the circulation from the lungs to the heart. The absence of both murmurs (indicative of valvular pathology), and of gross enlargement of the heart, prompted a tentative diagnosis of a space occupying lesion in the left atrium. The auricular fibrillation supported this hypothesis.

In the dog, interference with pulmono-cardiac circulation due to stenosis of the left A–V valve with a resultant pulmonary congestion, is not uncommon. In these cases, however, heart murmurs can be heard, due to the left A–V stenosis, as well as the resultant right A–V incompetency caused by the compensatory hypertrophy of the right ventricle.

This case has certain aspects which are not easily explained. It is difficult to visualize a congestion of the lungs which will result in a pleural transudate and still leave the animal only moderately embarrassed. One must conclude that there was an increased permeability of the visceral pleurae which allowed the accumulated interstitial fluid to escape easily. This deduction will also explain the absence of any marked hypertrophy of the right ventricle and the intactness of the right A–V valve.

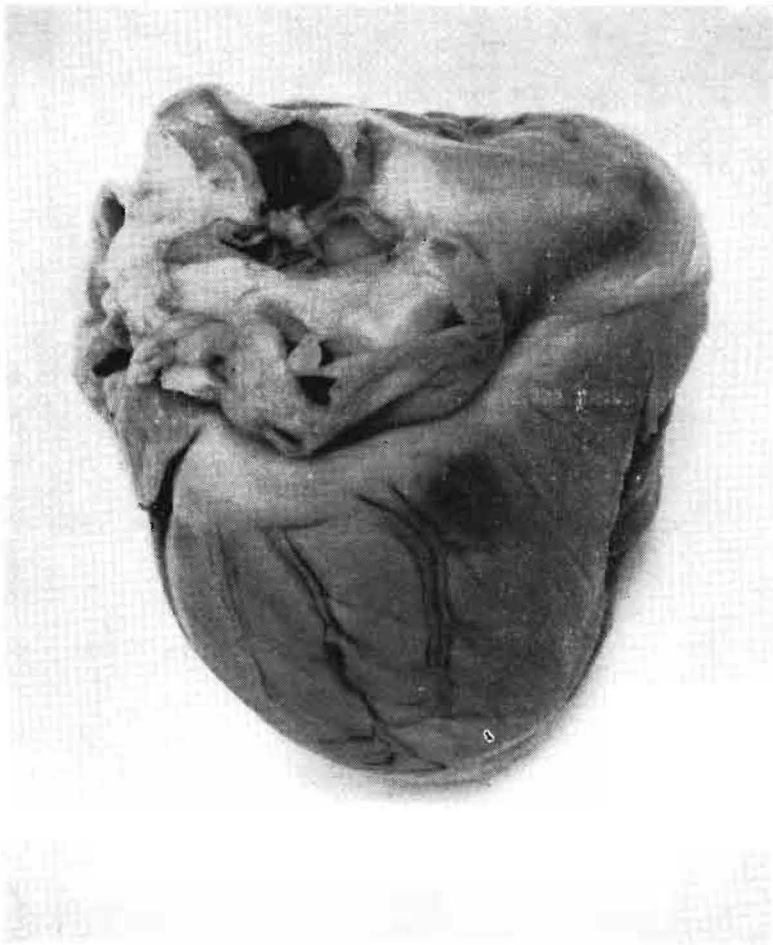
Post Mortem

The owner requested euthanasia. Post mortem examination revealed a thoracic cavity containing 100 ml. of watery fluid. The lungs were oedematous and emphysematous with a narrow, collapsed ventral edge. The left atrial wall was markedly thickened, reducing the atrial cavity to a fraction of its normal capacity.

Plate indicates the thickened left atrial wall.

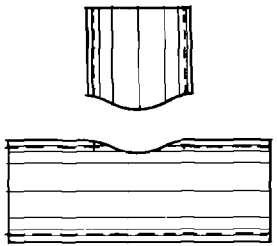
The right ventricle was only slightly enlarged. Histopathological examination of the atrial lesion revealed marked proliferation of connective tissue cells with prominent vascularization, i.e. an organizing thrombus.

In human medicine thrombus formation is a common sequel to auricular fibrillation and it is considered that auricular pathology may have been the primary cause of the lesion.

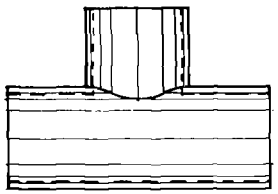


ACKNOWLEDGEMENT

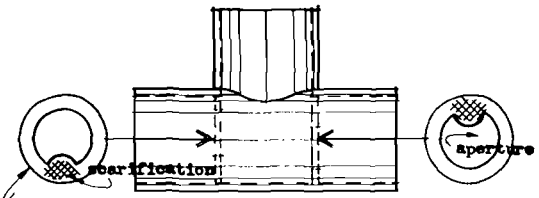
Appreciation is expressed for the constructive criticisms of Professor K. van der Walt and Professor R. Clark.



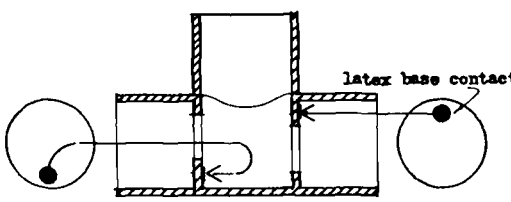
7/8" O.D. PERSPEX TUBES



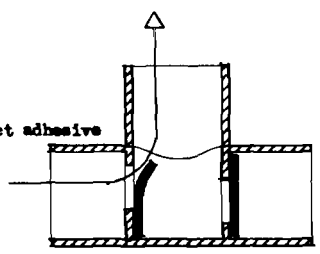
TUBES ASSEMBLED WITH PERSPEX CEMENT



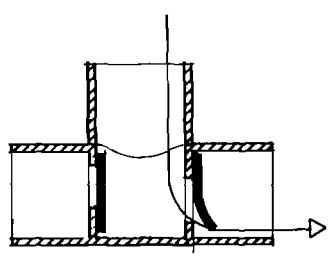
5/32" PERSPEX VALVE SEAT



1/16" BLACK RUBBER VALVE FLAP



VALVE ACTION : INHALE



VALVE ACTION : EXHALE

A SIMPLE NON-REBREATHING VALVE FOR A CLOSED CIRCUIT ANAESTHETIC MACHINE

P. H. le Roux 38 Rhodes Avenue Parktown, Johannesburg

The closed circuit anaesthetic apparatus described by the author* utilised a Ruben non-rebreathing valve. This valve proved unreliable when used on animals of less than 20 lbs. in weight as condensed water vapour caused the expiratory part of the valve to stick in a half-open position. This resulted in the building-up of a dangerous carbon dioxide concentration. The valve described here operates reliably on all sizes of animals from 1 lb. in weight. Condensation has no effect on the action and the resistance of the mechanism is imperceptible. The cost of the materials is 15 cents.

Three valves were made. The bodies were cut from $\frac{7}{8}''$ outer diameter perspex tubing and the catheter attachments were $\frac{7}{8}''$, $\frac{1}{2}''$ and $\frac{1}{4}''$ perspex tubes. The largest size fits into an infant's face mask and the others fit on to the Magill tubes either directly or with a simple adaptor. The valve seats were sawn from $\frac{3}{32}''$ perspex sheeting. The apertures were filed out as shown in the diagram and the attachment points for the rubber flaps were scarified to obtain maximum bonding for the adhesive. Due to the fact that perspex tube is an extrusion, internal stresses may cause cracks to develop spontaneously. This can be prevented by boiling the parts for twenty minutes. The parts were assembled with perspex cement. The valve flaps were cut from $\frac{1}{16}''$ black rubber sheeting and attached with a spot of latex-base contact adhesive.

After use the valve is cleaned in cetrimide solution and dusted with talcum powder when dry.

REFERENCE

1. LE ROUX, P. H., (1960): A closed circuit method of anaesthesia in small animal practice. *J. S. Afr. vet. med. Ass.*, **31**, 143–144.

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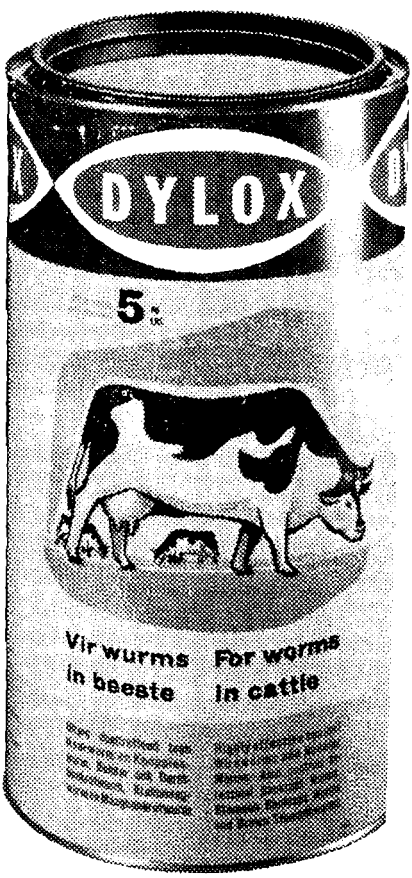


A

CASE REPORT: SUCCESSFUL TREATMENT OF A MULTIPLE TIBIAL FRACTURE IN A BOVINE

C. H. B. Marlow 21 Cypress Street Cradock C.P.

(*Received for publication*, 20*th April* 1961)

INTRODUCTION

Long bone fractures in large animals, previously encountered in this practice, have usually resulted in the destruction of the animal, mainly due to unfavourable prognosis, inconvenience to the farmer, and, perhaps the most important consideration, the value of the animal not warranting treatment. The use of a sling and/or casting of the affected limb have only met with a slight measure of success.

This report describes the successful treatment of a multiple tibial fracture in an Aberdeen Angus bull using a practical modification of the Thomas splint which enables the animal to stand, lie down and ambulate almost immediately after application.

It is considered that the use of the splint will greatly facilitate the treatment of fractures of the metacarpus, metatarsus and radius in bovines as well as equines.

CASE HISTORY

A valuable imported five year old Aberdeen Angus bull was found in the early hours of the 18th September, 1960, lying on its side, unable to rise, with the right hind leg obviously fractured.

EXAMINATION

Upon examination soon afterward, the animal was noted to be very short on the leg and in exceptionally good condition. His weight was estimated to be approximately 2,000 lbs. The bull lay in left lateral recumbency with the right hind leg hanging limply from the distal third of the tibia and the hoof touching the ground.

Palpation and manipulation revealed a severe fracture of the distal third of the tibia; approximately three inches of the bone was badly fragmented. The area was severely swollen but the skin fortunately unbroken. Although in great pain, the patient remained quiet during examination. To prevent bloat, he was moved into the sternal position and supported with bales.

A very unfavourable prognosis was given due to severity of the fracture, the patient's short limbs and heavy musculature. The owner, however, requested that everything possible be done to save the animal. In view of the success obtained by Beckenhauer,[1] it was decided to employ

the splint designed by him. Such a splint, with a few modifications, was made at a local engineering works by an employee and an assistant in less than four hours.

THE SPLINT

For convenience of readers full details are given.

The splint consists of the footplate with vertical extensions; the extension rods and side bars, and the ring with splint legs.

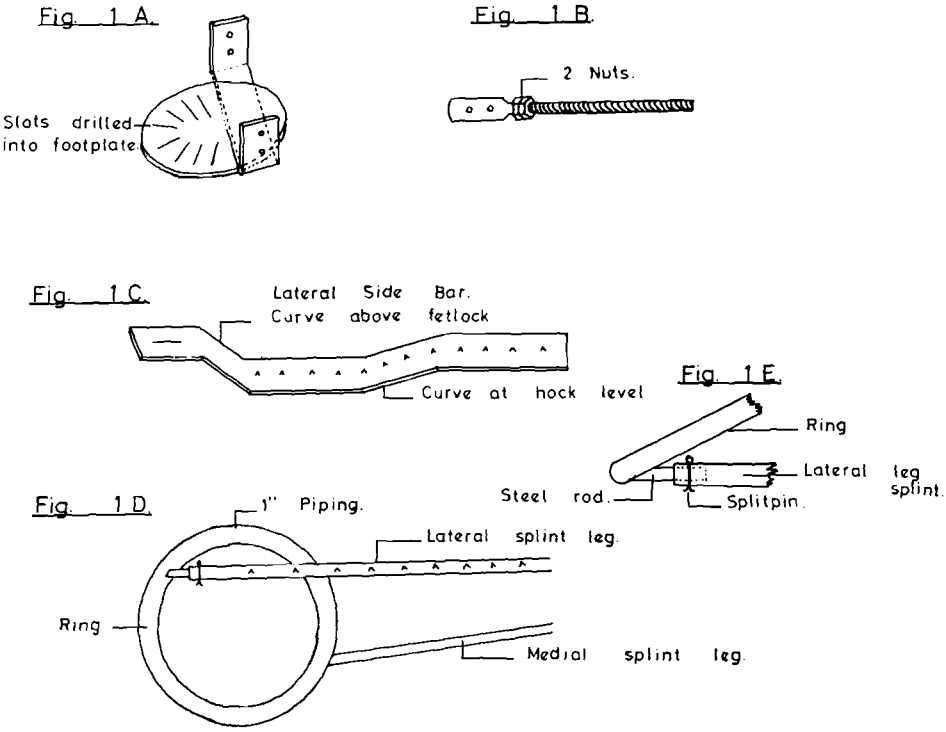


Fig. 1 The modified splint showing (A) Details of footplate, (B) Extension rod (C) Side bar, (D) Ring and splint legs, (E) Details of lateral leg detachment

The footplate (Fig. 1A) consists of an oval steel plate $\frac{3}{16}$ inch thick, 5 inches wide and 6 inches long with eight slots drilled through it. A heavy iron bar 17 inches long, $1\frac{1}{2}$ inches wide and $\frac{1}{2}$ inch thick is welded to the underside of the footplate. The protruding ends are then bent vertically and two $\frac{1}{2}$ inch holes drilled into each for bolting to the extension rods and iron side bars.

The extension rods (Fig. 1B) are 16 inches long, $\frac{3}{4}$ inch in diameter and threaded. To the end of each is welded an iron bar $\frac{3}{4}$ inches long $1\frac{1}{2}$ inches wide and $\frac{1}{2}$ inch thick. Two half inch holes are drilled into each to correspond with those on the footplate extensions. Two $\frac{3}{8}$ inch nuts are screwed on to each extension rod.

The iron side bars (Fig. 1C), which are used in the second phase of treatment, are 30 and 14 inches long, 2½ inches wide and ⅜ inch thick. The bars are bent in shallow double S curves to correspond to the contours of the limb. The lower ends for bolting to the footplate are slotted and a number of ½ inch long rods are welded 2 inches apart to the lateral surfaces. These prevent slipping of the plaster of paris cast.

The ring and splint legs (Fig. 1D) consist of 1 inch diameter piping. The diameter of the ring is 24 inches. The lateral and medial splint legs are 30 and 16 inches long respectively. The lateral splint leg is attached to the ring by means of a split pin passing through the splint leg and a 3 inch long steel rod, which is welded to the ring at an angle of 30 degrees to the plane of the ring (Fig. 1E). The medial splint leg is welded to the ring at an angle of approximately 145 degrees to the plane of the ring. A number of ½ inch rods are also welded to the lateral splint leg.

In future cases, a closely fitting model of the splint will first be made, using No. 8 gauge wire. This precaution will ensure correct diameter of the ring as well as accurate positioning of the splint legs and side bars. Lengths of the components will vary according to the breed and size of the animal.

Application and Treatment

In the early afternoon of the same day, the bull was haltered and 750 mg. ethyl isobutrazine ("Diquel", Jen-Sal) was injected intravenously. Five minutes later he was returned to lateral recumbency and the forelegs and left hind leg secured. The claws were cleaned and their solar surfaces marked to correspond with the slots in the footplate. Four holes, ⅛ inch in diameter, were drilled into each claw from the solar surface at the junction of sole and wall upward and outward, emerging approximately ⅜ inch from the ground surface. Four lengths of baling wire, two to each claw were passed through the holes in the hoofs, the footplate was placed in position, wires drawn tight and twisted together on the underside of the footplate. The ring was then padded with cotton wool and elastocrepe bandages and positioned. The extension rods, with nuts turned distally, were inserted into the splint legs and then bolted to the footplate extensions. Extension of the leg was effected by screwing up the nuts on the extension rods. The second nut acted as a lock.

The leg over the fracture area was liberally sprinkled with an antiseptic powder, cotton wool padding was applied, followed by a gauze bandage. A Plaster of Paris cast, using 6 inch by 6 yard "Gypsona" bandages, was applied, extending from just above the fetlock to above the stifle joint. The bandage included the lateral splint leg; slipping was prevented by the ½ inch rods. The footplate was then further secured to the foot by 3 inch by 3 yard "Gypsona" bandages.

When the casts had set, the ropes securing the other limbs were released and the bull returned to sternal recumbency. Within a few minutes he successfully attempted to rise and after shaking the affected limb a few times, placed weight on it and took a few steps forward.

A sixteen foot square stall of wooden beams was constructed around him. One side was closed and a roof added. Adequate bedding was supplied. The bull and surroundings were sprayed with a proprietary flykiller. This was repeated as often as necessary during convalescence.

In an effort to reduce his weight, the patient's diet consisted of 5 lbs. bran daily (to which bonemeal and salt were added) and green oats *ad lib*. Green lucerne gradually replaced the oats, as the latter became unavailable.

Subsequent visits during the following week revealed that he could lie down and rise without difficulty; not once did he lie down on the affected limb.

On the 30th September, pressure necrosis of the flank region became evident. Twenty per cent sulphanilamide powder in Euserine was applied. On 7th October, 19 days after application, "Diquel" was injected intravenously, the limbs and head secured and the cast removed by means of a hack saw. Soft callus formation was already evident. The lateral extension rod was unbolted and removed, followed by the lateral splint leg. The lateral side bar was then bolted to the footplate. The leg was lightly padded with cotton wool and a Plaster of Paris cast incorporating the side bar was applied. When set, the medial extension rod and ring with medial splint leg were removed. The medial side bar was positioned and secured, followed by a few rolls of Plaster of Paris bandages to secure it to the cast.

Diagram of splint and cast. In position.

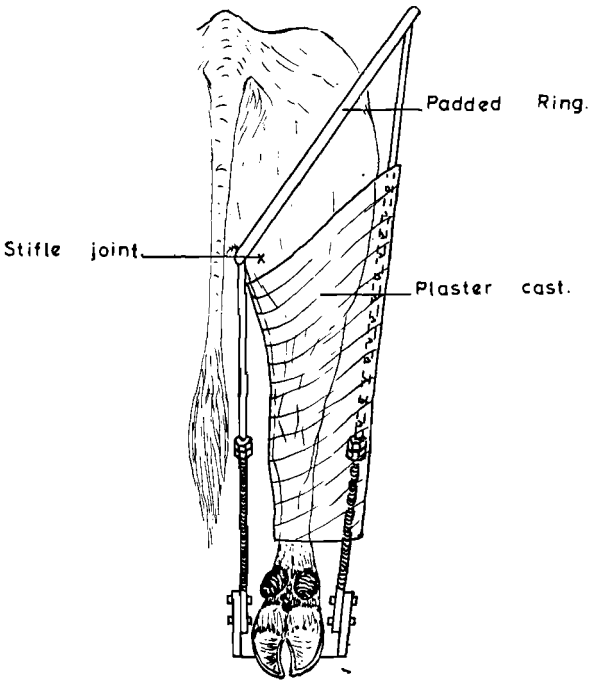
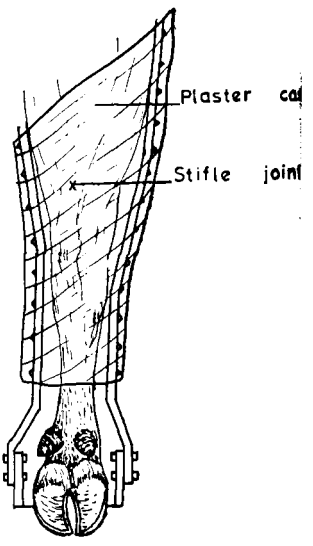


Diagram of side bars and casts in position.



When the bull rose and moved about, it was noticed that considerable outward rotation of the limb occurred. This was effectively prevented by passing a rope through a hole made in the top of the cast to another rope encircling the neck just in front of the shoulder.

On 29th October, the fetlock and pastern suddenly became swollen and the animal appeared to be in pain. After tranquillization, and removal of the cast, it was found that extensive callus formation and consequent pressure on the cast had interrupted venous return. The limb was again recast. On 28th November, the bull was moving about so well that it was decided to remove the cast and footplate. This was done in a standing position without tranquillisation. Callus formation was extensive and atrophy of the large muscle groups was pronounced. He walked with a pronounced limp.

A fortnight later the atrophy and lameness had almost disappeared and he was allowed to rejoin the herd. His weight was then estimated at approximately 1,700 lb. A few days later he was seen to serve a female without difficulty.

When seen again on 6th February, 1961, slight lameness was still evident and the limb appeared to be approximately one inch shorter than the other.

Conclusion

Where management is good and the value of the animal warrants treatment, it is considered that many animals, which would otherwise have been destroyed, could be treated with a large measure of success by this method. Apparently the dairy breeds would be easier to treat, as the bones are relatively longer and muscular development not so pronounced. In cases of fracture of the radius or metacarpus, only modifications to the ring, positioning of the splint legs and bending of the side bars would be necessary.

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CLINICAL OBSERVATIONS ON THE USE OF TRIFLUPROMAZINE HYDROCHLORIDE* AS AN ANAESTHETIC POTENTIATOR IN DOGS

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(*Received for publication, 21st October,* 1960)

INTRODUCTION

In the comparatively short time that tranquillisers have been in clinical use, they have found a real place in practice. In South Africa the most commonly used tranquilliser is undoubtedly chlorpromazine. The onset of effect is slow and quite often depression is still noted after 24 hours. This has both advantages and disadvantages but emphasises the need for a drug with a less prolonged effect. This consideration first focussed attention on trifluprom azine. Although the first report on the use of this tranquilliser in man appeared in 1957, a search of the literature failed to reveal any reference to its use in animals.

This drug is a phenothiazine derivative. The manufacturers state in their brochure that laboratory studies on a variety of experimental animals showed that the pharmacodynamic action of trifluprom azine is similar to that of chlorpromazine. The former is stated to be 2–3 times as potent as the latter, whereas the toxicity has not been found to be greater.

PROCEDURE

The present small series includes 48 dogs, mostly less than 18 months old, presented for oöphorectomy.

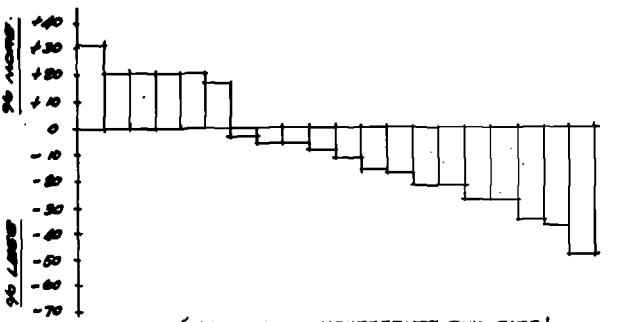
It was decided to start with an arbitrary dose of 0.5 mg./Kg. trifluprom azine intravenously and subsequently to adjust the dosage as indicated. It transpired that this represented a good dose for light tranquillisation. The subsequent doses were 0.75 mg./Kg. and 1.0 mg./Kg. The intravenous route was chosen, as there is a certain amount of variability in the subcutaneous or intramuscular routes (e.g. depth of injection, amount of subcutaneous fat). The pulse rate was taken before and after injection of trifluprom azine.

It is impossible to be exact as to the time of onset of tranquillisation. However, a narrowing of the palpebral fissure is usually the first sign. Subsequent tranquillity is shown by the way even nervous dogs remain lying on the anaesthetic table without restraint, even though they take some interest in their surroundings. Once the full effect of the tranquilliser became evident, intravenous pentobarbital sodium anaesthesia was induced.

* Siquil, Vesprin or Vetama (Squibb).

ANAESTHETIC POTENTIATION

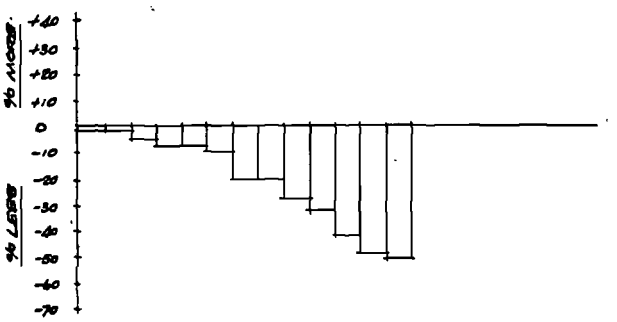
FIGURE 1.



(EACH COLUMN REPRESENTS ONE CASE).

DOSE OF PENTOBARBITAL SODIUM INTRAVENOUSLY GIVEN AFTER TRIFLUPROMAZINE (0·5 mg/Kg.) AS COMPARED WITH "NORMAL" DOSE OF PENTOBARBITAL SODIUM OF 25 mg/Kg.

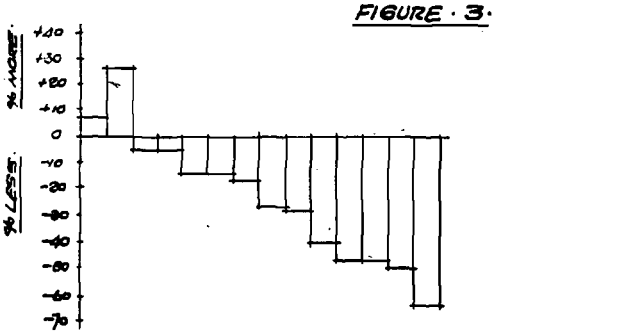
FIGURE · 2.



(EACH COLUMN REPRESENTS ONE CASE).

DOSE OF PENTOBARBITAL SODIUM INTRAVENOUSLY GIVEN AFTER TRIFLUPROMAZINE (0·75 mg/Kg.) AS COMPARED WITH "NORMAL" DOSE OF PENTOBARBITAL SODIUM OF 25 mg/Kg.

FIGURE · 3.



(EACH COLUMN REPRESENTS ONE CASE).

DOSE OF PENTOBARBITAL SODIUM INTRAVENOUSLY GIVEN AFTER TRIFLUPROMAZINE (1·0 mg/Kg.) AS COMPARED WITH "NORMAL" DOSE OF PENTOBARBITAL SODIUM OF 25 mg/Kg.

Results

The mean time between intravenous injection and full effect of the drug was as follows:—

(1) For 0.5 mg./Kg.: 8–9 mins. (±5) in 21 cases.
(2) For 0.75 mg./Kg.: 4 mins. (±2) in 13 cases.
(3) For 1.0 mg./Kg.: 5 mins. (±2) in 14 cases.

The mean percentage decrease of the anaesthetic dose of pentobarbital sodium required, taking the normal dose as 25 mg./Kg., was as follows:—

(1) For 0.5 mg./Kg.: 6.8%
(2) For 0.75 mg./Kg.: 20.4%
(3) For 1.0 mg./Kg.: 22.8%

An indication of the position in individual cases is given in Figs. I–III.

Discussion

Taking the series of cases as a whole, there was no significant change in pulse rate taken before and after tranquillisation.

Many cases were excited on the table and with the calming effect a fall in pulse rate could be expected. On the other hand, there would be in some cases at least a steep rise in pulse rate if triflupromazine caused a great fall in blood pressure. This has not eventuated, consequently there is a very strong suggestion that the effect on blood pressure is clinically unimportant.

No side effects of any kind at all have been noted.

To judge the degree of tranquillisation is very difficult and is liable to all the deficiencies of subjective judgment. One way of determining this tranquillisation is by employing an anaesthetic after the full effect of the tranquilliser has been exerted and then judging how much anaesthetic has been "saved" with each dose. This shows quite clearly that 0.5 mg./Kg. of triflupromazine potentiated anaesthesia to the degree of 6.8%; with 0.75 mg./Kg. the degree of potentiation was 20.4% and with a further increase in dose to 1.0 mg./Kg. the increase in potentiation was slight: only 22.8%. As three different dosage levels of triflupromazine were compared one with the other, it is sufficient, for statistical purposes, to assume a standard dosage of pentobarbital sodium as reference line. Many years of experience indicate this to be on an average 25 mg./Kg.

This procedure consequently determines the dose of triflupromazine as 0.5 mg./Kg. for medium tranquillisation and 0.75 mg./Kg. for full tranquillisation. An increase in dosage beyond this level does not induce a corresponding increase in tranquillisation.

Conclusion

Trifluprom azine has been found to be a good, comparatively short acting tranquilliser. The onset of effect is short and the duration limited to a few hours. As an anaesthetic potentiator used with pentobarbital sodium, there is a significant decrease of estimated dosage of anaesthetic. A substantial percentage of these cases, even though they are under full surgical anaesthesia as judged by usual tests, show lightened anaesthesia towards the end of the operation, which is prejudicial to good surgery. This is due most likely to the comparatively short period of tranquillisation.

Perhaps this objection would fall away if volatile anaesthetics are used instead of barbiturates, as the amount of volatile anaesthetic can be increased conveniently during surgery.

Summary

Trifluprom azine has been tested on 48 dogs.

The intravenous dose has been determined at 0.5 mg./Kg.—0.75 mg./Kg.

Using pentobarbital sodium as anaesthetic subsequent to tranquillisation by this drug, it was found that though well-marked potentiation could be demonstrated, many cases showed lightened anaesthesia towards the end of the operation.

Trifluprom azine acts for a few hours only. No side effects were seen.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to the Director of Veterinary Services for permission to publish this article, to Mrs. Cronje for technical assistance and Messrs. Squibb Laboratories (Pty.) Limited, for a trial supply of the drug.

THE USE OF THE STEINMAN STAINLESS STEEL PIN IN RECURRENT COXO-FEMORAL LUXATION IN THE DOG AND CAT

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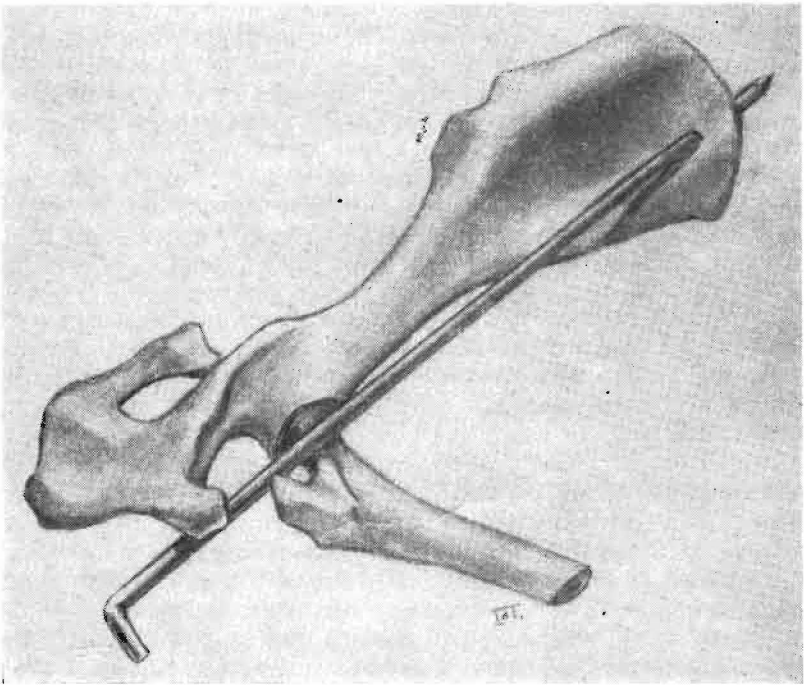
(*Received for publication, 1st July*, 1961)

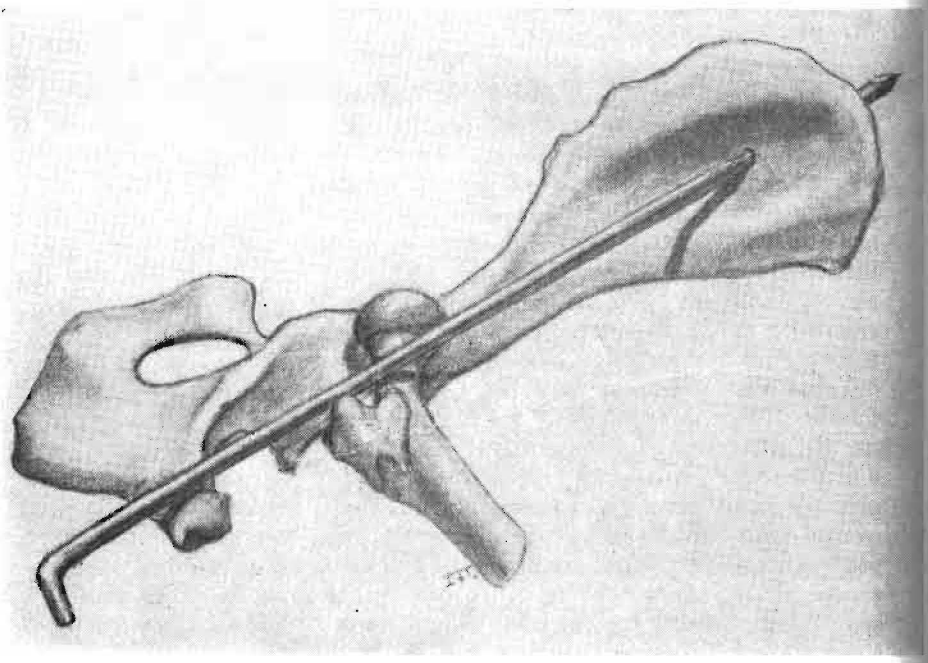
Dislocation of the hip joint is the most common displacement met with in dogs; it occurs to a lesser extent in cats. Early replacement of the femoral head into the acetabulum is essential. In cases "not presented for treatment until some days after the accident, the acetabulum may become filled with an organising blood clot: even though the femoral head is returned correctly to its proper position, it often reluxates."[1] A technique by means of which a firm anchorage of the joint can be obtained has been employed in such instances by Dalton.[2] "Any restraining device, which interferes with free motion of the joint, will give healing which will break down when motion is restored."[3] The operation itself is difficult. It requires a set of Roger Anderson mandibular splints, which, when inserted, remains outside the skin and causes some discomfort to the animal. The splint can easily be damaged or even torn out during hospitalisation of the patient, and the pins protruding through the skin encourage infection. A much simpler method was described by Devita[3] at the eighty ninth Annual Meeting of the American Veterinary Medical Association.

This method, slightly modified, was used by myself with encouraging results.

An X-ray of the dislocated leg is taken to ascertain the position of the femoral head, to exclude the possibility of a fracture of the femoral neck or pelvis and to confirm that the rim of the acetabulum is intact.

Morphine and atropine are given as pre-anaesthetic medication and anaesthesia is induced by thiopentone sodium. (Morphia, being a post-anaesthetic sedative, allows a quiet recovery until complete control of the remaining three legs is regained.) The anaesthetised animal is placed on the table with the dislocated hip uppermost. An assistant either grasps the animal by the tail or pulls on a rope or towel which is passed through the animals' groin. The operator then introduces a gloved index finger into the rectum and grasps the femur between the index finger and thumb. "With the position of the femoral head visualised in relation to the acetabulum, powerful traction is applied in a downward and forward direction either in snatching jerks or continuous pull"[1] with the thumb pressing firmly upon the trochanter, thus forcing the head of the femur over the rim into the socket. If this method fails, "the hip is slowly and gently abducted to its full extent and then flexed and extended in a similar manner. This is intended to break down adhesions, overcome muscle spasm and probably rupture some muscle fibres." [1] Outward and inward rotation with downward and forward traction is tried again.





In the most common upward and anterior dislocation the head of the femur slips over the rim of the acetabulum assisted by pressure over the trochanter. Once the luxation is reduced, the limb is tested for stability by flexing then extending and abducting the leg. The leg is then bandaged in the orthodox manner (figure of eight) and checked daily for 3–5 days, after which the bandage is removed and the pateint discharged.

In many cases, however, recurrent dislocation occurs. This is usually due to complete separation of the teres ligament and an extensive tearing of the joint capsule, or filling of the acetabular cavity with clots of blood, or fractures of the acetabular rim. In these cases it is necessary to resort to pinning.

An area of the skin is shaved over the tuber ischii and a suitable Steinman pin is selected and measured against the radiograph. With a scalpel a stab incision is made through the skin, just under and about three quarters of an inch medial to the tuber ischii. Locate the trochanter with the thumb and aim for this point with the pin. The pin is inserted by means of a chuck. Once the pin strikes the bone, withdraw it slightly and direct it until the top of the neck of the femur is felt. Locate the wing of the ilium and place one finger on the tuber coxae and aim the pin in the direction of this finger. Rotate the pin through the bone until the sharp end is felt under the skin. The posterior end of the pin is grasped with a pair of strong tooth forceps or a pair of pliers (sterile) and is bent at right angles close to the skin, using the chuck for leverage. The end is cut off, so that the bent section is about half-an-inch long. This end of the pin is inserted under the skin; the stab wound is closed by means of one mattress suture. It is essential that the pin is bent, if not, it is liable to move and may necessitate X-ray examination to ascertain its position.

Radiographs are taken in a lateral and ventro-dorsal position to confirm reduction of the dislocated hip and proper positioning of the pin. Fig. I shows the correct position of the pin and its action, viz. preventing upward movement of the head of the femur. Compare this with Fig. II where the pin is in the wrong position, i.e. above the tuber ischii. This position permits upward luxation.

The patient should be given antibiotic therapy[3] for three days and hospitalised if possible. After seven days the pin is removed and the pateint discharged.

I have used this method with ecnouraging results, in a great number of cases, both in the dog and cat, and have not observed any damage done to the sciatic nerve. Occasional failures are encountered, but these can usually be ascribed to poor technique. A prerequisite for success of the procedure is complete asepsis.

ACKNOWLEDGEMENT

I would like to thank Dr. I. F. Du Toit for his artistic illustrations.

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ACETYLENE GAS-HEATED SEARING IRONS FOR DOCKING LAMBS AND DEHORNING CALVES—A CLINICAL NOTE

G. D. Sutton Section Animal Management Onderstepoort

A trial was recently made of a new gas-heated apparatus for docking lambs and dehorning claves.

As shown in the illustrations the apparatus has interchangeable tail-docking and dehorning heads, which are heated by acetylene gas.

The gas flame, being shielded, cannot burn the animal nor the operator.

The equipment is manufactured in South Africa by Messrs African Oxygen Ltd.

The gas is supplied from a cylinder which is fitted with a regulator, gauge and valves for controlling the pressure and flow of gas; which is lead through a stout rubber hose to the burner. The gas is ignited at the burner and the flame plays on the inside of the irons thus heating them. Spanners and nuts for assembling and interchanging the apparatus are provided.

When used in the open, the docking iron takes 5 minutes to heat up to the required temperature which is tested by placing the sharp edge of the iron on wood. When the wood is scorched by the iron a satisfactory temperature has been attained. Once at this temperature the heat remains constant and the iron can be used continuously. For docking, the lamb is placed in the sitting position with its tail across a stout board or deal, to protect the sharp edge of the iron from damage after it has penetrated the tail. A metal plate (shield) is placed on the tail as close to the body as possible for protection against the heat from the iron and to constrict the ventral coccygeal artery which is the chief blood supply to the tail in sheep. The hot iron is held with the sloping side nearest to the lamb, the sharp edge placed on the tail as close as possible to the metal plate, and enough pressure applied to push it through and sever the tail. The iron appears to slip automatically into a joint between two of the vertebrae of the tail, and goes through quite easily. The iron was tested on 70 lambs varying in age from 1 week to 3 months and also on 2 adult sheep with long tails. The operation was successful in all cases. There was no bleeding and uninterrupted healing took place in 3–4 weeks.

With the lambs in a small pen close at hand, and four assistants to bring them to the operator, 25 lambs were docked in 5 minutes with this apparatus.

The dehorning iron takes about 3 minutes to reach the required temperature, which is also indicated when wood is scorched. This temperature too is maintained for continuous use. For dehorning the calf is placed on its side and secured. The hot iron is applied to each horn bud

for 3 to 5 seconds. With four experienced assistants 20 calves were dehorned in 30 minutes. This dehorning was completely successful in all cases and healing took place normally.

This equipment was found more convenient than irons heated in fires because there was no waiting for irons to be heated and reheated. The work was completed in less time.

ACKNOWLEDGEMENT

The apparatus for testing was supplied by courtesy of African Oxygen Limited, P.O. Box 207, Germiston, who also kindly provided the photographs.

The Director of Veterinary Services is thanked for approving the publication of this Clinical Note.

Photo No. 1. Plate and iron just before use.

Photo No. 2. Plate and iron in use.

Photo No.3. Dehorning iron in use.

A Clinical Communication

UNNA'S STICKY PASTE AS A PRACTICAL AID TO BANDAGING

D. H. G. Irwin and C. F. B. Hofmeyr
Department of Surgery Faculty of Veterinary Sciecne, Onderstepoort

An editorial in the Pennant[1] directed attention to the value of Unna's Sticky Paste (U.S.P.) as an aid to the application of bandages. This reference prompted further investigation with such gratifying results that U.S.P. is now in regular use in the large and small animal clinics of the Faculty of Veterinary Science of the University of Pretoria, Onderstepoort. It is felt that a brief description of the material and of the experience obtained will be of interest to colleagues.

Formulation

Wood and Bache[2] mention two rather similar preparations viz. "Unna's Soft Zinc Paste", which is made from zinc oxide, calcium carbonate, linseed oil and lime water: and "Unna's Sulphurated Zinc Paste" which contains zinc oxide, precipitated sulphur, silicic acid and benzoinated lard. No proportions are offered. The British Pharmacopoeia, 1958, gives the following ingredients as constituting zinc gelatin:—

Zinc oxide	*Gelatin*	*Glycerine*	*Water*
150 gm.	150 gm.	350 ml.	350 ml.

This preparation is rather similar to U.S.P., but is not so useful in bandaging.

The formula used in the Department of Surgery, Onderstepoort is:—

Zinc oxide	*Gelatin*	*Glycerine*	*Water*
300 gm.	400 gm.	500 ml.	800 ml.

The solid ingredients are mixed: the liquids are added, the mass well stirred, and heated in a double boiler. When the material acquires the consistence of enamel paint it is ready for use. When cold, the paste assumes the springy consistence of foam rubber. U.S.P. is made up in bulk. Unused paste is reheated in the double boiler, and used as required.

Application of U.S.P. Bandages

By means of a two to four inch paint brush, the paste is liberally applied to the part to be bandaged, and a gauze roller bandage is then secured. More U.S.P. should be used if necessary to ensure that each layer of bandage adheres to its predecessor. No knots, pins or other fastening devices are necessary. The animal is kept away from dust and bedding for 20 minutes, by which time the paste has set. The bandage is firm but flexible and can stay in place for a matter of weeks.

Removal

Removal is readily effected by cutting the bandage longitudinally and peeling it off: alternatively the paste may be liquefied by warm water.

Indications

(*a*) *In the dog:*

(i) To support the abdomen, e.g. after laparotomy in cases where impaired healing is anticipated.

(ii) To control or limit oedema after dermoid cystectomy in the Ridgeback, or after laminectomy.

(iii) To immobilize and protect the ears.

(*b*) *In the horse:*

(i) The bandage provides a good malleable support for tendons.[3, 4] Six cases of tendonitis showed gratifying resolution by the use of U.S.P. bandages. The pressure encourages resorption of excess synovia, and exerts a gelotryptic action on the tendon lesions.

(ii) It prevents filling of legs in horses confined to stable.

(iii) Pressure bandaging with this method is of great use in preventing and controlling excessive granulation in wounds on horses' limbs.

(iv) Sticky paste and cotton wool has been used instead of tar and tow,[3] in cases of punctured sole in the convalescent stage. The criteria of protection for the new and as yet thin sole, elasticity and provision of adequate pressure, are met in good measure.

(*c*) *In Cattle:*

(i) Dressing of claw amputation and other wounds on limbs is well supported and protected.

(ii) As dressing after dehorning.

(*d*) *General:*

(i) Various dressings such as drainage tubes, udder slings, etc. are well supported. An appropriate area is painted with U.S.P. and sheeting or toweling pressed on to it, which in turn supports tapes, etc.

(ii) Securing drapes about site of operation especially useful on large animals and for out-door surgery.

Contra Indications

None have yet been recognised.

COMMENT

U.S.P. and gauze bandage is superior to many commercial adhesive plasters because—

(*a*) it is cheaper;

(*b*) it is readily removed with warm water;

(*c*) it allows evaporation, whilst some adhesive plasters may provoke eczema through being impervious.

SUMMARY

The preparation, application, removal, and indications for use of Unna's Sticky Paste with gauze bandages in veterinary practice are mentioned. Other uses of U.S.P. are mentioned and compared with commercial adhesive plasters.

ACKNOWLEDGEMENT

The Director of Veterinary Services is thanked for kindly allowing the publication of this clinical note.

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A CASE REPORT

TRAUMATIC SUPPURATIVE CEREBROSPINAL MENINGITIS IN SHEEP

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(*Received for publication, 8th July*, 1961)

History

On June 9th, 1961 a farmer from the district presented a Merino lamb aged approximately six months for examination. The animal was in a moribund state.

The owner stated that between twenty or thirty animals were affected; some had died, others had been put out of their misery, while the balance were in various stages of retrogression.

The symptoms described by the owner in order of development were general lassitude, falling behind the flock, stiffness in the forelegs and neck, walking on the carpal joints, prostration, rapid blinking of the eyes, finally ending in death over a period of three to seven days or more.

Inquiry into the management and grazing gave no specific leads; though the animals had been dosed with Phenothiazine and Flowers of Sulphur on the 29th of May, i.e. approximately a week before the trouble started.

A dosing syringe of an old-fashioned type with a short nozzle and "Small plank" had been used; the latter for the Sulphur.

All sheep had been inoculated at least twice recently for Enterotoxaemia and for Bluetongue during the summer.

Mainly six month old lambs but also a few adult ewes were affected.

Ante mortem Examination

The animal was in reasonable condition, all external orifices were normal, ears were free of ticks and so was the body. There were no abnormal swellings, and respiration, though feeble, was free. The temperature was not taken. The animal was then destroyed.

Post Mortem Examination

Apart from a small consolidation in one lung, a little white mottling of the fat deposists, fairly empty digestive tract, and an abnormal absence of parasites, nothing unusual could be found.

It was then decided to explore the brain for the possibility of Multiceps. The opened cranium revealed a fairly severe congestion of the superficial blood vessels but no trace of any cysts.

Diagnosis

Encephalitis of unknown actiology—unsatisfactory to both the owner and myself.

Further Mortality

From the 9th of June until the 1st of July the owner phoned repeatedly in desperation to report further deaths, and suggested causes of death varying from Anthrax to internal parasites and poisoning. None of his theories fitted into the picture.

On July 1st the owner arrived with a sheep's head sawn longitudinally, and his dosing syringe. He demonstrated a small necrotic fistulous cyst ventral to the basillar part of the occipital bone, between the oesophagus and the articulation of the occiput and atlas, i.e. the site where the medulla is usually severed at slaughtering.

This cystic area contained a little greyish mucoid material and a small amount of greenish inspissated pus, in some of the fistulous tracts and pockets.

The cyst had a firm fibrous wall and there was no sign of any acute inflammatory condition of the adjacent muscles or fascia.

The oesophagus and posterior pharynx appeared to be intact.

The cyst, damaged by sawing, was explored with a probe and one fistulous tract did appear to lead forward, but no definite anterior opening into the digestive tract, could be located.

On exploring the cyst dorsally, it was found to be in direct communication with the spinal cord, the latter being severely inflamed, and eroded ventrally, in this area.

The owner then explained that the native who skinned and cut up all the previous carcasses had pointed this out as a constant feature.

The dosing syringe was then experimentally placed in all positions in the mouth, but it was impossible to approximate its tip with the lesion, and in any case, no injury had been located in the mucosal surface of the posterior pharynx or anterior oesophagus. The possibility of trauma could however not be excluded as a cause of the lesion. The problem was how the original trauma, if any, had been inflicted.

A Further Case

On July 4th the owner arrived with another moribund sheep. The rectal temperature was 107°F. It was destroyed by intravenous pentothal injection into a superficial vein on the foreleg, to avoid damage to the larynx, pharynx and adjacent structures, and in order to permit detection of possible lesions in this area, which could have been obscured when the animal's throat was cut.

The postmortem examination of the thorax and abdomen, as in the first case, was essentially negative.

The skin was dissected from the throat area and the oesophagus and trachea exposed. These were then severed fairly low down the neck and dissected towards the pharynx. The surrounding tissues were normal.

A slightly dark area was however observed through the connective tissue ventral to the articulation of the occiput and atlas. On incision a greyish fluid escaped. A probe was inserted from this cavity. It travelled freely forward towards the pharynx. The cheeks were slit on either side and the mandibles forcibly disarticulated to expose the oral surface, pharynx and larynx to find the end of the probe. It was found in the naso-pharynx, dorsal to the soft palate and appeared through an aperature of about 0.5 cm. in length.

The thickness of the tissue at this site, between the nasopharynx and the ventral surface of the occiput and atlas, is minimal. Continuity with the cyst and the medulla was again established, as was a suppurative meningitis.

It was proved that the Sulphur "Dosing plank", probably with a sharp corner, inflicted the trauma either through the sheep rearing, or the stick being forced semi-dorsally into the pharynx by the over-vigorous doser.

The main features of this case were:

(*a*) The large number of cases involved. Four ewes and 27 lambs died or had to be destroyed; another 5 remained affected.

(*b*) The relatively long period of time between trauma, morbidity and death.

(*c*) The site of perforation, dorsal to the soft palate, which can so easily be overlooked.

(*d*) The absence of acute inflammatory reaction at the site of perforation, and the immediately adjacent tissues. The explanation for this is probably that there was no leakage of ingesta, but only nasal mucus present which contained organisms of fairly low virulence.

A REPORT ON SUDDEN DEATHS OCCURRING IN LAMBS IN THE FREE STATE MIDLANDS

P. C. Belonje State Veterinarian Division of Veterinary Services.
Private Bag 138 Pretoria.

(*Received for publication*, 19*th August*, 1961)

SUMMARY

An account is given of thirty-four sudden deaths in lambs on a farm in the O.F.S. Midlands. Focal purulent hepatitis due to a Corynebacterial navel infection is blamed as a debilitator, while acute salt poisoning is incriminated as the actual cause of death.

INTRODUCTION

On 8th June, 1961, a farmer presented a lamb for examination. Thirty-four lambs had died suddenly, all showing the same post mortal symptoms.

On examination, there was an intense inflammation of the small intestine, focal abscesses dotted throughout the substance of the liver, and enlargement of the intestinal lymphnodes.

Specimens sent to Onderstepoort revealed the following:

(*a*) *Liver*: Fairly numerous small round foci of necrobiosis with numerous colonies of what appear to be small rod-shaped Bacteria. Not much reaction on the part of the host.

An organism closely resembling *Corynebacterium pyogenes* was isolated from the liver.

(*b*) *Lymphnodes*: Reactive hyperplasia.

(*c*) *Intestine*: Acute enteritis.

(*d*) No indence of Enterotoxaemia, Bacterial hepatitis or Pasteurellosis.

HISTORY

In August, 1959, Dr. P. P. Hugo inspected a Red Poll herd on this farm amongst which both adults and calves showed abscessation of the retropharangeal and submaxillary lymphnodes. Unfortunately no bacterial growth could be gained from the specimens submitted, but the nature of the pus led him to suspect Corynebacterium as the cause. However the animals progressed, and without medicinal treatment recovered completely: no other further cases have since been noticed.

It is interesting to note at this point that the owner has had only one case of caseous lymphadenitis reported to him by the abattoirs in the last 600–800 slaughter sheep, and that he has not seen any abscesses in sheep he has slaughtered for his household, and that no cattle have grazed in the "lambing" camp.

In May, 1961, the ewes started lambing down on flat, mixed veld, during a four week spell of continuous cloudy, drizzly, wet weather. After lambing the ewes were taken to a vlei camp for three days, and then put onto lands. After three weeks on these lands the lambs suddenly started dying.

Discussion

It seemed obvious that the farm was infected with strains of Corynebacterium and that the infection gained access to the liver through the navel during the wet lambing time. Although the livers were badly infected, the actual cause of death seemed to be linked more with the intense inflammation of the gut. Parasites, coccidia in particular, were excluded by repeated microscopical examinations.

After much enquiring, it was learnt that a salt lick had been laid out in troughs on ground level, and that the youngsters had been seen eating this. The final diagnosis was acute salt poisoning with accompanying focal purulent hepatitis due to navel ill.

Conclusion

Liver specimens have again been submitted to Onderstepoort for bacterial culture and vaccine production; the latter to be used on the spring lamb crop. The farmer has been advised to use a high lying camp for his ewes to lamb down in, to paint the navels with Tincture Iodine as soon as possible after birth, and also to put the salt troughs on legs high enough to prevent the lambs gaining access to it before at least 5-6 months of age.

Acknowledgments

My sincere thanks to Drs. Tustin and Cameron for the pathological and bacteriological reports.

BOOK REVIEWS

THE VETERINARY ANNUAL. 2ND ED. POOL, W. A. (EDITOR) (1960), BRISTOL: JOHN WRIGHT AND SONS LIMITED

The second edition of The Veterinary Annual, like the first, was compiled specially for the needs of practitioners who have very little time for reading at their disposal. It comprises a review of a vast amount of literature covering the latest developments in virtually all subdivisions of veterinary science. Special articles which are of general interest are included e.g. "Brucella's Challenge" and "The Control of Infectious Diseases in Poultry in the Netherlands". These, together with similar articles in the first edition, form a series.

The editor has succeeded in avoiding repetition and the style is conducive to easy reading. Many references are provided for those who wish to know more about specific topics. The book is strongly recommended to clinicians engaged in practice.

B.C.J.

COMPARATIVE MEDICINE IN TRANSITION 1960

Published by University of Michigan School of Public Health, Ann Arbor, Michigan, U.S.A., pp. 499 + XVIII

This is a record of the Proceedings of the First Institute on Veterinary Public Health Practice held in October, 1958. As a group effort it represents a summary of opinion of methods and techniques for implementing contributions by veterinary medicine for the improvement of the physical, mental and social well-being of man. It clearly illustrates the contributions made to date and suggests solutions to the changing health problems of the modern age. The very essential aspects of an inter-professional relationship is well outlined in this book, which contains contributions from all members of what might be called the public health team.

The book is divided into chapters dealing i.a. with Administration, Education, Experimental Medicine, Laboratory Services and Research, Biological and Pharmaceutical Production and Control, Food Hygiene, Chronic Diseases and Geriatrics, Dental Public Health, Occupational Health, Military Veterinary Medicine, Radiation and Civil Defence, and a Summary. The width and scope of responsibilities and activities open to the veterinarian in the United States is well illustrated.

L. W. v.d. H.

ANIMAL NUTRITION AND VETERINARY DIETETICS

John T. Abrams

4th Edition, 1961, pp. 826. Price 84/-
Published by W. Green and Son, Ltd., Edinburgh

This book is the successor to the work of the late R. G. Linton and, as it is not only concerned with the scientific principles of animal feeding but also with "animal dietetics which is an art that leans increasingly on the science of nutrition," the appearance of the latest edition with its store of new information should be welcomed by all Veterinarians in particular.

The book is divided into six sections dealing with different aspects of this vast subject, covered in 37 chapters.

The subject matter is initiated with "a quite new introductory section of which the first chapter presents a brief history of nutrition, whilst the second describes the more common nutritional techniques." This section is succeeded by others on the nutrients, including a very valuable chapter on water, its sources, physiological functions, the water requirements of livestock and the effects of a lack of or an excessive amount of water intake. General characteristics of feeding-stuffs the physiological bases of feeding standards, general principles for the construction of rations for the various species of farm animals, rabbits, small domesticated carnivores and poultry are discussed. There is a new section dealing with hunger, appetite and palatability, the animal and its environment, and an extensive chapter on malnutrition. Useful references are given at the end of each chapter and several very convenient and up to date tables regarding the composition and nutritive value of feeding-stuffs are given in the appendix.

The book is very well produced. It deals fully and clearly with all major aspects regarding the theoretical and practical feeding of animals, and can be wholeheartedly recommended to students, teachers and research workers in the field of nutrition as an excellent and authoritative reference book.

J.H.K.

THE ARTHROPOD PARASITES OF VERTEBRATES IN AFRICA, SOUTH OF THE SAHARA

(Ethiopian Region). Vol. 1 (Chelicerata)

By

F. Zumpt in collaboration with J. R. Audy, J. Gaud, R. F. Lawrence, G. Theiler, W. M. Till and G. P. Vercammen-Grandjean

A Publication of the South African Institute for Medical Research No. 1, Vol. 9. 1961*

Dr. F. Zumpt as editor, compiler and co-author of the book must be congratulated on what can only be described as a monumental piece

* Vol. 1 is obtainable from the S.A. Institute for Medical Research, P.O. Box 1038, Johannesburg. Price R6.00.

of work and a major contribution to the scientific knowledge of the arthropod fauna of the greater portion of the African continent and the book should prove to be of the greatest value to the taxonomist and student in the entomological field.

The volume under discussion which is confined to the parasitic mites and pentastomids of the mammals, bats, birds, reptiles and amphibia of the sub-continent represents by far the most comprehensive work of this nature to have appeared to date. The ticks have not been included under the *Chelicerata* in the present volume due to the fact that the *Icodoidea* have received so much attention in Africa by virtue of their great economic importance and the scientific literature dealing with them is so extensive that their treatment is being dealt with in a separate volume to appear later.

The work opens with a definition and discussion of the term parasitism as it is used throughout the text. The evolution of animal parasitism is discussed in some detail with particular reference to the orders and sub-orders dealt with in respect of morphological and biological adaptations, numerous examples being quoted. These introductory remarks, however, apparently serve the contemplated additional volumes as well, as the orders *Dermaptera, Phthiraptera, Heteroptera, Diptera* and *Siphonaptera* are included in so far as a discussion of host-parasite relationships are concerned.

Several pages are devoted to a general discussion of the degrees of specificity displayed by parasites towards their hosts together with their pathogenic effects and the modes of transmission of harmful organisms.

A short section dealing with the collection and preservation of the parasitic arthropods illustrated by diagrams of some of the more essential equipment required is followed by illustrated guides to the morphological features necessary for identification and classification of the mites and ticks.

The subject matter is dealt with systematically, essential keys for the recognition of families and genera are provided. The species together with their synonomy are named and complete literature references are included in the text. Locality and hosts together with remarks relevant to genera and species, where appropriate, fulfil a useful explanatory function. The value of the work is greatly enhanced by the numerous excellent line drawings of individual parasites and morphological features illustrating minor generic or specific differences.

The section dealing with the Pentastomida is of considerable interest in that it brings together for the first time a description of the genera and species known from the African sub-continent of this aberrant group of parasites.

The taxonomic section occupies 350 pages and is followed by a most comprehensive host-parasite list of 52 pages systematically arranged in two sections, one dealing with the wild vertebrates and the other with domestic animals and man in which the common as well as the scientific names of the hosts are included. References to literature of a more general nature not included in the text follows in the ensuing 7 pages and an index listing the parasites dealt with alphabetically over 26 pages with

page references precedes a page indexed list of the common names of hosts arranged alphabetically in the concluding 6 pages.

The book may be recommended with confidence to every scientific worker in the broad zoological field interested in the fauna of Africa and to the entomologist the work may be regarded as essential for reference purposes as the most complete and up to date check list on the parasitic mites of the African sub-continent.

R. du T.

PUBLIC RELATION SERVICE

Foot and Mouth Disease in South-West Africa

It is understood that the disease has been found on a large scale in domestic goats and in Kudu.

The Association deeply sympathises with those colleagues who have to bear the burden of the work concerned with these extensive outbreaks and expresses the hope that the vaccination approach which took Drs. Jansen and Lambrechts hurriedly to London will meet with unqualified success.

World Veterinary Association

Dr. S. W. J. van Rensburg, during his recent visit overseas, attended the meeting of the World Veterinary Association in Paris on 18th May, 1961, on behalf of the S.A.V.M.A.

On his return Dr. van Rensburg informed Council that the 17th World Veterinary Congress would be held at Hanover on 14–21st August 1963, which had been declared an Animal Health Year. It would celebrate a hundred years of Veterinary progress and development. The World Veterinary Association, he said, was tending to expand into a big concern.

His impression during his recent visit to Europe was that the Veterinarian was being accepted as the leading figure in animal husbandry particularly as regards animal breeding.

Members on Overseas Study Courses

Professor H. P. A. de Boom has left on a year's study course at Cornell University, Ithaca, New York. His family will follow him during December. We wish him a fruitful and pleasant stay in the U.S.A.

Dr. Philip Boyazoglu has left for the University of Minnesota, where he has been admitted to the Graduate Faculty for Animal Nutrition for specialization. He received a Scholarship from the Institute of International Education of the U.S.A. for one year initially. He is on full-time study leave.

News from the Inter-African Bureau for Animal Health: Muguga-Kenya

The following news item has been received from I.B.A.H.:—

Symposium on Poultry Diseases in Africa

During the period July 17th–19th, 1961, the Inter-African Bureau for Animal Health staged a Symposium on Poultry Diseases with special reference to Africa, as recommended by the Inter-African Advisory Committee for Animal Health in 1959.

The meeting was held at the Victoria Falls in the Federation of Rhodesia and Nyasaland, as a prelude to the annual series of meetings of the Advisory Committee and the Council of Management of the Bureau.

The delegates came from the Federation of Rhodesia and Nyasaland, the Federation of Nigeria, the Republic of South Africa, Mozambique, Sierra Leone, Upper Volta, United Kingdom, Bechuanaland, Kenya, Uganda and elected Mr. G. J. Christie of Southern Rhodesia as Chairman. Observers were present from F.A.O., Cyanamid International and Pfizer International.

The agenda included discussions on the place of poultry and their products as a source of human food in Africa and the factors which limit production, and then passed to the various systems of housing in use. Diseases of importance to Africa in the viral, bacterial and protozoal groups were covered with special emphasis on Newcastle Disease, the meeting passing a recommendation that in Africa prophylactic measures should include vaccination, preferably using a live attenuated vaccine. The epizootiology of the disease in Africa was also covered.

The meeting in addition recommended that Governments should accept that disease-free poultry production is an activity of first importance in Africa and should be supported by a network of facilities for early detection of disease by veterinarians. The delegates accepted a standard pro forma as a health certificate for export and import of poultry and recommended that courses on poultry management should continue to be arranged by C.C.T.A. in both East and West Africa.

The Veterinary Board

Dr. B. C. Jansen has been appointed Chairman of the Veterinary Board, by the Hon. the Minister of Agricultural Technical Services. We welcome Dr. Jansen to his new responsibilities and feel sure that he will carry these out with justice and zeal.

As a result of the recent election the names of Dr. H. P. Steyn and Dr. M. C. Lambrechts have been submitted to the Minister of Agriculture for his approval as members of the Board representing S.A.V.M.A.

"THERE IS NOTHING NEW UNDER THE SUN"

Dr. R. Clark has kindly supplied the following extract from an article in "*The Veterinarian*", Vol. 35 No. 420, December, 1862:—

> "We have been told that science should be loved for its own sake, neither counting its cost nor its reward, but simply because of its usefulness. . . .
>
> Certain it is that the rewards connected with veterinary medicine are not large. They may, therefore, be said to be intrinsic, and the motives by which the practitioner is actuated are purely philanthropic, since to do good to those animals placed lower in the scale of creation than himself is his object, and in the fulfilment of his duty he obtains his guerdon. Nevertheless, by perseverence, probity and the honest exercise of those talents God has endowed him with, a moderate competency may be gained, so that in the autumn of his life he may not only relax and obtain rest from the more laborious part of his profession, but retire if he so will, and enjoy his *otium cum dignitate*."

MEETINGS OF BRANCHES

The following reports of branch meetings have been received:—

VERSLAG AANGAANDE DIE VERRIGTINGE BY DIE JAARVERGADERING VAN DIE O.V.S., BASOETOELAND EN NOORD-KAAP TAK (S.A.V.M.V.), GEHOU TE BLOEMFONTEIN OP 22 JULIE 1961, OM 9.30 VM.

Die vergadering is deur 21 lede bygewoon, waarvan sommige groot distansies moes aflê om teenwoordig te wees. 'n Aantal lede is verhinder om die vergadering by te woon as gevolg van die Bek- en Klouseer uitbreking in S.W.A.

Dr. B. C. Jansen het die vergadering as kollegiale gas bygewoon en dit word hoog op prys gestel dat hy hom die moeite getroos het. Gelukwensing met sy aanstelling as Direkteur van Veeartsenydienste is oorgedra.

Ander gaste wat die wetenskaplike deel van die vergadering bygewoon het, was mnr. Barr (Redakteur van die „Farmers Weekly"), prof. Coetzee (Dekaan van die Fakulteit van Landbou—U.O.V.S.) en mnr. Hattingh (Hoofvoorligtingsbeampte—Bloemfontein).

Die voormiddag is bestee om die besigheidsvergadering af te handel. Sake voortvloeiend uit die verrigtinge was onder andere:—

Kunsmatige Inseminasie kursusse word op Landboukolleges net uitsluitlik vir boere gereël, wat K.I. op hul eie plase wil toepas, en nie as 'n opknappingskursus vir Veeartse nie.

In sy voorsittersrede het die voorsitter genoem dat die tak baie aktief is en dat lede selfs 300 myl reis om een dag se verrigtinge by te woon. Die verslag noem verder dat die tak alreeds sake aan die moederliggaam aanhangig gemaak het wat sodoende aandag geniet het en deurgevoer is, bv. skaal van fooie en dat die kongres op 'n ander plek as Onderstepoort gehou moet word.

Dr. Jansen het aan die vergadering kortliks geskets wat die huidige beleid van die departement (Veeartsenydienste) is, naamlik, die oprigting van streeks diagnostiese sentra om dus die Veeartsenykunde in geheel te help om meer wetenskaplike diagnosis daar te stel.

'n Resolusie is aangeneem waarin die opinie uitgespreek word dat Veeartse in die handel nie as verkoopsagente moet optree nie, ook dat hul professionele naam nie aan produkte gekoppel word nie, en indien dit gebeur dissiplinêre stappe teen sulke veeartse geneem moet word.

Die komitee wat verkies is vir die volgende jaar is soos volg:— Drs. D. J. Louw (Voorsitter), W. J. Ryksen (Onder-Voorsitter) en H. G. J. Coetzee (Ere-Sekretaris/Penningmeester) met addisionele komiteelede drs. N. Barrie, C. H. Flight en J. C. Wessels.

Die namiddag is gewy aan wetenskaplike voordragte:—

(1) 'n Filmvertoning is aangebied deur 'n firma wat farmaseutiese middels vervaardig omtrent „Stremming in kuikens" en „Diarree in Varke."

(2) 'n Interessante voordrag oor „Veeartsenykundige probleme en ander aspekte van aangeplante weidings" is deur dr. W. J. Ryksen gelewer en dr. P. P. Hugo het in aansluiting daarby 'n kort referaat oor die sg.

„Groenhawervergiftiging" gelewer. Die onderwerpe het 'n lewendige bespreking uitgelok.

(3) 'n Gevalsverslag is deur dr. D. J. Louw gelewer betreffende beserings by dosering van skape met gevolglike encephalitis.

Die lede, hul gades en gaste het 'n gesellige skemerkelkpartytjie by 'n plaaslike hotel bygewoon en dit het 'n baie suksesvolle dag afgesluit.

S.A.V.M.A. Cape Western Branch

The annual general meeting of the Cape Western Branch was held in the Offices of the Director of Maitland Abattoirs on 18th August, 1961. Twenty-seven members attended the meeting.

It is with great pleasure that we record that the meeting was opened by Dr. A. M. Diesel, Secretary of the S.A.V.M.A. On the previous evening an informal dinner was held at the Glendower Hotel to welcome Dr. Diesel and a gratifying number of members and their wives enjoyed a very pleasant social occasion.

Following the opening address, in which Dr. Diesel outlined proposals for the Journal of the Association, a demonstration was given of closed circuit inhalation anaesthesia by Dr. Brownlie.

A visit to the new feed mixing plant of Vereeniging Consolidated Mills, which was sponsored by Dr. Stephan, brought the morning proceedings to a close and a braaivleis was held during the lunch hour.

After lunch the business session was held, in the course of which the following new office bearers and Committee members were elected:—

Chairman	Dr. A. Albertyn.
Vice Chairman	Dr. C. H. Basson.
Secretary	Dr. J. K. Thomson.
Committee	Dr. Dorrington.
	Dr. Faull.
	Dr. Horwitz.
	Dr. Masters.
	Dr. Stephan.

A series of most interesting clinical discussions, introduced by Drs. Faull, Walters and Schneider, in which most members took part occupied the remainder of the time.

The meeting was concluded with a vote of thanks to Dr. Diesel.

A very enjoyable cocktail party finally terminated the proceedings.

Oos-Kaaplandse Tak van die S.A. Veterinêr-Mediese Vereniging

'n Geslaagde vergadering is op 15 Julie 1961 gehou, bygewoon deur 16 veeartse waarvan 13 lede van hierdie tak en 3 besoekers was, nl. drs. Adelaar, Brown en Anderson.

Die ou komitee was herkies, nl. dr. J. M. de Wet, Voorsitter, dr. R. Buchalter en W. P. van Aardt as bykomende lede en dr. McHardy as sekretaris.

NEW PREPARATIONS AND APPLIANCES OFFERED BY FIRMS TRADING IN PHARMACEUTICALS AND INSTRUMENTS

(Compiled by the firms concerned—Ed.)

South African Cyanamid (Pty.) Ltd.
(P.O. Box 7552, Johannesburg)

The theme of this exhibit was a three-way control programme against Mastitis in Dairy Cows, for Veterinarians. These products, sold only to Veterinarians were featured:—

Staphylococcus Aureus Toxoid, Slanetz Strain No. 7

A whole broth chemically killed culture of Staphylococcus Aureus, Slanetz Strain No. 7, containing toxoids derived from the Alpha, Beta and Delta toxins produced by these cultures and aluminium hydroxide adjuvant. This product has proved successful as an economical aid in the prevention of Staphylococcal mastitis. Available in 50 dose (5c.c.) multidose vials for intramuscular injection.

Targot Mastitis Ointment

A free flowing ointment containing Aureomycin, Neomycin and Dihydrostreptomycin.

Varizyme. Streptotsinase—Human Plasminogen—

Streptodornase, an enzyme combination specially designed to ensure liquification of viscous exudates, fibrin and clotted blood in inflammatory processes in all species of animals. Available in 12,500 unit and 125,000 unit vials.

Merck Sharp & Dohme International

New 2nd edition is published of the *Merck Veterinary Manual*

The 1,600-page Second Edition of the Merck Veterinary Manual, in English, substantially expanded to incorporate the many advances in veterinary medicine since the first edition of this compendium appeared in 1955, has been published by Merck & Co., Inc., Rahway, New Jersey. The new volume is a companion publication to the 10th Edition of the Merck Manual, standard reference work of the medical profession (the 10th Edition appeared only a few months ago) and the Merck Index, an encyclopedia of chemicals and drugs presently available in the 7th Edition of 1960. These three volumes, edited by Merck Sharp & Dohme Research Laboratories, form part of the company's programme of service to the medical and allied professions.

More than 250 authorities in various fields of veterinary science have contributed to the Second Edition of The Merck Veterinary Manual, which contains 422 chapters, 48 of them entirely new, devoted to the diagnosis and treatment of animal diseases. The chapters are grouped

into 20 main sections, each covering a specific field of practice, and the volume is thumb-indexed by section.

Members may order the Merck Veterinary Manual from their usual booksellers.

PUBLIC RELATIONS DEPARTMENT, PFIZER LABORATORIES SOUTH AFRICA (PTY.) LTD., JOHANNESBURG

With the advent of Spring in the Republic of South Africa, farmers are turning their attention once more to the problem of ticks. Apart from the debilitating effect of heavy infestation many species of ticks are carriers of serious stock diseases such as heartwater, gall-sickness and redwater.

The weapons of modern science are being used by farmers with increasing effectiveness in preventing and treating these diseases. These weapons fall into two broad categories: the first is aimed at destroying the tick, and the second aimed at curing the diseases when the ticks get through the first barrier.

Large amounts of money are spent annually on research by the world's scientific and chemical companies in developing this two-pronged attack and making it more effective.

Up to now, Pfizer has concentrated on the cure of these tick-borne diseases with its well known range of Terramycin products, but now, in order to complete the circle, Pfizer has entered the dip and spray field. Farmers are offered for the first time in the world, by Pfizer in Southern Africa, a complete preventive and curative service, by the introduction of a range of dips and sprays. These are made to the rigid Pfizer standards of uniformity and potency.

A range of dips and sprays is introduced, as no single type of dip or spray can be relied upon to destroy all ticks at all times. During recent years various strains have developed which are resistant to one or other of the insecticides used. This applies in particular to the blue tick, strains of which resist arsenic, toxaphene, B.H.C. and more recently D.D.T. Consequently it is imperative that farmers familiarize themselves with the types of ticks infesting their stock and then obtain expert advice on which dip or spray or combination thereof will ensure maximum protection for them.

The choice of insecticide depends on the type of tick present, whether a plunge dip or spray race is used, and the type of stock involved.

This service is made possible because Pfizer, one of the world's largest producers of antibiotics, are increasing their investment in Southern Africa. This development is confined to Southern Africa at present, scoring a "first" in Pfizer International.

Pfizer's service department is always ready and willing to give free advice without obligation.

Acetylen-heated Lamb Tail-Docking Iron and Dehorning Iron by African Oxygen Ltd.

A gas-heated appliance with interchangeable heads for docking lambs' tails and dehorning calves is now being manufactured in South Africa by African Oxygen Limited and is available from all their branches and distributors. *An article on this epuipment, discussing the clinical aspects, appears in this issue.*

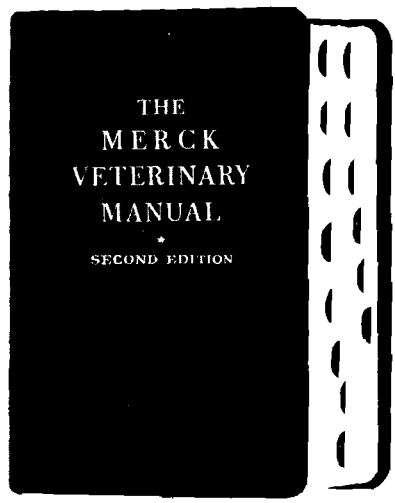
The irons are heated by a mixture of air and acetylene, the latter travelling to the burner built into the handle, from a portable cylinder through 20 feet of $\frac{3}{16}$ in hose. The "D" type acetylene cylinder holds enough gas to dock from 1,500 to 2,000 lambs' tails.

The full kit of equipment retails at R48.83 and includes the handle with its burner, the docking head, the dehorning head, a gas regulator, a cylinder gland spanner, a spindle key, an outfit spanner, the length of hose, a $\frac{5}{16}$th hexagonal nut, a pair of "0" clips and a flint lighter.

ANNOUNCING THE SECOND EDITION OF

THE MERCK VETERINARY MANUAL

This new Edition of THE MERCK VETERINARY MANUAL provides the veterinarian with well-organized, up-to-date facts on diagnosis and treatment of animal diseases. It follows the pattern established in the First Edition by including sufficient etiologic, pathologic and other background material to insure a rounded, thoughtful approach to each entity presented.



More than 250 authorities in various fields, working under the editorial direction of the Merck Research Division, served as authors or consultants in a joint effort to make this new edition of The Merck Veterinary Manual as complete in content and as relevant in choice and order of subject matter as any comparable volume:

- over 1600 pages (200 more than in the First Edition) and nearly ¾ of a million words of text — yet less than 2 inches thick.
- 422 chapters on the diagnosis and treatment of animal diseases, conveniently grouped in 20 thumb-indexed sections according to field of practice.
- several hundred carefully selected prescriptions, along with four special therapy chapters, grouped in one handy section according to indications and mode of action.
- more than 48 completely new subjects, new findings related to well known diseases, and the latest reliable information on several newly discovered clinical entities and exotic diseases.
- much new material incorporated in special sections devoted to fur, laboratory and zoo animals; poultry; toxicology; nutrition and deficiency states; parasitic diseases.
- informative advice on office, laboratory and immunization methods; veterinary radiology, oxygen therapy, etc. — along with practical reference tables.
- handbook-size format, durable gold-stamped Sturdite binding; printed on strong thin paper (so strong that the entire volume can be suspended by a single page between two fingers).

The Second Edition of THE MERCK VETERINARY MANUAL is available internationally as part of a program of service to the veterinary and allied professions. It may be ordered from your local book dealer.

MERCK SHARP & DOHME INTERNATIONAL

Division of Merck & Co., Inc. — 100 Church St. New York 7, N.Y., U.S.A.

Enquiries:
MSD (PTY.) LTD., P.O. Box 7748, JOHANNESBURG.

VERSLAG VAN UITBREKINGS VAN GEPROKLAMEERDE VEESIEKTES
REPORT OF OUTBREAKS OF NOTIFIABLE STOCK DISEASES

Vir die kwartaal geëindig 31 *Augustus* 1961
For the Quarter ended 31*st August*, 1961

SIEKTE DISEASE	DISTRIK DISTRICT	GETAL UITBREKE NUMBER OF OUTBREAKS
Bek- en Klouseer Foot & Mouth Disease	Nelspruit	1
	Letaba	1
	Rustenburg	1
	Waterberg	4
	Potgietersrus	5
B.W.D.	Bethlehem	1
	Potchefstroom	1
	Lichtenburg	1
	Kroonstad	1
	Reitz	1
Brandsiekte Sheep Scab	Barberton	2
	Carolina	2
	Nigel	2
Epizootiese Limfangitis Epizootic Lymphangitis	Port Elizabeth	1
	Uitenhage	1
Gonderiose	Nelspruit	1
Milde bees Benign bovine	Piet Retief	1
	Nongoma	1
	Port Shepstone	1
	Mahlabatini	4
	Carolina	1
Kwaadaardige bees Malignant bovine	Hlabisa	1
Kwaadaardige Buffel Malignant Syncerine	Hlabisa	4
Hondsdolheid Rabies	Letaba	2
	Abel	1
	Heilbron	1
	Viljoenskroon	1
	Posmasburg	1
	Grahamstown	1
	Kuruman	2
	Bloemfontein	1
	Wolmaransstad	4
	Bultfontein	3
	Boshof	3
	Lindley	1
	Ingwavuna	1
	Fouriesburg	1
	Vryburg	1
	Soutpansberg	2
	Reddersburg	1
Hoender Kolera Fowl Cholera	Tulbagh	1

Siekte Disease	Distrik District	Getal Uitbreke Number of Outbreaks
Hoendertifus Fowl Typhus	Brandfort	1
Knopvelsiekte Lumpy Skin Disease	Marico	16
	Mafeking	2
	Hoopstad	1
	Waterberg	1
	Vryburg	7
	Umtata	1
	Wynberg	1
	Heidelberg	2
	Eshowe	1
	Pietersburg	1
Miltsiekte Anthrax	Bloemhof	1
	Entonganeni	37
	Komgha	1
	Hoopstad	1
	Mahlabatini	1
	Bergville	1
	Sibasa (K.N.P.)	1
	Ixopo	1
	Lower Umfolozi	10
	Mtunzini	10
	Lindley	1
	Nkandhla	18
	East London	1
	Eshowe	4
	Dundee	1
Slapsiekte Dourine	Kuruman	2
	Bultfontein	1
Skurfte Mange	Kingwilliamstown	4
	St. Marks	5
Bok Goat	Ngqeleni	5
	Mqanduli	9
	Kentani	10
	Tsomo	5
	Elliot	2
	Middeldrift	5
	Willowvale	8
	Hlabisa	3
	Ingwavuma	3
	Namakwe	3
	Glen Grey	1
	Idutywa	5
	Butterworth	3
	Ngcobo	1
	Nongoma	1
	Heidelberg, T.	1
	Umtata	1
Perd Equine	Umtata	1
Bees Bovine	Estcourt	1

Tuberkulose Bees.....	Viljoenskroon.....	3
Tuberculosis Bovine	Piet Retief.....	6
	Gordonia.....	3
	Polela.....	1
	Victoria East.....	1
	Belfast.....	1
	Riversdal.....	3
	Potgietersrus.....	1
	Soutpansberg.....	1
	Wellington.....	1
	New Castle.....	1
	Pretoria.....	1
	Bethlehem.....	1
	Malmesburg.....	1
	Virginia.....	1
	Piquetberg.....	1
	Fouriesburg.....	1
	Prieska.....	1
	Johannesburg.....	1
Varkkoors.....	Rustenburg.....	1
Swine Fever		

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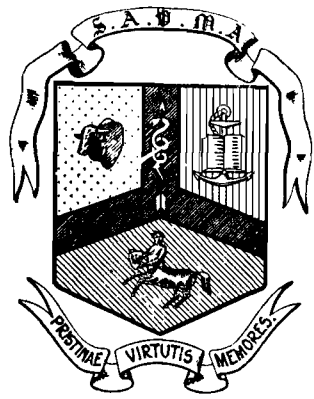
THE SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION

REPORT ON THE PROCEEDINGS OF THE ANNUAL CONGRESS HELD IN DURBAN ON SEPTEMBER 25-28, 1961

The Congress Papers appeared in the June, 1961, issue of the Journal of the South African Veterinary Medical Association (Volume XXXII No. 2)



VERSLAG OOR DIE WERKSAAMHEDE VAN DIE JAARKONGRES GEHOU OP DURBAN 25-28 SEPTEMBER 1961

Die Kongresreferate het in die Junie 1961 uitgawe (Jaargang XXXII No. 2) verskyn

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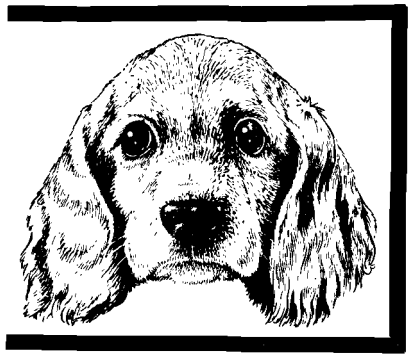

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ANNUAL SCIENTIFIC CONGRESS AND FIFTY-SIXTH ANNUAL GENERAL MEETING HELD IN THE KILLARNEY HOTEL AT DURBAN, ON 25th—28th SEPTEMBER, 1961.

SCIENTIFIC CONGRESS

OPENING CEREMONY

THE PRESIDENT, in addressing Congress, referred to the privilege to be enjoyed by guests and delegates through the presence of His Honour, the Administrator of Natal, and Mrs. Trollip and His Worship the Mayor of Durban, Councillor C. A. Milne.

He called upon His Worship, the Mayor to welcome the guests and delegates to Durban.

HIS WORSHIP, THE MAYOR OF DURBAN, regarded it a great honour and a very happy occasion to welcome so many delegates to the "*Premier Rugby Playing Province and Premier City of the Republic*". He was particularly pleased to welcome visitors from such distant parts as the United Kingdom, Australia, The Federation of Rhodesia and Nyasaland, as well as from Basutoland and other parts of South Africa.

He indicated that Durban played an increasingly important part as a venue for conferences which discussed matters relating to Science, Industry and Trade, Education and Social Science.

As a layman he had watched the development of Veterinary Science at Onderstepoort and elsewhere; the progress had been staggering.

Towards the end of last century Theiler had founded a great Research Institute and later a Veterinary School. At that time there was little in abundance, except disease. Week after week and year after year he had devoted himself to his work as a true scientist does. It was a long uphill fight. Allerton had been built and developed and Onderstepoort had become a great seat of learning.

He was proud that Durban had been chosen as the first venue for a Veterinary Congress to be held away from Onderstepoort. Durban had much to offer in this regard.

In his opinion there were two types of delegates who attended conferences. There was the delegate and the delegate-at-large. *The delegate was the man who came with his wife.*

He praised the work of the veterinarian in all its aspects. As the guardians of public health they had prevented communicable diseases between animals and man; this was especially true for the Republic with its sub-tropical climatic influences.

The work done by the private veterinary practitioners was especially commendable. Their activity in this field was greatly appreciated and their kindness and helpfulness towards the pets, which had become so much a part of man's daily life, reflected greatly to their credit; they had saved many a heartache to the family.

In wishing the Congress every success he hoped the delegates would add pleasure to business and enjoy the amenities which Durban had to offer.

THE PRESIDENT requested His Honour the Administrator to open the Congress.

HIS HONOUR THE ADMINISTRATOR OF NATAL regarded it a privilege and a pleasure to welcome the members of the South African Veterinary Medical Association and their distinguished guests to Natal. Some had travelled long distances to attend this meeting of veterinarians. It was an honour to him to be present on this important occasion, when as an experiment the conference was being held away from Onderstepoort for the first time.

Natal appreciated the compliment, and in his capacity as Administrator he wished to extend a very warm and sincere welcome to all attending the Congress. He hoped their visit would be both fruitful and enjoyable.

(*The Administrator's address appears in full in this issue*).

THE PRESIDENT called on Dr. L. C. Blomefield to thank the Administrator for his opening address.

DR. L. C. BLOMEFIELD, in thanking His Honour the Administrator for his most encouraging address, referred to the privilege which had been assigned him to offer the thanks of the Association for graciously agreeing to open the Congress. Seldom was one furtunate to hear such a concise exposition of the aims and achievements of the Veterinarian and his Association. His Honour was renowned in Natal for his ability to give concise expression to any occurrence and he was especially proud of him now, as his excellent address must have occasioned a similar regard for him by all the veterinarians present. (*Vide full text*).

THE PRESIDENT then welcomed the guests to the Scientific Congress and in particular extended the good wishes of the Association to Dr. W. T. Harrow of Imperial Chemical Industries, United Kingdom, Dr. K. J. Astill of Imperial Chemical Industries, Australia and Dr. C. G. L. Beveridge of May Baker, United Kingdom, Dr. H. Thornton, Chief Veterinary Officer and Meat Inspector to the City of Newcastle-on-Tyne.

These veterinarians were at present on a visit to South Africa and he trusted that their stay would be both pleasant and profitable.

He also welcomed Drs. G. D. Shaw, D. de Waal, J. T. R. Robinson, P. H. Brown and R. Swanepoel, visiting veterinarian from Northern Rhodesia, Southern Rhodesia, Basutoland and Nyasaland. He extended good wishes to the British Veterinary Association, The Australian Veterinary Association and the S.A. Wool Producer's Union who were represented by Drs. J. H. Mason, R. K. Reinecke, and J. A. de Kock.

He expressed the pleasure of the Association at the presence of Dr. R. Elsdon-Dew (Director Amoebiasis Research, Durban), Dr. A. L. Ferguson (Chief Regional Health Officer, Natal), Dr. C. R. Mackenzie (representing the Medical Officer of Health, Durban), Professor I. Gordon

(Dean of the Faculty of Medicine, University of Natal), Mr. E. Adler (Director, Natal Region, Department of Agricultural Technical Services), Messrs W. R. Mottram, G. Smith and W. G. Winckler (Bureau of Standards), Mr. Bosman (Messrs Cooper and Nephews), Mr. M. C. van Rooyen (Secretary, Natal Agricultural Union) and Mr. R. Hirzel (Technical Advisor, Livestock and Meat Industries Control Board).

Apologies for inability to attend and wishes for a successful conference were received from Col. J. A. Irvine-Smith (Past President of the Association), Dr. Gilles de Kock (ex Director of Veterinary Services) Dr. H. Nelson (Medical Officer of Health, Pretoria), Dr. J. H. Gear (Director, South African Institute for Medical Research), Dr. E. G. Malherbe (Principal, University of Natal), Dr. B. M. Clark (Secretary for Health), Dr. Vorster (Secretary for Agricultural Technical Services), Dr. S. M. Naude (President, Council for Scientific and Industrial Research), Dr. B. A. Dormer (Superintendent, King George V Hospital, Durban), the Directors of Veterinary Services of Angola and Mocambique, The President of the Pharmaceutical Society, The Secretary of the S.A. Pharmaceutical Manufacturers' Association, The Secretary of the S.A. Agricultural Union, The Manager, S.A. Poultry Association and many others.

A letter expressing good wishes for a successful conference was received from Dr. Jac Jansen, Secretary-Treasurer of the World Veterinary Association, Utrecht, Holland.

Dr. Steyn then presented his Presidential Address.

(*The Presidential address appears in full in this issue*).

ADDRESS BY HIS HONOUR THE ADMINISTRATOR AT THE OPENING OF THE SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION CONGRESS, AT DURBAN, ON 25TH SEPTEMBER, 1961.

MR. PRESIDENT: It is my privilege and pleasure today, as Administrator of Natal, to welcome to our Province, and particularly to Durban, the members of the South African Veterinary Medical Association, and their distinguished guests, some of whom have travelled long distances to take part in this Conference. I assure you it is an honour for me to open this important Conference which is really unique in that it is the first of its kind to be held away from Onderstepoort. We appreciate that it is being held in Natal, and I would, on behalf of Natal, extend to you all a warm and sincere welcome to our Province. We hope your visit will be both fruitful and enjoyable.

The objects of the Association are to encourage the study of veterinary science, to promote the highest standards of skill and efficiency in its practice and to maintain the traditional standard of ethics in the profession. This purpose has been achieved over the last half-century by holding regular meetings of the numerous local branches of the Association and also by holding annual meetings which are readily accessible to all members in various parts of the country. It has been the custom to hold annual meetings at Onderstepoort and this meeting in Durban is really an

experiment. I hope it will be so successful that meetings in future will be held in various parts of South Africa. I think Durban must have been chosen as it is known for its hospitality (and warmth).

I see from the Agenda that many experts will take part in the Scientific programme which covers many facets of veterinary science and the specialities attached thereto. I am authoratitively informed that many of the scientific papers that will be presented at this gathering will make public the recent advances in various fields of veterinary science, possibly for the first time.

The South African Veterinary Medical Association has a long record of achievement behind it. I will not detain you with the vital statistics, but I think there are a few facts that should be mentioned. These are available in a brochure which was issued when the Association celebrated its Golden Jubilee in 1955 in Pretoria when that city celebrated its Centenary. Its membership has grown from 20 to 430, with about 55 members living outside South Africa. The great majority of members have graduated in South Africa with a minority holding the British degree (M.R.C.V.S.) and a few with European degrees, including one American and there are about twelve women members. Only about 25 Veterinarians graduate annually and unfortunately this number does not supply normal wastage and expansion of services. This is a serious matter for our Country, and I know from debates I heard in Parliament that it is causing the Government some anxiety. With some fifty million domestic animals, excluding pets and poultry, to care for, it is obvious that our relatively small force of 350 veterinarians is faced with an almost impossible task.

It is interesting to me to note that a number of firms exhibit and demonstrate to the members, the latest drugs, instruments, appliances, etc. This is of great assistance and serves to keep members abreast of the times and to establish and keep a close relationship with the manufacturing chemists.

As far as I have been able to judge veterinarians are very active in the pursuit and the affairs of their profession. They are a happy band of workers, well disposed towards their fellow professional men and imbued with a fine sense of camaraderie in their brotherhood, which is a most important thing in the body of a profession. We have it in the legal profession. The Veterinary profession is one of which members may well be proud.

Veterinary science is a progressive, evolutionary subject. The pattern of scientific research is constantly changing: keeping in touch is the great thing. It means meeting as many people working in your field as possible and meeting them as often as possible. If you could meet them every day, in a great laboratory, so much the better. Failing that, there is your annual meeting or Conference. If an important discovery or technique is brought forward on the first day of such a meeting it will be minutely scrutinised, turned inside out, taken apart and put together again so many times during the next few days and so man thousands of words will pour over it round the coffee tables that alread before the Conference is ended, it will have become historical.

This is an age of research teams, big laboratories and internationa

research projects and new ways of estimating scientific capability are continuously appearing.

It is of inestimable value that an organisation such as yours brings together all its members once a year, for the duscussion of common problems, the publication of original research and for the maintenance of a high professional ethical code.

In declaring the 56th Congress of the South African Veterinary Medical Association officially open, I wish the meeting every success and express the hope that its deliberations will be fruitful and of great value to our Country.

EXPRESSION OF THANKS TO HIS HONOUR THE ADMINISTRATOR, HIS WORSHIP THE MAYOR AND DR. L. C. BLOMEFIELD, CHAIRMAN OF THE NATAL BRANCH

MR. PRESIDENT, YOUR HONOUR, MRS. TROLLIP, YOUR WORSHIP, LADIES AND GENTLEMEN, to me has fallen the privilege and honour of replying to the opening address of our very distinguished guest, His Honour, The Administrator of Natal.

At the outset, let me say that seldom have we had the privilege of listening to a more inspiring and encouraging analysis of the history, the aims and the achievements of our profession and this association.

We in Natal are, and always have been, extremely proud of you sir, but the obvious interest you have taken in our Association, as exemplified by your excellent address has, I am sure, elicited a similar pride in the hearts of all my colleagues here this morning.

The fact that you are a non-Veterinarian and no less a personage than the head of the local Provincial Government, and that you have found the time and interest to observe the activities of our profession, is indeed encouraging.

I have often felt despondent in the thought that non-Veterinarians show generally little or no interest in the activities of our Profession, but your address this morning comes to us as a breath of fresh air and gives a very welcome lie to the thought. It will go a long way to encouraging Veterinarians to even greater efforts while the public, I am sure, will take a lead from your remarks.

Sir, we are the guardians of Animal Health in the Republic.

The whole country is virtually dependant upon sound and adequate Veterinary Service — the stock farmer for his finances, the city dweller for a sustained supply of healthy and wholesome food of animal and poultry origin—and the Government for the health and economics of the nation.

We agree that there is a shortage of Veterinarians in South Africa and for that matter throughout the world. The shortage in the Republic is probably due to the constant improvement in the quality of farm stock, to the public becoming more veterinary minded, to the Bantu population taking more to European feeding habits, and to a material increase in the consumption of food of animal origin.

You have mentioned the fact that this is the first occasion that our Annual Congress has been held away from Onderstepoort.

While we will miss the environmental effect of the academic and scientific surroundings of that world-famous institution and, of course, the opportunity of having personal discussions with the various specialists in their very own dens, I do feel that the deviation is a step in the right direction.

It will give an opportunity to those members who, because of expense or pressure of work have seldom been able to attend Congress, the opportunity to do so and to meet many colleagues whom they have heard much about but never met.

It will give, and now has given, the members the pleasure of meeting and hearing notables such as you, your Honour, and His Worship the Mayor of Durban and others we look forward to meeting throughout our country.

It finally gives us the opportunity of living in and enjoying the pleasures offered by such fair towns as Durban—and after all, we cannot have all work and no play.

In conclusion, Mr. President and members, I would like to express to His Honour the Administrator of Natal, on your behalf, our deep appreciation and thanks for the most stimulating and encouraging address he has given us.

THE PRESIDENTIAL ADDRESS

YOUR HONOUR, MRS. TROLLIP, YOUR WORSHIP, LADIES AND GENTLEMEN: This is a great occasion for our Profession. Each of our annual meetings is an occasion of considerable significance to us because many of us are able to reunite, renew old acquaintances, and simultaneously receive, what you might call, a booster to our scientific approach to our daily problems. The latter statement applies particularly to those of us who find ourselves in comparative isolation in practice, or stationed at isolated spots in the Government Service.

But this meeting has the added significance of being the first annual meeting of the South African Veterinary Medical Association held away from Onderstepoort. This meeting was arranged as an experiment or probe, and the success or failure of this meeting will have an important effect upon any future decisions on the venue of annual meetings.

The excellent attendance here; there must be some 130 veterinarians present, has gone a long way towards assuring a very successful meeting, although numbers alone do not assure success. The proceedings and the spirit among delegates are probably more important than mere numbers.

Those of us who have been anxious to arrange annual meetings at different centres throughout the Republic have done so for essentially two reasons. These are: *First*, that we hoped that by this means it might be possible to familiarize the general public more readily with the work which is being done by the Veterinary Profession, and thus possibly

stimulate more veterinary mindedness and more interest in the Profession. In short we hoped to be able to give the Profession a greater degree of publicity.

The second, and even more important reason, is that we hoped by this means to attract colleagues working in the immediate vicinity of wherever an annual meeting may be held, whereas they might not attend a meeting held at a more distant centre.

Attendance at annual meetings, where views can be exchanged and where at least some knowledge of recent scientific advances can be gained, is considered to be of the utmost importance by those of us who are responsible for administering the affairs of the Profession. A great deal of knowledge may not be gained by attending one meeting, but the contact with many colleagues engaged in a variety of activities must serve to stimulate scientific interest, and that is what we so keenly desire.

If holding annual meetings at different centres is going to assist in achieving this result all the extra work and expense involved will be fully justified.

It is necessary for me to refer to some events of the past year which are of considerable importance to the Profession and to the livestock industry of the country.

There have been two Committees and one Commission of Enquiry into matters of veterinary and general agricultural interest. The report of the first Committee has been completed; that of the second Committee is not yet completed and the Commission of Enquiry is still hearing evidence. No findings nor recommendations have yet been made public and I merely mention these facts to indicate that we may expect very considerable changes to be brought about in the veterinary and agricultural spheres in the near future.

One material change which has become public knowledge is the very considerable increase in the commencing salaries offered to new veterinary graduates in the Public Service, and I believe that I would be giving expression to your feelings when I say that the Profession is truely grateful for this token of goodwill shown by the authorities concerned.

It is possible that there may be a considerable increase in the demand for veterinarians in the years that lie ahead. In fact there have been two estimates of the likely shortage of veterinarians by 1965. The more moderate estimate is that there will be a shortage of 150, the second estimate, and it may be the more reliable, is that the shortage will amount to more than double this number.

Naturally, making any sort of prediction, in a world as topsy turvy as the world of today, is fraught with the grave danger of being told in a year or two that you were a bad prophet. However, if we were to abandon planning because the modern world is a dangerous place to live in, we are likely to be accused of having been cowards and having failed in fulfilling our duty. I would rather be a bad prophet than a coward and therefore I am going to impart to you some of my veterinary dreams.

The first of these is that there is going to be a second veterinary faculty. I am not prepared to say how soon, but I would say comparatively soon.

My reasons for saying this are that it is obvious that even though the present veterinary faculty at Onderstepoort must be expanded to meet the ever increasing demand for veterinary surgeons, it will be impossible to maintain the necessarily high standard of training demanded, if more than thirty graduates annually are allowed to qualify at Onderstepoort. In my opinion there is not sufficient animal material available, except perhaps pets, in the immediate vicinity of Onderstepoort to provide the clinical material needed for really good training.

It is necessary for me to acknowledge very frankly that many of my colleagues disagree with me heartily on this score. However, in spite of all the arguments against the idea of a second faculty, I fail to see how we can make do with one veterinary faculty when we bear in mind the fact that the livestock industry of this country yields an annual income of something like R386,000,000. And this figure is likely to increase rapidly even though there might be minor recessions or oscillations due to causes beyond our control.

Apart from the livestock industry, there is an ever increasing demand by the city and town dweller for veterinary attention to his pets, and there is the considerable, and as yet comparatively unexploited field, for the veterinarian in public health.

In addition commerce is finding more and more work for the veterinarian every year and finally the biggest single employer viz. the Department of Agriculture, is going to employ more veterinarians than ever before.

This is not the time nor place to deal with all the objections raised against the establishment of a second faculty but two objections should be mentioned in passing. The first is that there should be a research institute linked with, or in close proximity to any faculty.

To me it would appear that a second research institute might be an advantage. Not a second Onderstepoort but a much smaller affair. If other comparable countries with fewer stock diseases than we have, can afford a number of research institutes and veterinary faculties, surely we can afford two.

The other big objection raised is that of cost. That may be a legitimate objection, but it can only be if the second faculty is not a real necessity. When a war has to be fought is cost a consideration? When a water conservation scheme becomes a necessity is cost a consideration?

Let us very briefly consider some important aspects of the economics of the problem.

The country which appears to have given more attention to this aspect than any other is the U.S.A., but the animal population of the United Kingdom is closer to our own in numbers, and we can justifiably use figures published for Great Britain as a comparison. I do not believe that any similar statistics are available here.

The cattle population for the United Kingdom is given as 11,000,000; our own 12,000,000. There are 27,000,000 sheep in the United Kingdom; 38,000,000 here. Their pig and poultry population is probably much greater than ours. The value of the annual income from livestock in the United Kingdom is estimated as roughly £1,000,000,000 (R2,000,000,000), ours is a mere R386,000,000 (£193,000,000).

Their losses from disease are estimated to be about 15 per cent, i.e. R300,000,000 per annum. American losses from diseases of all stock are similarly given as 15 per cent, or R720,000,000 per annum for cattle alone. These losses are not caused by actual mortality but are an estimate of all losses caused by disease. Neither of these countries suffer anything like the annual mortality of livestock which occurs in this country. Our annual losses from mortality alone amount to 7-8 per cent of the cattle population and the Receiver of Revenue in his usual generous way, allows our farmers a 10 per cent deduction for mortality.

Our own losses from disease would probably be in the neighbourhood of at least 20 per cent, and the actual loss may be much higher. This means that our livestock industry is losing at least R772,000,000 annually. A very large proportion of this could be prevented.

This seems a staggering figure, but it is conservatively based upon estimates which have been arrived at in other countries by careful investigation.

Our methods of disease control in the past have been directed chiefly at preventing the decimating epizootic types of disease. We have not really begun to control those losses caused by diseases which are not mass killers.

Think of the losses caused by diseases such as tuberculous mastitis, calf diseases, internal parasites, various deficiencies and a host of others.

In addition it must be remembered that farming methods are becoming more and more intensified and greater intensification inevitably leads to more disease. Furthermore greater intensification means mass production with smaller profits per unit animal. This means that rapid growth and maximum efficiency in food conversion is necessary if profits are to be maintained. Disease, especially occult disease, causing reduced growth rate and food conversion can easily prevent an animal breeding unit from being profitable.

These influences are most clearly demonstrated in the more intensive types of farming seen in poultry and pig breeding establishments, but they play an important role in all types of stock farming.

The need for spending large sums of money on research in all spheres is thoroughly appreciated by scientists and often by industry, but it would appear that governments do not generally appreciate the urgency of this need. Let me illustrate the point.

In the United Kingdom in 1955 the manufacturing industries produced £6,500,000,000 (R13,000,000,000) worth of goods and spent £183,000,000 (R366,000,000) on research i.e. 2.8 per cent of the gross production. The expenditure on all agricultural research was £6,000,000 (R12,000,000) of which £4,000,000 (R8,000,000) was spent on animals showing an annual income of £1,000,000,000 (R2,000,000,000), i.e. 0.4 per cent.

I am not going to talk about our own figures except to say that it is safe to assume that an analagous state of affairs exists and to point out that the actual cost of veterinary research to the country has been infinitesmal by comparison with the value of the work which has been done during the last fifty years.

It must be obvious to even the near sighted among us that the work which must be undertaken in the years that lie ahead cannot be carried out by the small number of veterinarians available to the country. Arrangements must be made to train more veterinarians and in order to attract suitable young men the salaries offered must be attractive and the facilities under which they are expected to work suitable.

During the last two years, I am told, the number of undergraduates seeking admission to the existing Veterinary Faculty has declined to such a degree that the number required has not been forthcoming. There have been many reasons for this, but probably the most significant has been the poor salaries offered. There has been a vast improvement in the salaries offered by the Government since December of last year. This has already had a notable effect upon salaries offered in other avenues of employment, but the full effect has yet to come.

Another factor influencing many prospective English-speaking entrants has been the common belief that Onderstepoort is an Afrikaans Faculty. In fact, it is fully bilingual.

An experience I had recently, illustrating that language is not really a problem, is of interest. I stopped to give a young gentleman a lift between Onderstepoort and Pretoria. En route to Pretoria we conversed in Afrikaans until I asked him whether he was Afrikaans speaking. He replied that he was not, that he was from Rhodesia and that he was a third year student at Onderstepoort. He said that he had overcome the language difficulty in six months by enrolling for the first year, which can be taken at any university, at the University of Pretoria.

And now a suitable place for my dream faculty and research institute.

This might be difficult to decide upon, and as serious consideration has not yet been given to the establishment of a second faculty, the choice of a suitable site has not arisen. I have given the matter some thought and it would appear that the most suitable site would be here in Natal, and possibly somewhere in the neighbourhood of Pietermaritzburg. There appears to be a suitable site available at Allerton Laboratory.

A new veterinary faculty is about to be established at Melbourne, the third in Australia. A veterinary chair has just been advertised there and the gentleman who is lucky enough to get it is to be entrusted with the creation of the new faculty, almost from the laying of the first brick. What occurred to me as striking was that they have a fund raising committee which has raised A£100,000, and is still operative. This is only a small contribution towards the cost of running the faculty. Now in this country there has never, to my knowledge, been a single bequest towards the cost of a veterinary faculty nor for any research project. There have been and are research grants donated by one or two organizations such as the Meat Board, but surely, bearing in mind what veterinary services and research have done for this country, it would not be too much to expect, that at some time some person or persons would express their appreciation, by the establishment of a fund to aid this work.

In conclusion let me quote to you what has been said by another speaker:

"Our whole modern industrialized civilization is based on the application of science. It is now universally recognised that research is an

essential item of expenditure for industry and for governments. Not only is it essential for progress and for keeping up with other countries but it is necessary even to maintain the status quo. Like the Red Queen in Alice in Wonderland, we have to keep running in order to stay in the same place and to run very fast indeed if we are to make any progress."

THE SOCIAL FUNCTIONS AND ENTERTAINMENTS AT THE 1961 CONGRESS HELD AT DURBAN

Messages of Welcome

On arrival at the Killarney Hotel each delegate received a card of welcome from the Chairman and Members of the Natal Branch.

In addition the ladies each received a bunch of flowers.

This kind thought by the Natal Branch was very much appreciated.

The Attendance at the Opening Ceremony

The presence of the ladies at the opening ceremony added prestige to the proceedings and encouragement to the delegates and their visitors.

One hundred and seventy-five persons were present to hear His Worship the Mayor address his cheerful words of welcome to Durban, and His Honour the Administrator's sincere words of encouragement to the delegates.

The expression of thanks by the Chairman of the Natal Branch and the President's address completed the proceedings and sent the Congress off to a very good start.

Entertainment of the Ladies

As far as the few male delegates, who found themselves out-of-bounds, were able to judge, the Mannequin Parade was an outstanding display. They were probably less responsive to the ultimate invitations, to implement their wives' good taste.

The Sporting Events

The weather proved disappointing for sport and it became necessary to decide the winners of the mixed doubles for the Maybaker Tennis Trophy, by drawing lots.

The Golf Trophy was won by Dr. Anderson: the Bowls Trophy by Drs. S. W. J. van Rensburg and G. F. (Okkie) van der Merwe and the Tennis Trophy by Mrs. R. du Toit and Dr. Cloete.

Deep Sea Fishing Expedition

Here again the weather proved disappointing. Few fish were caught, and many delegates were overcome by Marine Nausea in spite of the use of anti-seasick tablets. However the Benevolent Fund benefitted by R2.50 as the result of an excess in the collection of fares.

The Civic "At-Home"

All delegates and many of their friends were entertained by the Mayor and City Councillors of Durban at a Cocktail Party in the City Hall one evening.

The function was indeed a great success and highly appreciated by all who attended it.

The President extended the thanks of the Association at the time, but an additional expression of appreciation here is by no means a duplication.

The Buffet Supper

The Management of the Killarney Hotel are to be congratulated on the very fine display of "Buffet" so handsomely and decoratively arranged. The music supplied by Denis van Ryn's Band added greatly to the entertainment, while the President and the Chairman of the Natal Medical Association vied with each other in tall statures and still taller stories.

The function went off very well indeed and rounded off a very pleasant Congress.

The Overall Costs of Congress to the Association

Taking all major expenses into account the Association showed an increase of revenue over expenditure by over R100.00.

DISCUSSION ON PAPERS PRESENTED AT THE ANNUAL CONGRESS HELD AT DURBAN ON 25-26 SEPTEMBER. 1961

SYSTEMIC MYCOTIC DISEASES

J. D. Smit

Dr. Smit introduced his paper by saying that these diseases constituted a considerable danger to the human, and professional hazards had to be faced. Comparatively little was known about these diseases, and they were therefore rarely diagnosed. Failure to diagnose correctly leads to exposure and possible infection.

He then proceeded to illustrate his paper by 35 m.m. colour slides, each of which were explained to the audience.

Discussion

Dr. Jansen opened the discussion by referring to the fairly general complacency which existed in South Africa towards fungal diseases. He welcomed Dr. Smit's paper as a means of directing attention to these conditions and for providing the essential information necessary for a proper understanding.

He referred to recent Russian work on the toxicity of fungi and infected foodstuffs.

Fungal diseases were essentially granulating suppurative conditions in animals and man. Facilities existed at Onderstepoort for the differentiation of the various pathological conditions and for cultural identification of fungi. It was noteworthy that where the organism appeared as yeast like cells in tissues, it was likely to assume a myceliae type of growth on artificial media, and vice versa.

Dr. Jansen emphasized that the veterinarian had entered the public health field, and in this case the private veterinary practitioner was particularly concerned. It was up to every one to become fully acquainted with the clinical picture and to avail himself of the facilities created at Onderstepoort for confirmatory diagnosis. He emphasized the importance of full co-operation with the medical profession when fungal diseases were diagnosed or suspected in domestic animals.

DR. C. C. WESSELS het verwys na die verloop van verdagte mucor mycoses—in sy ondervinding was dit gewoonlik dodelik by beeste as gevolg van penetrasie van die ulserasies en uiteindelik peritonitis.

PROF. K. VAN DER WALT referred to the necessity for details to be provided regarding the procedure of obtaining biopsy material and how to preserve and submit specimens. He emphasized that a diagnosis at post mortem examination was not adequate, but that diagnosis on clinical examination was necessary to prevent exposure of persons.

DR. D. H. IRWIN, referred to the successful use of "Hibitane" in three cases of subcutaneous and reticular nocardiosis, and asked for details, if any, of the use of other drugs.

DR. M. C. LAMBRECHTS emphasized the public health aspect of these diseases and their transmissability to man.

DR. L. W. VAN DEN HEEVER expressed the idea that compulsory notification of the dagnosis or suspicion of these diseases should be considered, not only so that action might be taken but in order that a record of the incidence and types may be obtained. Possibly other diseases e.g. tuberculosis in household pets might also be included.

DR. A. J. SNIJDERS referred to cases of nocardial mastitis in cows which had been treated with antibiotics for 3 months.

DR. BEVERIDGE (MAY BAKER) commented on the use of "Hibitane" in fungal conditions and mentioned the successful use of Hydroxy-stilbamidine for systemic mycoses in South America. The essential requirements for successful chemotherapy was for any drug to be able to cross the pus barrier and then to be able to destroy the organism.

DR. J. G. THORBURN inquired about "Cave Disease" in S.A. and whether instances had occurred where spelaeologists had taken pets with them into caves.

DR. D. COLES asked for enlightenment on the application of skin tests using coccidioidomycin, histoplasmin, etc. He mentioned that mycotic diseases affecting farm workers was often associated with silage pits, and aspergillosis with the bases of hay stacks.

DR. SMIT REPLIED TO THE DISCUSSION AS FOLLOWS:
TO DR. WESSELS: Mucor mycosis resulted in a raised ulcer, there was no tendency to penetration, and peritonitis was rare. The disease was more incidental and not usually fatal.

TO PROF. VAN DER WALT: Regarding specimens, he said that clinical diagnosis could not be certain, but that a definite diagnosis could only be made on specimens. The material required was similar to that for Toxoplasmosis, viz. lymph nodes, spleen and liver. Specimens for culture were best sent in dry ice without preservatives. Histological specimens were to be sent in formalin, as usual.

TO DR. IRWIN: Systemic cases of nocardiosis usually responded poorly to treatment.

TO DR. LAMBRECHTS: Die metode van oordraging is nog 'n vraag. Die gis-sel of spoor-stadium—veral in die droë stadium—was veral gevaarlik, nat materiaal was redelik veilig, maar vloeistof moet nie toegelaat word om droog te word nie. In die natuur was stof veral besmetlik.
TO DR. VAN DER HEEVER: He agreed with the need for co-operation in Toxoplasmosis as well as in the fungus conditions. He thought it was important to focus attention on cryptococcus and nocardiosis in the udder, but possibly the fact that milk was consumed as such i.e. in the wet form, the danger to the consumer might not be so great.
TO DR. SNIJDERS: He pointed out the existence of a variety of spp. of nocardia and the many saprophytic forms which existed. This was a real problem and presented a difficulty in diagnosis, as the organisms may simply be contaminants. For this reason, cultural and histological investigation was necessary so that the typical cell reaction could be demonstrated.

TO DR. BEVERIDGE: He had no knowledge of therapy. Clinical cases for therapy trials were not readily available because most cases were diagnosed at post mortem. He agreed on the reasons for difficulty of therapy viz the pus and the capsule around the lesion, and the resistance of the yeast forms.

TO DR. THORBURN: Histoplasma capsulatum or related spp. were responsible for "Cave Disease" which in S.A. was mostly abortive and rarely progressive. Few fatal cases occurred here.

TO DR. COLES: Stein tests were not really reliable due to lack of specificity. An increasing titre with several tests might be more useful. Patients often were merely sensitised.

A DISEASE OF CALVES RESEMBLING SPORADIC BOVINE ENCEPHALOMYELITIS

R. C. Tustin, J. Maré, and A. van Heerden

In introducing the paper Dr. Tustin pointed out that the disease had as yet not definitely been confirmed to be sporadic bovine encephalo-

myelitis although they had every hope that this would be done in the very near future. He then presented the paper, and explained that the work was based on two outbreaks of the disease. He emphasised that it was an enzootic condition.

DR. J. D. SMIT: In opening the discussion he tendered his congratulations to the authors; he himself had seen these cases in the course of rabies investigations and had never made a diagnosis. He was sure the condition had been masquerading under various other names for some time.

The differential diagnosis was important inasmuch as there are many diseases in South Africa causing nervous symptoms; the correct diagnosis was not always easy to make. Awareness of the condition and its symptoms would invariably lead to diagnosis.

DR. RIJKSEN also congratulated Dr. Tustin and his co-workers. He had seen five outbreaks altogether, and would like to enlarge somewhat on the clinical pathology. The first cases looked like lead poisoning. The affected animals were three to seven months of age and showed a tendency to circulate over a large area eventually returning to the same point. Pyrexia was an early symptom and swaying occurred later, eventually leading to complete loss of control over locomotion. Difficulty in rising was evident, and total paralysis supervened. Salivation was a marked symptom. In the early stages the animals showed complete disregard for any form of restraint, and even ignored barbed wire fences. On post mortem examination peritonitis and pleuritis were prominent, with liver changes quite marked, especially active congestion.

He disagreed with Dr. Tustin on the existence of macroscopic brain lesions. He had recorded an initial oedema of the brain and in cases of longer standing the brain presents a shrunken appearance with quite a noticeable yellowing. The progressive paralysis was very like that seen in rabies.

DR. ALEXANDER stated that he wished to cross swords with the pathologists. In fact, the virologists had done the basic work, satisfied Koch's postulates and showed the presence of an aseptic encephalitis. The disease was easily confused with heartwater and with chronic traumatic pericarditis. Smears from peritoneal exudate showed up the organisms.

DR. TUSTIN replied: He thanked Dr. Smit for his opening remarks and Dr. Rijksen for the clinical description of the disease in the field. He agreed that brain lesions do exist. He also thanked Dr. Alexander and the virologists for confirming the diagnosis.

SLIDE PROJECTION — FOOT AND MOUTH DISEASE

M. C. Lambrechts

A very interesting and informative talk, illustrated by a series of excellent slides was given by Dr. Lambrechts, Deputy Director of Veterinary Services (Field Section).

Congress greatly appreciated the trouble taken by the Division of Veterinary Services in arranging projection of such an instructive set of colour slides.

SYMPOSIUM: THE USE OF MILKING MACHINES

I. S. McFarlane, R. Clark, L. W. van den Heever

DR. LE ROUX opened the discussion by emphasising a preventive medicine approach to lower production costs. The more intensive farming today increases the necessity for proper utilization of machines. Competent advice to farmers on production management is important. In this respect the authors are congratulated on their foresight in presenting the symposium.

DR. UYS: Much trouble can be caused by malfunction of the pulsator. An instrument is however available to test the pulse ratio. Mechanical parts of the pulsator may be worn or dirty. The pulsator "sucks out" the milk and massages the teats to prevent congestion. High bacterial counts in milk are frequently ascribed to a heavy infection in the vacuum tube. This results from cracked teat cups and manufacturers do not warn farmers to keep the vacuum tubes clean.

DR. MCFARLANE replied: Variation of the pulsator is important. More important however is the action of the liner. The pulsator is some distance from the liner and poor demarcation may result, the time lag of the liner being the biggest problem. Cup crawling is another problem, but now some liners are available which "crawl" very little or not at all. A valve of polythene tubing and a wad of cottonwool between machine and vacuum line reduces infection.

DR. LOUW asked:

(1) How is plastic material cleaned?

(2) When sampling for mastitis must the first milk be used or discarded?

(3) Have milking machines anything to do with the fact that streptococcal mastitis is decreasing and staphylococcal infection increasing?

DR. VAN DER HEEVER replied: No particular antiseptic can be recommended. There are many types of tubes. It is important that these retain their glossy hard surface and remain unscratched.

When culturing or incubating milk for mastitis, the first portion should be discarded. Other tests such as the catalase test and leucocytic count can be done.

Streptococcal mastitis is probably diminishing as it is easily controlled by therapy. Staphylococci are becoming the more important because they are able to develop resistance.

SYMPOSIUM: HELMINTH RESEARCH IN SOUTH AFRICA

W. B. Hobbs, L. W. Rossiter, R. K. Reinecke, G. L. Muller, Anna Verster, K. van der Walt, R. C. Tustin

In opening the symposium DR. REINECKE mentioned that in recent years there had been a shift from the taxonomic to the parasitological aspect of helminthology; special emphasis being placed on epizootiology.

A survey, to determine the seasonal incidence of nematodes in calves between the ages of three and seven months, in the Natal coastal area, was discussed by DR. HOBBS. The object of this survey was to determine the rhythms of parasitic infection, so that control and treatment could be applied logically. From this survey it would appear that *Haemonchus* is the most important worm in the spring and summer in this area, *Cooperia* is common in calves up to 10 months of age, whereas *Oesophagostomum* is only of consequence in calves over the age of nine months. Calves over the age of 20 months, that have been exposed to prior infestation, have a strong acquired immunity to all species excepting perhaps *Oesophagostomum.*

A speaker mentioned that he had encountered *Cooperia* in adult cattle in the Eastern Cape province and that in his experience *Trichostrongylus* occurred throughout the year in cattle.

DR. ROSSITER'S paper dealt with the seasonal incidence of nematodes in sheep and goats in the Grahamstown area. He suggested that five strategic drenches should be administered to control parasites in sheep in this area, namely microfine phenothiazine in July and March, and "Neguvon A" in August, September and December. A survey on the seasonal incidence of nematodes should be continued for at least three years, to obtain a true annual reflection of this incidence. Sheep and goats do not seem to acquire the same immunity to nematodes as do cattle. The eggs per gram (e.p.g.) counts often rise in ewes after lambing, due to the stress of parturition.

A film was shown demonstrating the McMaster method for determining faecal e.p.g. counts in cattle and sheep; a method of making faecal cultures for larval differentiation, and a method to determine trematode infestation by a faecal e.p.g. count. It was suggested that collecting faeces samples from sheep by means of a finger, was as effective in some cases as using a sampling tube.

DR. MULLER in presenting his paper, remarked that despite the encouraging results obtained from the use of "Thiabendazole" as an anthelmintic in sheep, critical slaughter tests would have to be carried out to evaluate this drug correctly, as a reduction in e.p.g. counts, as described in his paper, was not a reliable criterion of anthelmintic efficacy. He then discussed various cases in which e.p.g. counts were not a true indication of the actual worm burden in sheep as indicated in the table.

TABLE

EGG COUNTS AND ACTUAL WORM BURDENS IN SHEEP

Sheep No.	Age	On Pasture	E.p.g. Count	Total Adult Worms
0835	2 years	Permanently	300	6426
089	2 years	Permanently	167	4513
0823	2 years	Permanently	267	2878
0824	2 years	Permanently	300	5357
0968	12 months	Permanently	7467	24451
0932	12 months	Permanently	3900	43220
034	7 years	Permanently	3600	42937
003	3 months	1 month	267	7920
K603	3 months	2 weeks	0	500 (5th)
K605	2 months	2 weeks	0	2590 (5th)
005	2½ months	4 weeks	1133	800

In the ensuing discussion, the efficacy of some of the latest anthelmintics against the immature stages of nematode parasites was mentioned. It would appear that marked oedema, as in the case of *Haemonchosis*, can adversely affect the oesophageal-groove reflex resulting in loss of efficacy of anthelmintics. DR. JANSEN stressed the fact that the use of any anthelmintic could be the trigger mechanism for enterotoxaemia and hence all sheep which are not immune should be inoculated for this condition at least a month before drenching.

MISS VERSTER'S paper on *Echinococcus* in South Africa drew attention to the fact that although the tape worms resulting from bovine hydatid cysts morphologically resembled *Echinococcus granulosus* they differed in three aspects from the generally accepted description of this worm, namely that parasites of bovine origin are mainly fertile: secondly, the Cape hunting dog is apparently more susceptible to infestation than is the domestic dog which is considered one of the normal hosts of the parasite; and thirdly a small percentage of worms took and matured in the domestic cat, whereas *E. granulosus* has not been known to mature in this host.

A survey on the incidence of hydatid cysts in livestock during the past 12 months revealed that the overall incidence in cattle was 4.9%; in sheep 2.6%; in goats 3.2%; and in pigs 2.2%. The incidence in livestock in the Eastern Cape was the highest in the country; that in the Eastern Transvaal appears to be fairly high. Farming methods and climate seem to have an effect on the incidence of hydatidosis. In Worcester, the incidence is high in cattle, sheep and pigs; the cattle and sheep slaughtered at Worcester come from S.W.A. and are not a reflection of the local incidence. The pigs in the Worcester district are allowed to graze on free range, and thus come into contact with faeces of the numerous carnivores, which inhabit the surrounding mountains. Mention was made of the high incidence of hydatid cysts in the lungs of Gemsbok in the Kalahari desert.

PROF. VAN DER WALT was commentator during a film on *Coenurus cerebralis* in sheep in which acute and chronic stages of this disease were depicted and the macroscopic pathology of these cases demonstrated. He made mention of a case where 77 cases of this disease occurred in sheep in an area where all the dogs were negative for *Taenia multiceps* and apparently no jackals occurred.

ENZOOTIC PNEUMONIA OF CALVES IN SOUTH AFRICA

S. J. van Rensburg and R. Every

PROF. K. VAN DER WALT congratulated the authors for focusing attention on the disease, which had not previously been recognised as a distinct entity in South Africa. Most of the organs in the body were affected; the disease was not primarily a pneumonia.

As far as prevention was concerned, he had found a cheap and effective method for housing calves. This involved the construction of portable pens for individual calves, which could be made for five Rand each.

In the treatment of the condition, sulphadimidine had been found to give better results than the antibiotics.

There were two questions he wished to ask the authors. Firstly, what was the earliest age that they had seen the condition in calves? In his experience calves did not contract the disease until they were three weeks of age. Secondly, could the authors inform him if any immunity developed after recovery?

DR. J. MARÉ also wished to congratulate the authors on their paper. The slides that were shown convinced us that the condition was a generalized disease and not primarily a pneumonia.

As far as the etiology was concerned, he was convinced that the condition was caused by one of the psittacosis lymphogranuloma venereum group of viruses. Had the authors encountered a peritonitis, pleuritis or pericarditis?

THE REPLY:

DR. S. J. VAN RENSBURG. Pneumonia has been experimentally induced with a P-LV virus by Palotay and Christensen. The pathological aspects of this pneumonia, however, differ somewhat from that seen by us. Pneumonia has also been described by Omori and co-workers in Japan in S.B.E.

He had never seen peritonitis or pericarditis in cases of enzootic pneumonia, although one occasionally encountered a pleuritis.

Slaughtered calves two weeks of age had been seen to show early lesions.

The immunity after infection appeared to be poor, as relapses were frequent in the presence of predisposing factors. After one year of age the condition rarely appeared to recur.

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THE TUBERCULIN TEST IN CATTLE

H. H. Kleeberg

As the paper was published more than a year ago, (J.S. Afr. Vet. Med. Ass. XXXI: 2) it is felt that some additional information is necessary especially as regards the more dilute tuberculins.

The differences in tuberculins and techniques used in the various countries proves that we are far from a method and a tuberculin of choice. There are official standard tuberculins in use overseas made from human strains, from bovine strains or mixture of both; there are PPD preparations, HCSM (heat concentrated synthetic medium) tuberculins and "Old tuberculin" (OT); their strengths varies between 40,000 and 100,000 I.T.U. (International Tuberculin Units) per ml, the dose between 0.04 ml and 0.2 ml; the site of injection, the neck, the shoulder or the caudal fold, is laid down by regulation.

The standardisation of tuberculin is still a difficult task. An easy method does not exist. The chemical assay of the tuberculo-protein (micro-Kjeldahl) gives an indication of the strength only; it does not detect the polysaccharides; a part of the active principle. The biological test on guinea pigs and cattle depends on a standard tuberculin which should be prepared in exactly the same way as the batch to be tested. Although one tuberculin unit of "old tuberculin" is internationally well defined, it is not strictly scientific to compare a raw product such as O.T. made from human strains with a purified preparation like PPD made from bovine strains.

Opinions differ widely about the best method of artificial sensitisation of cattle and guinea pigs, to be used for standardisation of tuberculins. At the Onderstepoort Institute, heat killed tubercle bacilli of a heterologous strain but homologous type, suspended in liquid paraffin, are used to sensitise guinea pigs and cattle. The results of an experiment are presented comparing 4 different tuberculins on 4 differently sensitised groups of cattle.

TABLE I

Average skin-fold increases of cattle artificially sensitised with different types of mycobacteria

Breed and number of cattle	Sensitizing organisms	Onderstepoort		Behring Werke—Germany	
		Bovine PPD 5.000 TU	Avian PPD 2.500 TU	Mammal HCSM 5.000 TU	Avian HCSM 2.500 TU
4 Herefords	2 bovine field strains	9.1 mm	0	6.1 mm	0
5 Friesians	10 diff. bovine field strains	13.4 mm	6.8 mm	11.5 mm	3.6 mm
3 Jerseys	2 avian field strains	4.0 mm	10.5 mm	2.1 mm	5.1 mm
3 Jerseys	1 Lab. strain of Johne's bac.	7.8 mm	12.0 mm	5.1 mm	7.1 mm

In this experiment PPD tuberculin caused higher reaction than HCSM tuberculins, although both these tuberculins are being carefully standardised. Bovine and avian PPD's used comparatively, were better able to detect avian and Johne's sensitised cattle, than the two HCSM tuberculins. However, the HCSM avian tuberculin showed less non-specific reactions in animals sensitised with a large number of bovine field strains. This group showed greater non-specific sensitivity than cattle with only 2 bovine field strains.

When using PPD tuberculin in the field, care should be taken not to expose the tuberculin contained in bottles or syringes to sunlight, or to leave tuberculin in the boot of a car. Tuberculin should never be frozen, and half empty bottles discarded, as there is a loss of potency due to absorption to the glass.

When using a McLintock syringe if tuberculin spurts out of the needle after withdrawing from the skin, then there is air in the syringe. Cleaning of the skin can be done using 70% alcohol. Dipping in a dirty plunge dip directly after the injecting, did not appear to cause more non-specific reactions in a tuberculosis-free herd of 800 Afrikander cattle.

Mechanical transmission of infectious diseases is very unlikely. During outbreaks of contagious diseases, however, testing should not be undertaken.

Intensive sunlight can occasionally cause photosensitisation of the clipped injection site. This is easily recognised by an equal swelling of the whole clipped area, but it makes the reading difficult. In herds where this condition has been seen, only a small strip should be clipped to mark the site of injection.

In selecting a case for test slaughter, one should avoid oxen with their high sensitivity to tuberculin, very old cows, as they often have only small, partially healed lesions, and cases with extremely acute reactions, as they might be recently infected and not show necrotic foci yet. The 5 to 8 year old age group contains the greatest number of cases with disseminated lesions. An autopsy should preferably not be performed in a busy abattoir where there is not sufficient time for careful examination. In cases where no lesions have been found, lymph nodes of head, lung, mediastinum and mesenterium should be sent for bacteriological examination.

Retesting of herds after 2 months is essential before final division is made into tuberculous and non-infected groups. There are always some more reactors at the retest, as the tuberculin probably has a boosting effect on antibody production, in cases with low level sensitivity. In herds showing a high percentage of non-specific reactions, a careful study of the result of a number of retests will greatly assist in the elucidation of the problem.

The effect of isoniazid on the tuberculin reaction of tuberculous cattle treated with 10 mg/Kilo per os daily for a period of 8 months, as recommended by the author, is illustrated in Table II and Graph I.

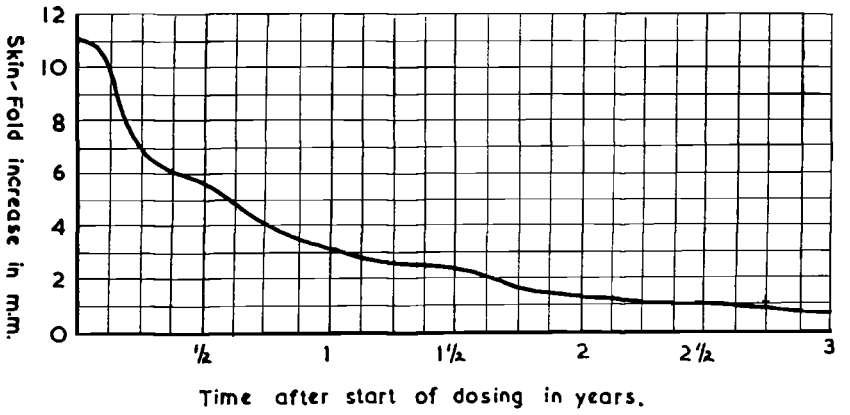
TABLE II

Percentage of tuberculous cattle becoming non-reactors due to treatment

Interval after start of isoniazid therapy					
5 mths	8 mths	12 mths	18 mths	24 mths	36 mths
20%	25%	42%	56%	87%	92%

GRAPH I.

Average reactivity of TB cattle treated for 7 to 10 months.



The graph represents the mean reaction of over 500 cattle during the first year, of over 300 cattle during the second year, and of 200 to 50 cattle during the third year.

A field experiment to evaluate the more dilute tuberculin containing 7,000 T.U. per dose has been carried out and the results are presented in the following Circa; 10,000 doses of the new tuberculin have been issued and 7,150 comparative tests comparing 7,000 I.U. and 10,000 I.U. on the same animal at the same time were found suitable for statistical analysis. It should be remembered that exceedingly big increases with highly sensitive tuberculous cattle are not so important in evaluating a tuberculin. The important factor is to have a great mean difference between skin-fold increases, in the tuberculous and non-tuberculous cattle. More tuberculosis-free herds than tuberculous herds were tested in this trial with 7,000 T.U. and 10,000 T.U. comparatively. The test results of 57 herds were suitable for comparison, the other 22 herds being completely negative. Of the 57 herds, 14 were tuberculosis infected with a total of 340 reactors: the other 43 herds were tuberculosis-free but showed group- or non-specific reactivity with a total of 620 "reactors". In Table III the summarised results can be seen.

TABLE III

Comparison of two different strengths of bovine PPD tuberculins in cattle

Type of sensitisation	Number of reactors	Average Reaction in millimeter Skin-Fold increase	
		10.000 T.U.	7.000 T.U.
Tuberculosis (bovine)	340	8.0 mm	8.6 mm
Non- or group-specific factors	620	3.4 mm	2.3 mm
Difference between the reactions of specifically and non-specifically sensitised cattle		4.6 mm	6.5 mm

It became evident that a dose of 7,000 T.U. was by no means inferior to a dose of 10,000 T.U. in detecting tuberculous cattle. Furthermore, in most herds tested, the number of doubtful reactions was smaller with 7,000 T.U. than with 10,000 T.U. The average swelling in non-specific reactions was 1.1 mm less with 7,000 T.U. than with 10,000 T.U. The most important finding is that the mean difference between specific and non-specific reactions was 6.3 mm for 7,000 T.U. compared with 4.6 mm for 10,000 T.U.

Table IV shows the results of comparative testing of the tuberculosis-free herd of the Onderstepoort Institute, which is also free of any group specific sensitisation.

TABLE IV

Results of comparative tests on a TB-free herd of 986 cattle

Interpretation	Skin-fold increase	10.000 Units	7.000 Units
Negative	0	23.5%	49.8%
	0.5—2.0 mm	70.6%	45.8%
Doubtful.....	2.1—4.0 mm	5.4%	4.0%
Positive.....	Over 4.0 mm	0.5%	0.4%

Here again the tuberculin with 7,000 T.U. per dose is preferable, as it caused no skin swellings in 50% of cattle compared with 23.5% for 10,000 T.U.

As the result of the experiments, the standard tuberculin for official intradermal tests issued from Onderstepoort has been bovine PPD containing 70,000 I.T.U. per ml from the 1st November, 1961.

In a number of countries, small scale trials have been carried out comparing highly diluted tuberculins with current standard tuberculins, in an effort to decrease the number of non-specific reactions in cattle. Favourable results have been reported with the use of 500 to 100 T.U. per dose, but skin-fold increases of 2.5 mm or 3.0 mm were regarded as positive for tuberculosis. Under African conditions, especially with thick-skinned indigenous cattle, such small reactions will inevitably result in many wrong diagnoses.

In our experience even a dose of 1,400 T.U. is insufficient to induce reliable positive in all tuberculous cattle. A 100 tuberculous cattle on two infected farms in the Transvaal were tested comparatively, using 7,000 T.U. and 1,400 T.U. per injection. The average skin fold increase with 7,000 T.U. was 17.1 mm and with 1,400 T.U. 7.9 mm. Using 7,000 T.U. 97% of cattle gave a reaction of 4 mm or more and 3% a doubtful reaction of 2–4 mm. Using 1,400 T.U. only 81.5% of cattle gave a reaction of 4 mm or more and of the remaining 6% gave reactions of under 2 mm. In the majority of cases the reactions caused by the dilute tuberculin were much more circumscribed, less oedematous and less painful.

The author wishes to express his thanks to all colleagues who participated in field trials during the course of this experiment.

Discussion

Dr. M. C. Lambrechts opened the discussion; he stressed the importance of a test history and announced that in the near future the tuberculosis eradication campaign will start in a specific area on 200,000 head of cattle.

Dr. A. Meeser asked whether it would be good policy to regard all reactions of 4 mm or more as positive at the first test on a herd and whether the Stormont test was of value in pregnant animals.

Dr. J. Robinson (S.R.) mentioned that a quarter of a million cattle are at present under test in Southern Rhodesia. Non-specific reactivity is more frequent where animals graze on bushy hill sides and near water.

Dr. van den Heever said it would be advisable to X-ray farm labourers to prevent sensitisation of cattle by the human type of TB. He confirmed the fact that a thorough post mortem for TB cannot be done under normal abattoir conditions.

Dr. H. P. Steyn asked whether there were objections to using the skin behind the shoulder in all cattle.

Dr. H. Kleeberg in reply said that 4 mm swellings should only be regarded as positive in herds where tuberculosis was definitely established and that the Stormont was found to be unsatisfactory in South Africa.

As regards the site of injection, the skin of neck has been shown to be more sensitive and to give better reactions and the skin behind the shoulder should only be used where the skin of the neck is unsuitable i.e. too thick or mangy, etc.

THE ISOLATION OF VIRUSES ASSOCIATED WITH INFERTILITY IN CATTLE: A PRELIMINARY REPORT

J. Mare; S. J. van Rensburg

DR. MARE: Presented a brief resume of the paper.

The authors would welcome material submitted from cattle showing infertility of unknown or dubious aetiology. Material such as discharges from the vulva, or from swabs collected from the cervix and anterior vagina, were more likely to yield virus isolates if obtained in the early stages of infection.

DR. S. W. J. VAN RENSBURG: Since 1938, when the separate disease entity variously known as infectious sterility, epivag, contagious epididymitis and vaginitis of cattle, etc., was forcing its attention on veterinarians, the aetiology of the disease had persistently caused difficulty to research workers.

The paper was conspicuously modest in that its authors did not claim complete elucidation of the problem.

They had satisfied Koch's postulates in respect of the cow, but, as yet, not to their satisfaction, in respect of the bull.

There are three possible reasons why difficulty is being experienced in experimentally producing the well-known epididymitis: *Firstly*, it is accepted that venereal diseases of animals are highly inconstant in their manifestation. The low degree of invasiveness or pathogenicity of vibrio and trichomonad infections is a case in point. Experience over the last two or three years, with Brucella in rams, has shown a similar picture of unpredictability. Rams have been demonstrated actively to shed Brucella infection, yet no gross pathology was evident. This is in contradistinction especially to systemic diseases of a bacterial or protozoal nature, in which artificial infection is regularly and predictably followed by the disease in susceptible animals. Anthrax, Blackquarter, Anaplasmosis and Babesiosis are relatively easily produced artificially.

Secondly, it has been found that some bulls may become infected, and show clinically clear-cut gross pathology of the epididymis, whilst other individuals, serving the same herd of cows, do not contract the disease. The reason for this is not yet known.

Thirdly, it is yet to be shown that anterior vaginitis and epididymitis are two distinct disease entities. He would like to congratulate the authors, and feels that strain F.H. 335 will prove to be the aetiological agent of this infectious infertility. Experiments conducted on a larger number of bulls may prove the solution of the problem.

INVESTIGATIONS INTO THE CAUSE OF ABORTIONS IN ANGORA GOATS IN SOUTH AFRICA

K. M. van Heerden

In introducing his paper the author quoted the following from an article by K. Wallace on "Farming Industries of the Cape Colony" 1896:

"There is trouble from abortions which—although the immediate cause may have been an accident or injury — ought to be treated as a catching or contagious disease, affected animals being separated without delay, the tendency to this and to pulmonary weakness, and also the difficulty experienced in getting female Angoras to recognize and care for their kids when young, may possibly be due to some extent at least to the in- and in-breeding to which they have been subjected".

Slides were shown from the hypophyses of normal ewes and of aborters. These indicated that the acidophiles in normal ewes were actively secreting while the basophiles displayed low activity. The position was reversed in the hypophyses of the aborters, the basophiles revealing marked activity while the acidophiles were in a state of exhaustion or depletion.

In opening the discussion DR. R. CLARK stated that the author had just received the D.V.Sc. degree for a thesis on this work, which was a wonderful example of basic research being conducted under field conditions.

He informed the meeting that a number of normal kidding ewes and a number of aborters were being studied at Onderstepoort. During the past breeding season determinations made on the pregnanediol output in the urine of these ewes during pregnancy support the author's conclusions on the aetiology of abortion.

DR. S. J. VAN RENSBURG gave the preliminary results of observations being made on the ovaries of these goats by laparotomising non-pregnant ewes as well as pregnant ewes in various stages of gestation. Abnormal development of the corpus luteum was found in the non-pregnant aborters and also marked regression of the corpus luteum in the pregnant aborters. It was further shown that, contrary to what obtains in sheep, the corpus luteum was essential throughout pregnancy in Angora goats, its removal at any stage being followed by abortion.

In reply to DR. REINECKE who had suggested stilboestrol as a preventive, DR. VAN HEERDEN said that this had been included in one of the experiments and that it resulted in 100 per cent abortions.

THE CHEMOTHERAPY OF NEMATODE PARASITES OF SHEEP AND CATTLE

W. T. Harrow,

DR. HARROW in introducing his paper mentioned that the last few years had seen rapid strides in the development of new anthelmintics and that many of these were effective against the immature parasitic stages of nematodes. These new drugs do have their drawbacks and these lie in the increased cost to the farmer per animal treated.

Mention was made of the lesions arising from the subcutaneous use of "Methyridine": it was suggested that the drug should be administered by the intraperitoneal route. "Methyridine", apart from its effect on

the intestinal nematodes, has a marked clinical effect on cases of lungworm infestation. Attention was drawn to the fact that the efficacy of the drug against abomasal nematodes was variable due to the acid pH of that organ.

INVESTIGATION INTO AND THE DEVELOPMENT OF HEXACHLOROPHENE AS AN ANTHELMINTIC

C. J. Bosman, P. W. Thorold, H. S. Purchase

The following points were raised during the discussion on this paper. Drugs containing chlorinated-hydrocarbons were more toxic during winter in South Africa, and especially so, in the Eastern Orange Free State and the Transvaal highveld. Dosage rates must be assessed according to weight and not according to age. Animals must be inoculated regularly against enterotoxaemia. Very old and very young animals and animals in poor condition are more susceptible to the toxic effects of anthelmintics. When dosing with tetrachlorethylene or carbon tetrachloride, there must be a four week interval before dosing with an organic phosphate. A two week interval must be allowed between dipping and dosing with an organic phosphate.

For a lamb weighing under 20 lbs, the recommended dose of hexachlorophene of 15 mgm/K was not effective as an anthelmintic, and must be increased slightly. This drug is reasonably effective against *Monezia species* but has no effect on *Stilezia hepatica* or on the immature stages of *Fasciola hepatica*. The efficacy of this drug appears to be lower against adult *Paramphistomum* than against immature stages of this worm.

TRANSPORTATION OF ANIMALS BY RAIL

MR. R. HIRZEL: Technical advisor to the Livestock and Meat Industries Control Board, in opening the discussion, referred to:

EATING AND DRINKING "EN ROUTE". He had seen cattle drinking before eating when offloaded during very hot summer days.

FEEDING CATTLE "EN ROUTE". Tests carried out conjointly by the Railway Administration and the Control Board had shown that cattle are best fed out of hay racks placed high on the sides of the resting pens, so as to leave maximum floor space and avoid injuries to the hookbones. The bars of the racks should be $4\frac{1}{2}$ inches apart and each rack must be provided with a shallow trough, equal in width to the top of the rack, to collect falling hay and so reduce wastage to a minimum.

LOSS OF CARCASE WEIGHT AND GRADE. In a test, 800 cattle were divided according to live weight and grade into two equal groups. The one group was slaughtered at Walvis Bay in South West Africa and the cattle of the second group transported by rail for slaughter at Cape Town. After four days in rail transit, the carcases of the latter group weighed, on the

average, only 1.07 per cent less than did the carcases of the cattle slaughtered at Walvisbay. In average carcase-grade there was no difference. The livers of the Walvis Bay cattle averaged 11 lbs. as against 10 lbs. for the Cape Town group, and the caul fat 6.9 lbs. compared with 6.5 lbs.

BRUISING. In the above investigation, the cattle slaughtered at Cape Town showed 50 per cent more bruising on the pinbones (1.25% against 0.82%) and 30% more on the hookbones (1.42% against 1.09%), but there was no difference in the bruising over the topline and ribs (respectively 10% and 15% in both groups).

Horned and polled cattle, sent in separate trucks over 400 miles to abattoir from the same farm, showed no quantitative difference in the bruising of their carcases over the hook and pin bones, but over the ribs, the bruising score for the horned cattle amounted to 0.51 per cent, compared with only 0.04% for the polled group.

Extensive trials with both horned and dehorned or polled cattle in padded and in non-padded trucks, have failed to show any results in favour of padded trucks. Statistics collected by the Control Board show that during the three years up to 1954, the average weight of bruised meat trimmed off from beef carcases, amounted on an average to 1.15 lbs. For the last ten years the average weight of "trim" was 0.9 lbs. For the five years ending in June 1945 the average trim per pig carcase was, according to the Departmental Committee on bruising, 0.107 lbs. and for sheep carcases 0.003 lbs.

DEATHS DURING TRANSIT BY RAIL. The records of the Johannesburg Abattoir show that during the period of 4 years ending in 1956, 0.04% of the cattle, 0.06% of the sheep and 1.10% of the pigs received by train, were found dead on arrival.

ON THE USE OF TRANQUILISERS. Mr. Hirzel reported that no beneficial effects were obtained on two train loads of cattle from South West Africa to Cape Town. Because no facilities were available at railhead, the animals were injected before leaving their owners' farms and the effects of the drugs had worn off before they were loaded.

Mr. Hirzel concluded his remarks by stating that careful handling during loading and transportation by rail, and sufficient rest prior to slaughter, would greatly reduce economic losses suffered through bruising. Animals killed in a rested state showed a lighter colour meat than fatigued animals, and their meat had more flavour.

DR. C. C. WESSELS: recommended that nervous and wild animals should be trucked separately, since by example, they upset normally docile and tractable animals.

DR. I. S. MCFARLANE: supported Dr. Wessels' recommendation and added that tranquilisers were often more necessary for the humans in charge of the animals than for the animals themselves. Quiet handling and good stockmanship were essential factors in rail transportation of livestock.

DR. SHAW: reported that in mid and north African states, where wood is used as locomotive fuel, eye injuries from flying wood cinders are

common and that the Channel Island breeds of cattle appear to be especially susceptible. The nearer the truck to the engine the higher the incidence of the injuries. In woodburning trains animals should not occupy the first ten trucks.

DR. THORNTON: considered that man and animals prefered to stay in surroundings to which they are accustomed. Change of surroundings and journeys cause stress, and livestock react sharply to stress. To obviate or overcome stress and its deleterious effects, cattle should be well fed prior to trucking, but pigs should not, because a full stomach presses up against the diaphragm and can so cause death. Stress and fatigue are the causes of ham-taint in pigs and dark beef in cattle.

It is essential that slaughter-stock be well rested and kept warm in lairages after arrival at abattoirs. If cattle become cold and shiver, adrenalin is discharged into the bloodstream, there is a loss of glycogen and black beef may result. Proper rest is necessary to promote the flavour of the meat and slaughter under quiet conditions is equally important.

Fatigue and hunger can cause the livers of calves to become yellow and increase the chances of septicaemia.

DR. P. J. MEARA: Emphasized the bruising in cattle, caused by horns.

DR. BEVERIDGE: Stated that the use of tranquilisers on farmstock during transportation by rail has so far not been a success. They are difficult to administer, and for conditions in this country the effects do not last long enough. There were no public health hazards or damage to the meat. He felt that further investigations should be conducted.

PROFESSOR BISSCHOP AND DR. SUTTON gave appropriate replies to the matters raised.

COBALT IN RELATION TO RUMINANT NUTRITION IN SOUTH AFRICA

C. C. Wessels

DR. WESSELS in speaking to his paper said:—

The study of trace elements, especially Cobalt, is still in its infancy. Scientists all over the world claim results, some of which are contradictory and it will still take us years before definite conclusions can be drawn. I am sure if we go into the chemistry, physiological processes, cellular reactions, enzymes, co-enzymes, brought about in the living organism by cobalt and copper, we can discuss the matter for days. In my paper, however, you will note I have attempted to explain some of the changes even though they are just postulations.

It has taken me over 2½ years to find out what I have set out in my article and the work is not yet finished, especially in connection with wool findings. Most farmers shear only once a year so that it takes 2 years to establish wool results. One year the fleece must grow on a sheep

whilst on deficient pasture and thereafter for another year another fleece must grow during which time the animal undergoes treatment. It is therefore obvious that this is a time-consuming study and a very costly one. The physical and chemical estimations on the wool were carried out by the South African Wool Textile Research Institute at Grahamstown, and in most cases the physical changes were confirmed on duplicate samples by the Textile Institute at Leeds in the United Kingdom.

Some trace elements have interactions of antagonism or stimulation, for e.g. molibdenum and copper on the one hand and copper and cobalt on the other hand. I am not going to discuss these phenomena here, they can be found in literature.

In these trials it has been shown that cobalt deficiency can vary from place to place according to soil types, flora variations and meteorological changes.

Furthermore, in these tests it is very evident that cobalt deficiencies can occur in different degrees varying from acute deficiency with symptoms of advanced emaciation (pining), loss of appetite, lachrimation, anaemia and wool lesions to subacute deficiency where the animals remain "just healthy".

I am not a chemist or a physicist, but as a Veterinarian I have made every endeavour to show our rightful place in the field where a disease as a result of a deficiency comes into the picture. If not, our rights as Veterinarians will be usurped. From time to time articles have appeared in semi-official journals by non-veterinarians on diseases brought about by trace elements. It is our bounden duty to see that we serve our rightful part in all investigations where diseases of domestic animals are concerned, no matter what the aetiological factors may be.

I wish to emphasise that my claims are not the alpha and omega. I have only given a true reflection of these findings and present them for what they are worth to assist my colleagues, especially those in the field, and other interested people, as also farmers. The interpretations of the results are my own and I do not for a moment wish to convey the idea that I am dogmatic about the correctness of agreement of others. It is quite possible that the interpretations of others may be different and more logical and even more correct. I am merely stating the facts here as I found the results so obtained.

Before I undertook this survey and studies, I made every endeavour to find out the cobalt status in the Republic. Nobody could tell me anything and whatever evidence existed was too scant to rely upon. The only advice I got from authorities was to undertake actual field feeding tests, as analyses of organs, soil or pasture are unreliable.

The danger of indiscriminate feeding of so-called "shot gun" mixtures of trace elements are well known to you and one of the objects of this study was to find out the existence of the lack of only one of these elements with the object of advising the use of only one which is the most important.

With a small staff of lay assistants, I started the survey first just with the object of establishing the incidence of the deficiency in certain localised areas, but as findings came to hand, especially the dramatic improvement in wool, the work was carried on beyond the scope it was originally intended for, and at this moment, Mr. President and Gentlemen, I can

assure you further work in this direction, with the combined efforts of all our colleagues in the different parts of the country will be well worth while in the interests of the profession and our sheep, as also cattle farming communities.

After having viewed the projected tables of live weights, wool weights and photographs of wool quality improvements, the following possible conclusions can be drawn:

1. After having carried out tests on 185 farms comprising 6,080 sheep, 478 cattle, it would appear as if on approximately 50% of the farms in the Republic and South-West Africa, sheep and cattle could find benefit with cobalt supplementation to the extent of improvement only on 23%, subacute deficiency 13% and acute deficiency 14%.

2. Findings in these tests also prove that correction by cobalt treatment of the lack of crimp formation in merino wool restores substance, leading to closer packing of the staples, thus eliminating the entry of foreign material and bringing about better scoured wool weights.

3. Cobalt administration not only corrects cobalt deficiency in the system, but also eliminates the symptoms of cobalt, and in many instances also copper deficiency in the wool itself.

4. In several experiments with a total of 213 sheep used, greased wool yields showed significant improvements even in cases where live weight gains could not support a diagnosis of cobalt deficiency.

During the projection of a film on "*Phalaris Staggers*" in sheep, the following characteristic symptoms are to be seen viz. hyperexcitability, inco-ordination, facial muscle tremors, bobbing of the head. During my investigations in the Cape, I encountered a severe outbreak of "*Staggers*" in cattle showing symptoms not unlike those of the sheep shown in the film. On the same farm in previous years, sheep became afflicted with symptoms similar to phalaris staggers. Recently the grass responsible for this staggers was found to be *Phalaris minor*, also known as Canary grass.

Since regular cobalt administration to the animals on this farm, the problem of staggers has been solved. As a result of this finding, one must not lose sight of the possibility of other phalaris species causing sporadic deaths on different occasions.

The following two questions were put by DR. J. B. QUINLAN:

Question 1: The rôle of Cobalt and Vitamin B12 synthesis in the horse?

Question 2: Whether the cereals (oats, wheat, barley etc.,) grown in the deficient areas as found by me, could also be deficient after reaping?

Answer 1: Although very little is known in this regard, all attempts made by different workers in the different parts of the world, have failed to induce cobalt deficiency in the horse.

Answer 2: The cereals could be deficient especially on lands where heavy fertilization has taken place over long periods.

RESPIRATORY DISEASES OF FOWLS

L. Abrams

DR. ALEXANDER (opener) presented the virological aspect of the work undertaken by Dr. Weiss and his staff, of the Virus Section at Onderstepoort.

He noticed that the contributor had used the previous name of C.R.D.; whereas the disease was now known as *Avian Respiratory Mycoplasmosis.*

A year ago it had been stated that Newcastle Disease, Infectious Bronchitis and Infectious Laryngotracheitis were not present in South Africa. It has now been established that these diseases were present: although the butogenic form of Newcastle Disease virus had never been isolated, the diagnosis being based on the H.I. test.

Numerous strains of I.B. had been isolated which caused dwarfing of the chick embryo. A virus (Degenar) resembling I.B. had also been isolated but this appeared to be an orphan virus.

A type-serum from the U.K. had been used to confirm the diagnosis of I.B. and it was then found that the U.K. serum also neutralized the Degenar virus.

He referred to a similar virus isolated by van den Ende, who, when working with Lumpy Skin Disease, isolated a bronchitis-like virus in 1947.

Another virus had been isolated from terns which had died in large numbers on the Cape coast. This virus caused mortality in chickens subjected intra-tracheally to the infectious agent, but did not spread by contact. A virus isolated by Wilson in Scotland from kittiwakes was subsequently proved to be an identical virus to that isolated from terns.

DR. MULLER briefly sketched the importance of these respiratory diseases to the large poultry population in the Western Province.

DR. COLES congratulated Dr. Abrams and supported many of the statements made by him. He expressed his appreciation of the appointment of a full-time virologist for the poultry section at Onderstepoort. He mentioned that aerocystitis due to coliforms could be found in the absence of microplasma. He congratulated Dr. Jansen, Director of Veterinary Services, on the attitude adopted by the Division regarding respiratory diseases. Avian mycoplasmosis reduces body weight and egg production, but not in all cases. This sometimes caused doubt regarding the significance of P.P.L.O.'s.

He referred to a type of Newcastle Disease occurring in Nyasaland which produced haemorrhages in the duodenum.

DR. BEVERIDGE asked whether chemotherapy was to be recommended in avian mycoplasmosis. In America chemotherapy was practiced extensively because of the difficulties of eradicating the disease.

DR. ABRAMS in replaing stated:

(*a*) Coli had been isolated.

(*b*) Coli isolated from infected air-sacs had not produced clinical symptoms or lesions when introduced into poultry, but when combined with I.B., mild strains of I.L.T., or P.P.L.O's, the symptoms and post-mortem lesions were apparent.

Regarding chemotherapy he considered it of value in the *all-in-all-out* systems of poultry farming, but where there was a weekly introduction of fully susceptible poultry it was of little value.

THE BUSINESS MEETING

MINUTES OF THE FIFTY-SIXTH ANNUAL GENERAL MEETING HELD AT THE KILLARNEY HOTEL, DURBAN, ON THE 27TH SEPTEMBER, 1961

PRESENT

Dr. H. P. Steyn (President), the outgoing Vice-President (Dr. R. du Toit), the incoming Vice-President (Dr. R. Clark), the Secretary (Dr. A. M. Diesel), the Hon. Treasurer (Dr. G. D. Sutton), and the following members: Abrams, L., Adelaar, T. F., Alexander, R. A., Amos, V. J., Anderson, P. J., Barrie, N., Bangay, R. T., Bezuidenhout, R. J., Barnard, W. G., Bishop, G. P., Bisschop, J. H. R., Blomefield, L. C., Brookes, J. W. A., Brown, P. H., Brummer, W. A. S., Buchalter, R., Canham, A. S., Canham, I. S., Cavanagh, F. E., Chase, W. H., Clow, D. G., Cloete, P. R., Cilliers, S. W., Coetzee, H. G., Coles, J. D. W. A., Collier, P. N., Dalzell, K. K., de Kock, J. A., Dent, G. C., de Villiers, O. T., de Waal, D. J., de Wet, J. M., de Wet, P. D., Dickson, J. L., Dore, J. L., du Toit, I. F., Every, R., Groenewald, J. W., Harber, A. F., Holtz, H., Hobbs, W. B., Horak, I., Horwitz, B. M., Howell, R. J., Hugo, P., Irwin, D. H. G., Jansen, B. C., Kleeberg, H. H., la Grange, B. A., Lambrechts, M. C., le Roux, D. J., Liebman, V. A., Louw, A. J., McCreanor, M., McDonald, C. T., McFarlane, I. S., McHardy, W. M., Mansvelt, P. R., Martinaglia, G., Mason, J. H., Mare, C. J., Meara, P. J., Meeser, M. J. N., Mehnert, O. H. J., Morford, L. R., Muller, G. L., Osbourn, D. E., Paine, B. T., Pols, J. W., Poole, J. D. H., Pfaff, G., Reinecke, R. K., Quinlan, J., Robinson, M. C., Robinson, J. T. R., Retief, G. L., Rose, M., Rossiter, L. W., Ryksen, W. J., Scholtz, H. E., Shaw, G. D., Shires, G. M. H., Smith, P. R. B., Snr., Smith, P. R. B., Jnr., Simpson, L. A., Snijders, A. J., Snyman, P. S., Solomon, R. A., Solomon, S., Stampa, S., Strydom, H. F., Swanepoel, R., Tarr, A. F., Terblanche, H. J. J., Thiel, A. R., Thorburn, J. A., Tustin, R. C., Uys, P. L., van Aardt, W. P., van den Heever, L. W., van der Merwe, G. F., van der Walt, K., van Heerden, A., van Heerden, K. M., van Niekerk, J., van Rensburg, S. W. J., van Rensburg, S. J., Viljoen, W. C., von Backstrom, U., Wacher, D. C. L., Wacher, P. P. C., Wessels, C. C., Wessels, T. C. W., Wheeler, W. J., Williams, J. G., Winterbach, P. B., Zwarenstein, J.

Apologies for non attendance were received from Dr. G. de Kock, Dr. H. P. de Boom, Dr. Schuss, Dr. M. de Lange, Professor M. Henning, Dr. Warnes, Dr. Kempster, Dr. T. A. T. Louw, Dr. Watt and staff.

The President welcomed members to the Fifty-sixth Annual General Meeting of the Association and reminded them that the report of the Fifty-fifth Annual General Meeting was reviewed in the September, 1960 issue of the Journal. The Minutes of the Meeting were adopted without dissension, and consideration of the succeeding items on the Agenda followed. The President appealed for brevity in respect of all items under discussion.

ITEM 2—MATTERS ARISING FROM THE MINUTES OF THE FIFTY-FIFTH ANNUAL GENERAL MEETING: The President intimated that:

(*a*) *The full-time Secretary* had been in office since the 1st August, 1961 and was now present at the meeting in that capacity.

(*b*) *The matter of the Amendment of the Veterinary Act* was receiving attention.

(*c*) *The revised Constitution* was now available free to members on receipt of their signatures. Anyone desiring a second copy would, however, have to pay for it.

(*d*) *Resolutions of the previous meeting.*

Resolution No. 1: had been implemented and the fifty-sixth Annual General Meeting was being held at Durban this year.

Resolution No. 2: Legal advice had been obtained indicating that the exclusive use of the word "Veterinary" was not necessarily assigned to the Veterinary Profession. The meeting was fully informed by the President in this regard.

Resolution No. 3: A Reproduction Group within the Association had been formed and a meeting of the Group had been held on the first day of Congress, as indicated in the programme.

Resolution No. 4: Professor de Villiers intimated that the proposal to degrade the Professorate of Veterinary Science to that of Senior Lecturer at the University of Stellenbosch, had not yet been decided by the authorities.

(*e*) *Veterinary Archives;* The Secretary was anxious to build up an historical record of veterinary material in South Africa and he hoped members would assist him in his endeavour.

ITEM NO. 3.—THE PRESIDENT'S REPORT

This was read to the meeting by the President: a copy appears in this issue.

Dr. Jansen het lede herinner van die fasiliteite wat op Onderstepoort met die grootste welwillendheid aan alle kollegas beskikbaar gestel word. Smere kan ondersoek word en tyd word afgestaan om probleme met kollegas te bespreek.

ITEM NO. 4.—MEMBERSHIP

Deaths. The President intimated that since the last Annual Meeting the death had occurred of Drs. H. C. Watson, N. T. v.d. Linde, A. C. Kirkpatrick and J. G. Becker. He asked the meeting to respect the memory of these deceased members by standing in silence for a few minutes.

Resignations

The following members had resigned for the reasons stated, and the meeting agreed to accept the termination of their membership with regret:

Dr. Lionel Steel—To take Holy Orders.
Dr. D. Burgess—returning permanently to Ireland.
Dr. J. W. Nixon (Nr. Rhodesia) ceasing activities as a veterinarian.
Dr. van den Hagen—returning to Germany.
Dr. B. Moring—returning overseas permanently.

New Members

The following applicants having been duly proposed, seconded and recommended by Council were elected as ordinary members:

Adams, J. W. E. (Salisbury—Overseas member), Belonje, P. C., Bezuidenhout, R. J., Boyazoglu, P. A., Cross, A. F. J., Erasmus, B. J., Holding, A. S., Horton, B. G. W., Jackson, O. F. (Nr. Rhodesia—Overseas member), Kritzinger, L. J., Liebman, V. A., Lucouw, H. L., MacNab, E., Owen, N. C., Pretorius, J. L., Pienaar, Miss A. L., Retief, G. P., Rous, R. C., Schnetler, J. F., Scholtz, H. E., Swanepoel, R., Terblanche, M., van Blerk, N. S., Wolmarans, D. J.

Dr. P. S. Snyman, Elected as Hon. Life Vice-President.

The President informed the meeting that Council had considered the proposal to elect Dr. P. S. Snyman to the esteemed post of Honorary Life Vice-President, and was pleased to make this recommendation to the meeting. Dr. Snyman had served the Association faithfully as a member of Council for very many years and had been its President for a number of years. He was unquestionably worthy of this high honour and he thought that the meeting should have no hesitation in electing him to this position.

Agreed with acclamation.

Dr. Snyman appropriately thanked the President and members for creating him an Hon. Life Vice-President.

ITEM 5—CONSIDERATON OF REPORTS OF STANDING COMMITTEES

Finance Committee. The Hon. Treasurer Dr. G. D. Sutton reminded the meeting that the Balance Sheet and Income and Expenditure Account for the year ended 31st March, 1961 had been sent to all members. Council had considered these financial statements and had approved them. He was prepared to answer any queries members may wish to put to him.

Their adoption having been proposed and seconded, their approval by the meeting was unanimously accepted.

The Chairman of the Finance Committee, Dr. S. W. J. van Rensburg then appealed to every member to do his share in keeping the finances of the Association in a sound state and expenditure within limits.

The future expenditure connected with the management of the affairs of the Association was likely to be heavy, and careful account would have to be exercised in order to balance the finances until the Journal could pay its way. He referred to the expenses connected with travelling, by the Secretary, the President and even by members of Council on occasions. These would have to be kept in check. It might be necessary to approve a vote of say R400.00 per annum for this purpose.

Contributors to the Journal too could assist in preserving the finances of the Association by presenting suitably prepared copy: avoiding the need to retype manuscripts.

The prompt payment of subscriptions and the elimination of reminders in this regard would help the Association very materially.

From the discussion which arose, it was clear that the Branches of the Association would on occasions be prepared to contribute towards the costs of travel of the office bearers of the Association who may from time to time visit them.

THE PRESIDENT drew attention to the provisions of *Article* 16 of the constitution and asked the meeting for authority to warn those members who were three and more years in arrears with their subscriptions, of the implications of this provision. This was unanimously agreed to, provided there was no response by the end of the financial year in March, 1962. It was agreed too that the executives of the local branches be advised of the names of the offenders and that they assist in approaching the members concerned and persuading them to settle their accounts with the Secretary.

General Purpose Committee

The Chairman, Dr. R. du Toit, gave the meeting details of the activities of this committee and referred particularly to the preparation of draft contracts for Veterinary Employment by members, Legal Advice in respect of the word "Veterinary" and to assistance given in principle to the Congress Committee in regard to arranging the present Congress.

Editorial and Library Committee

Prof. Clark in the absence of Professor de Boom, the Editor, gave details concerning the publication of the Journal and the improved conditions obtaining in respect of the Student's Library. He appealed to members to donate interesting books of a non-veterinary nature for use by the students.

Disciplinary Committee

In the absence of Professor C. F. B. Hofmeyr, Dr. L. W. v.d. Heever reported on the activities of the Disciplinary Committee and particularly referred to the work being done in connection with the ethical conduct

concerned with Veterinarians employed in commerce. A special sub-committee had been appointed to consider this matter in detail.

ITEM 6—PUBLICATION OF THE JOURNAL OF THE ASSOCIATION

DR. D. H. G. IRWIN congratulated the Editorial Committee on bringing the issues of the Journal up to date. He felt that the Committee should be enlarged and the work distributed.

He considered that the Journal should be published every two months from 1962.

Dr. Clark was in agreement with most of what Dr. Irwin had proposed and felt that he should be coopted to the Editorial Committee.

ITEM 7—VETERINARIANS IN COMMERCE

THE PRESIDENT reviewed the position regarding the activities of the sub-committee which had the matter in hand, but saw little hope of concluding the matter before the next Annual General Meeting.

ITEM 8—USE OF THE TITLE M.R.C.V.S.

THE PRESIDENT explained how this matter had arisen and indicated that some members considered it unfair to permit the appearance of the letters M.R.C.V.S. on letterheads and nameplates by persons in South Africa who had only acquired the title by payment of a subscription on a visit to Britain.

DR. JANSEN informed the meeting that during his visit to London the previous week, he had interviewed Mr. Oates, Secretary of the Royal College of Veterinary Surgeons and had discussed this matter with him. Mr. Oates had divided the problem into two parts; viz:

(i) The use of the title M.R.C.V.S. by a South African who had paid the necessary subscription, and was placed on the Commonwealth list.

(ii) The reciprocal use of the title M.R.C.V.S. by B.V.Sc. (South African) degree holders upon entry into the United Kingdom and the acquisition of all privileges of the British Veterinarian upon payment of the subscription fixed for registration.

As South Africa was no longer a member of the Commonwealth the preservation of the *status êuo* would have to be considered. The Council of the B.V.A. was giving consideration to the matter. South Africa would now be regarded as a foreign country, but there was still the opportunity of defining "foreign country". Dr. Jansen said he had made it clear to Mr. Oates that South Africa desired to be retained on the Commonwealth list. Mr. Oates agreed that this was desirable and that the S.A.V.M.A. would duly be informed of the decision of his Council.

After discussing the matter in some detail the meeting decided to defer a suggested notice of motion until next year.

ITEM 9 — REFRESHER COURSES

PROFESSOR R. CLARK informed the meeting of the progress made by the Veterinary Faculty of the University of Pretoria. He intimated that further details would be made available later and that there would most likely be a charge of about R10.00 payable to the University. The course would probably last about a fortnight and be held during July.

ITEM 10 — SCHEDULE OF FEES

THE PRESIDENT intimated that the Witwatersrand Branch had recently agreed to a new scale of fees. Anyone interested in being furnished with a copy should communicate with the Secretary.

ITEM 11 — WORLD VETERINARY ASSOCIATION

THE PRESIDENT called on Dr. S. W. J. van Rensburg to report to the meeting the information he had obtained when attending the meeting of the *Permanent Committee* of the World Veterinary Association in Paris during May, 1961.

Dr. van Rensburg conveyed the following information to the meeting:

1. The Association was up to date with its subscription.
2. The next World Veterinary Congress would be held in Hanover, Germany, in 1963. This would be designed to depict "*One hundred years of Veterinary Progress*".
3. Associate Membership (S.A.V.M.A. is an Associate Member) is sub-divided into various branches of specialization—e.g. Zootechnicians, Small Animal Veterinary Practitioners: branches were being considered for Pathologists, Virtologists, Bacteriologists Parasitologists.

The future representative on the Permanent Committee was then discussed and it was agreed to refer the matter to Council for attention.

ITEM NO. 12—SCIENTIFIC EXHIBITION

The Secretary advised the meeting that a Permanent Exhibition was staged in Pretoria under the auspices of the South African Association for the Advancement of Science, and professional bodies were invited to contribute scientific and popular talks at their convenience.

ITEM NO. 13 — NOTIFICATION OF RESULTS OF ELECTION OF OFFICE BEARERS FOR THE ENSUING YEAR, 1961/62.

The Secretary intimated that as the result of the recent election the following members became office bearers for the forthcoming year, 1961/62:

President — Dr. H. P. Steyn.
Vice-President — Dr. R. Clark.
Members of Council—Drs. C. F. B. Hofmeyr, B. C. Jansen, L. W. v.d. Heever and K. v.d. Walt.

The remaining members of Council were Drs. J. D. Coles, M. de Lange, M. C. Lambrechts and A. F. Tarr.

ITEM 14 — GENERAL

Jaagsiekte

DR. M. C. LAMBRECHTS informed the meeting of a survey in connection with jaagsiekte, which was now being undertaken by the Division of Veterinary Services in the Republic and South West Africa. It would extend over the next five years. He appealed to members who knew of the existence of the disease to inform the nearest state veterinarian.

Dr. J. H. Mason elected as Honorary Life Vice-President

On the proposal of Dr. R. Clark, seconded by Dr. R. Alexander, Dr. J. H. Mason was elected to the office of Honorary Life Vice-President.

Dr. Mason in acknowledging the recognition, said he was very touched but very pleased to receive this honour which had been paid to him.

A Group Insurance Scheme for the Profession

A suggestion that a Group Insurance Scheme applicable to the profession, be examined by Council, found no support.

K.I. Kooperasies en die Uitreiking van Sertifikate

DR. LA GRANGE het die wenslikheid vir univormiteit by die uitreiking van veeartsenykundige sertifikate sterk bepleid. Die bulstasies is afhanklik van die sertifikate en uniformiteit sal moet geskied. Na bespreking het die vergadering besluit om alleenlik die sertifikate te ondersteun wat deur die vereniging uitgereik word. Kennis moet in die Joernaal gepubliseer word, aangaande die sertifikate wat beskikbaar is.

Notice of Motion to Amend the Constitution

DR. D. H. G. IRWIN intimated that he wished to give notice to amend the Constitution to provide for the election of the President by Council and to withhold voting by Honorary Life Vice-Presidents who attend Council Meetings.

THE PRESIDENT advised Dr. Irwin to submit his proposal to the Secretary not later than three weeks before the next Annual General Meeting.

Formation of an Association of Artificial Inseminators

DR. MCFARLANE discussed and proposed the following resolution which was seconded by Dr. D. J. le Roux and unanimously adopted:

> *"That this 56th Congress of the S.A.V.M.A. welcomes the formation of a constituted Association of Artificial Inseminators and instructs Council to investigate the possibility of affiliating this Association with the S.A. Veterinary Medical Association."*

Election of Members of the Veterinary Board

The question of the desirability of authorising Council to make recommendations to the Minister for Agricultural Technical Services to fill vacancies on the Veterinary Board was raised, but it was decided to defer the matter for a decision until the next Annual General Meeting, and meantime to obtain the opinion of members.

Expression of Thanks to the Stock Diseases Fund Advisory Board

It was suggested that the Secretary address a suitably worded letter of thanks to the Stock Diseases Fund of the Control Boards in South Africa, indicating the appreciation of the Association for what has been done for the Veterinary profession, including veterinary education, and that the matter be raised at the next Council meeting to enable the Secretary to draft a suitable letter.

Expression of thanks to the Natal Branch for its Organisation in so successfully arranging the present Congress.

DR. BLOMEFIELD paid tribute to the Organising Committee of the Natal Branch and particularly thanked Dr. Viljoen the Secretary, Dr. A. J. Louw, Dr. Doré, Dr. "Jack" Cavanagh, Dr. Thiel, Mrs. Tarr, Mrs. Zwarenstein, Mrs. Coles and Mrs. Dore and all the other helpers.
THE PRESIDENT in endorsing the remarks made by Dr. Blomefield, also thanked Dr. Dore for his outstanding film on the use of the Closed Circuit Anasthesia apparatus and for projecting the slides and films for the benefit of contributors and Congress attendants.

Expression of thanks to Dr. G. D. Sutton

THE PRESIDENT expressed his, and the Association's sincere thanks to Dr. Sutton for the sterling services he had rendered as Hon. Treasurer during the past 12 years. The members voiced their appreciation and acknowledged the tribute paid to Dr. Sutton by cheering him with acclamation.

Dr. Sutton in replying expressed his appreciation for the assistance given him by two ladies in particular, viz. Mrs. Coles and Mrs. Klerck; they were both pillars of strength and had done an enormous amount of work for the Association behind the scenes

Leemte in Veeartsenykundige Opleiding

DR. LA GRANGE het op 'n moontlike leemte gewys in die opleidingskursus van veeartse wat deur die Fakulteit tans gereel word. Sonder om enigsins refleksie op die verantwoordelike owerhede te werp, meen hy dat die kursus 'n breë veeteelt opleiding behoort in te lyf. Hy het die volgende voorstel gemaak wat deur dr. K. M. van Heerden gesekondeer was en deur die Vergadering algemeen aangeneem:

> *"Dat hierdie Vergadering ons Raad versoek om in die lig van die nuwe rigtings in ons veeteelt-nywerheid, bv. dierevoortplanting, K..I nywerheid, genetika, voedingsleer en veeteelt in die algemeen ens. ens. 'n ondersoek moet instel of ons huidige B.V. Sc. kursus ons as veeartse volledig genoeg toerus om 'n leidende rol in hierdie nuwere rigting te vervul".*

DR. DU TOIT (Dekaan van die Fakulteit Veeartsenykunde) het die vergadering meegedeel dat hierdie saak alreeds die aandag van die Fakulteit geniet.

DR. MCFARLANE proposed a vote of thanks to the Director of Veterinary Services for permitting the attendance of a number of State Veterinarians.

PROFESSOR DE VILLIERS proposed a vote of thanks to the Natal Branch for a very successful Congress.

DR. DICKSON proposed a hearty vote of thanks to the Chair.

The President then adjourned the meeting until next year and thanked all Members for their attendance.

VERSLAG VAN DIE VOORSITTER VIR DIE JAAR 1960–61

Die Raad het ses keer vergader en het 'n groot hoeveelheid werk afgehandel.

Daar is besluit dat as gevolg van die hoë koste verbonde aan drukwerk die notule van die Raad vir die afgelope jaar nie soos voorheen gepubliseer sou word nie, maar dat ek aan die jaarvergadering verslag sou doen van die bedrywighede van u Raad. Dit is van selfsprekend dat 'n groot deel van ons werk van 'n roetiene aard is en dat ek u dus nie daarmee hoef te bemoei nie.

Die belangrikste werk wat seker gedurende die afgelope jaar deur u Raad verrig is, het bestaan uit drie taamlike lywige memoranda wat voorberei en voorgelê is aan verskillende komitees van ondersoek, betreffende Landboutegniese Dienste, sover dit veeartsenykunde aangaan.

Getuienis is reeds ook gelewer voor twee van die Komitees nl. die *van der Wath-komitee* wat ondersoek ingestel het na kunsmatige inseminasie-dienste; en die *Rautenbach-komitee* wat 'n volledige ondersoek ingestel het na Landboutegniese Dienste in al sy bedrywighede. Die derde memorandum is ingedien aan 'n Kommissie van Ondersoek na Abattoir en Verwante Fasiliteite. Getuienis moet nog aan laasgenoemde voorgelê word.

Dit sou onmoontlik wees om in besonderheid verslag te lewer omtrent die getuienis wat voorgelê is, maar die hooftrekke was om, eerste bewys te lewer van die belangrikheid van veeartsenydienste aan iedere besondere vertakking van die veenywerheid en openbare gesondheid: daarna te verwys na die redes vir die tekort aan veeartse en die nodige middele ter verbetering van die tekort. Ook is daar met al die krag tot ons beskikking nadruk gelê op die gebreke aan die huidige dienste wat gelewer word.

Daar is 'n lang brief aan die Staatsdiens Kommissie gerig waarin salarisskale vergelyk is en aangedring is op verbetering van die salarisskaal van Staatsveeartse. Dit het, soos u weet, bevredigende resultate gelewer maar slegs nog op 'n tydelike grondslag; permanente verbetering word met alle vertroue ingewag.

Ook was daar 'n onderhoud tussen myself en die Sekretaris van Landboutegniese Dienste, en 'n briewewisseling met Sy Edele Min. P. M. K. le Roux, oor veeartsenykundige aangeleenthede. 'n Onderhoud met die Minister is gereel vir 26 Oktober 1961.

Verder is daar getuienis afgelê aan 'n paar komitees van ondersoek, van ietwat minder belang, soos die Komitees oor ioniserende bestraling, antibiotika in melk, openbare gesondheidsdienste ens.

Die jaar was verder van besondere belang vir ons Vereniging omdat ons baanbrekers werk verrig het met die hou van 'n eerste Jaarvergadering weg van die ou tuiste, en ek meen dat u my sal ondersteun in my dank betuiging aan die lede van die Natal tak wat in hoofsaak die werk onderneem het. Veral wil ek ons waardering uitspreek aan dr. Blomefield, hul voorsitter, dr. Viljoen, hul sekretaris, en die lede van hul kongreskomitee.

Nog 'n belangrike stap is geneem deur die aanstelling van 'n voltydse Sekretaris in die persoon van die alom beminde dr. Don Diesel. Ons het nou ook ons eie kantoor met al die nodige toebehoorsels.

Alles in aanmerking geneem wil dit voorkom dat ons een van die belangrikste jare van ons bestaan tot op datum deurgemaak het. My voorspelling is dat ons, as gevolg van die verrigtinge van die afgelope jaar, geweldige veranderinge ten goede van die Professie en die veenywerheid, gaan sien.

Huishoudelike sake van belang wat afgehandel is, is as volg:

(i) 'n Reproduksie Groep is gestig.

(ii) Deur die toedoen van laasgenoemde groep is 'n sertifikaat opgetrek vir voltooiing tydens die ondersoek van ramme vir vrugbaarheid. Die sertifikaat is op so 'n manier saamgestel dat dit ook as leidraad dien vir diegene wat die soort van werk onderneem.

(iii) 'n Komitee van die Raad ondersoek tans die toepassing van ons Gedragskode op veeartse in kommersieële lewe. Die aanbevelings van die komitee is nog nie voltooi nie.

(iv) Verteenwoordigers van u Raad het vanjaar vir die eerste keer opgetree as arbitreerders in 'n geval van twis tussen die werkgewers en 'n kollega. Die uitslag van die arbitrasie was bemoedigend, maar dit was veral van waarde om ons te leer wat die regte optrede in soortgelyke gevalle in die toekoms behoort te wees.

Dit is nou my plig om namens ons Raad 'n beroep op alle kollegas te doen. U sal merk dat ons deurgaans in ons pogings om verbeterings te verkry, daarop moet wys dat verbeterde diens aan die veenywerheid, die veeboer en openbare gesondheid, ons eise regverdig. Dit is ook 'n voldwonge feit dat die Staat die onkoste aan veeartsenydienste in die algemeen alleen kan regverdig in die belang van groot landsbelange. Die versorging van weeldedienste is nie die plig van die Staat nie.

Dit spreek dus vanself dat die dienste wat ons aan die veenywerheid en boere verskaf ons belangrikste funksie is, en sal bly. Om die rede is dit dan ook 'n noodsaaklike vereiste dat, waar ons dienste aan boere lewer, die dienste bevredigend moet wees en dat ons oor genoeg kennis beskik oor werk wat ons onderneem, om te verseker dat goeie werk gelewer word. Ongelukkig blyk dit dat in baie gevalle ons nie werk van dieselfde standaard lewer wanneer ons met plaasdiere te doene het as wat oor die algemeen aan troetel diere gelewer word nie. Daar is redes vir die skynbare verskil waarop ons nie hier hoef in te gaan nie.

Die gebrek aan kennis waaroor klagtes ontvang word word gewoonlik uitgelok i.v.m. werk wat eintlik van 'n gespesialiseerde aard is. Daar het, byvoorbeeld, 'n baie skerp en verkleinerende aanklagte in die Landbou Weekblad verskyn omtrent 'n sekere veearts wat, na beweer word, 'n vrugbaarheidssertifikaat vir ramme uitgereik het, na 'n eenvoudige inspeksie van die ramme, sonder enige ondersoek.

Baie klagtes van die aard, asook klagtes oor die ondersoek van kuddes word ontvang.

Sommige van die klagtes mag ongegrond wees, maar blykbaar is baie van hulle wel die waarheid. Dit doen ernstig afbreek aan ons Professie se goeie naam en dit is ons plig om die onaangenaamhede te verhoed. Dit is tog eenvoudig genoeg om te erken dat ons nie op hoogte is met enige nuwe of vreemde onderneming, en om dan die nodige kennis in te win, voor die werk onderneem word.

My beroep op al my kollegas is net, om eerlik te wees. Moet nie voorgee dat jy is wat jy nie is nie, en moet nie onverwyld enige werk aanpak as jy jouself nie daarvoor voorberei het nie. Terwille van ons almal se welsyn is dit van die aller grootste belang.

Hierdie beroep is geldig vir almal van ons waar ons ookal werksaam mag wees, of dit in die Staatsdiens, private praktyk, besigheids instansie, of openbare gesondheid mag wees. Onthou dat ons nog nie spesialisering erken nie en enigeen wat hom as sodanig voorgee mag in onguns raak tussen sy kollegas, indien hy nie in meer ernstige moeilikheid beland nie.

REPORT ON THE *FIFTH* ANNUAL GENERAL MEETING OF VETERINARY PUBLIC HEALTH GROUP HELD ON MONDAY, 25TH SEPTEMBER, 1961, AT THE KILLARNEY HOTEL, DURBAN

PRESENT

B. M. Horwitz, M. C. Lambrechts, A. J. Louw, M. J. N. Meeser, J. G. Thorburn, A. J. Snyders, F. E. Cavanagh, J. W. A. Brookes,, C. P. Anderson, J. T. R. Robinson, H. G. J. Coetzee, P. L. Uys, B. T. Paine, M. C. Robinson, P. S. Snyman, P. J. Meara, W. Wheeler (Chairman), L. W. van den Heever (Hon. Secretary).

THE CHAIRMAN welcomed visitors and members to the Group meeting. He stated that the Group had dealt with a variety of matters in the past year, and had once more served as a channel for the Association as such, to deal with those matters of concern to veterinary public health.

THE SECRETARY detailed briefly the matters referred to, i.e. the evidence to be submitted by the Association to the Commission of Inquiry into Abattoir Facilities, etc., and the *ad hoc* Committee to investigate the contamination of milk with antibiotics, insecticides, etc.

Regarding the former, one of the terms of reference was the question as to who should be responsible for the health inspection of meat. A lengthy memo had been prepared in which the need for veterinary control of meat inspection was emphasised; at the same time indicating the advantages of the direction of all abattoir processes by a veterinarian.

The questionnaire submitted by the Commission had also been completed, and verbal evidence would be offered in support of representations made. The Secretary agreed to forward copies of the memo, as yet confidential, to interested members for their information.

Regarding the *ad hoc* Committee which had been appointed by the Secretary for Agriculture and on which various sections of the Department of Agriculture, the Department of Health, the Dairy Industry Control Board, the S.A.V.M.A., the fresh milk industry, as well as the Agricultural Unions were represented, Dr. Meara was the S.A.V.M.A.'s representative. The committee had already started its work.

The Secretary gave details of the efforts being made to establish post graduate training in Veterinary Public Health. It was very likely that a D.V.P.H. course would soon be offered in conjunction with the D.P.H. course at present run by the Medical Faculty at Pretoria University. Ninety per cent of the course would be given concurrently, and on a part-time basis. It was hoped later to make arrangements with the other medical schools where D.P.H. courses were offered, to admit veterinarians to their courses so as to make it possible for colleagues living away from Pretoria to take such a post-graduate training. Possibly the possession of such a D.V.P.H. would become obligatory for veterinarians entering the Public Health field in the future.

The Secretary referred to the M.Med.Vet. degrees now being considered by Faculty. He hoped that colleagues would avail themselves of these opportunities.

The Secretary reported that Drs. Meara, Wheeler and himself had, on invitation, met Drs. Peacock and Bernstein from the Medical Association's M.O.H. (State Medicine) Group to discuss the shortage of Public Health Veterinarians and the lack of scope in this field for those interested in the work. The discussions had shown that legislation rarely required the services of a veterinarian in P.H. work, even though many local authorities appreciated the value of such services. It was agreed that efforts should be made to incorporate certain requirements in the legislation, in a manner similar to that pertaining to the employment of medical officers and sanitary or health inspectors. Specific duties or fields of activity should also be laid down. In addition, the need for post-graduate training for veterinarians in Public Health was stressed. The M.O.H. Group was proceeding with the matter and would advise this Group in due course of progress made and assistance required.

DR. SNYMAN spoke at length on the views held by organised agriculture, with which he was closely concerned, on the question of meat inspection and the direction and ownership of abattoirs. A discussion followed which showed that some of the views were not shared by members of the profession. The discussion was valuable in giving an insight into what might be ahead.

THE FUTURE OF THE GROUP

The Secretary felt that the time had come to consider whether the existence of the Group was justified in the light of the misgivings

expressed by some when the Group was formed in 1956–1957. It was fairly unanimous that the Group was serving a useful purpose and that it should continue. A discussion took place regarding the desirability of having at least two meetings per year. It was agreed that if specific problems or matters were to be discussed, a semi-annual meeting was likely to be well attended. It was also mentioned that attendance of such meetings by other persons concerned, e.g. M.O.H.'s, would enhance the value of our deliberations.

REPORT OF THE *FIRST* ANNUAL GENERAL MEETING OF THE ANIMAL REPRODUCTION GROUP, S.A.V.M.A., HELD AT THE KILLARNEY HOTEL DURBAN, ON 25TH SEPTEMBER, 1961

The first annual meeting of this Group was held at the Killarney Hotel, Durban on the afternoon of 25th September, 1961. There was a large attendance.

THE CHAIRMAN (Dr. S. W. J. van Rensburg) stated that the formation of the Group emanated from a resolution adopted at the last Annual General Meeting of the Association. He said that the Council of the S.A. Veterinary Medical Association had since approved of the objects of the Group, namely, to do all things necessary for the advancement of animal reproduction.

The meeting decided that the affairs of the Group be managed by a committee consisting of at least four members, three to be elected by the annual meeting of the Group and *one to be a member of Council of the Association and to be nominated by Council.* The elected members will hold office for three years, but for each of the three successive years following the original election, one will retire by drawing of lots, and shall be eligible for re-election. A chairman and secretary will be elected annually from the elected members at the annual meeting of the Group.

A membership subscription of R1.00 per annum was decided on. The following office bearers were elected:

Chairman	S. W. J. van Rensburg.
Hon. Secretary	I. S. McFarlane
Members of Committee	A. B. la Grange, and T. C. Wessels.

VETERINARY CERTIFICATES

THE CHAIRMAN informed the meeting of the certificates of health and fertility for rams which are now available to veterinarians. He stated that, mainly as a result of the prevalence of brucellosis in sheep, there was an increasing demand for veterinary certificates for rams from both breeders and buyers. One breed society actually demands such certificates in respect of all rams offered for sale. The Council of the Association had therefore approved of the form of a certificate for this purpose, and books of certificates are now obtainable from the Secretary of the Association.

A lengthy discussion followed on the issuing of veterinary certificates in general. Several members expressed concern over the many pitfalls involved, such as identification, substitution, and the possibility of animals contracting infection or other defects soon after certification. It was also alleged that certificates were sometimes issued without adequate tests or proper examination to substantiate the opinion expressed.

THE CHAIRMAN emphasized that any certificate for health or fertility can refer only to the findings on the day of examination, and that the veterinarian concerned cannot be held responsible for any unforseen misfortune that may befall the animal subsequently, provided he made a complete and thorough examination before granting the certificate. One of the main objects of the various certificates that had been drawn up and supplied by the Association, is to protect veterinarians against all snags, by indicating the various tests that should be applied. He therefore appealed to members to utilize the approved forms in order to obtain uniformity and ensure that the relative tests and examinations are applied before a certificate for health and fertility was issued.

MINUTES OF THE ANNUAL GENERAL MEETING, NATAL BRANCH OF THE S.A.V.M.A., HELD AT ALLERTON, ON 21ST JUNE, 1961

PRESENT

Drs. L. C. Blomefield (Chairman), G. Martinaglia, B. T. Paine, P. S. Snyman, A. R. Thiel, D. Coles, A. M. Diesel, J. Zwarenstein, G. P. Bishop, A. Tarr, S. G. Turner, G. K. Shaw, W. B. Hobbs, B. du Casse, A. Littlejohn, G. R. Retief, H. Holtz, C. J. Roos, I. Wolleschak, J. M. O'Grady, D. E. Osborn, D. J. le Roux, P. N. Collier, G. M. H. Shires, R. A. Solomon, J. L. Dore, C. Jonker, H. F. Strydom, J. M. Erasmus, A. J. Louw, J. G. Pienaar, P. Wacher and W. C. Viljoen.

Visitors

Drs. H. P. Steyn, R. du Toit, R. Elsdon Dew and W. McHardy.

THE CHAIRMAN welcomed the members and visitors and asked Dr. H. P. Steyn, President of the S.A.V.M.A. to open the meeting. In his address DR. STEYN referred to various aspects of Veterinary Research, education and what had been achieved by the profession in the past in controlling diseases such as East Coast Fever, Horsesickness etc., Dr. Steyn was thanked by Dr. Tarr for his address and for what he had done for the profession since he became President.

THE CHAIRMAN then gave his address in which he referred to the Annual Congress of the Association to be held in Durban, the shortage of Veterinarians particularly on the platteland, Veterinary salaries, etc.

Immediately after the above, office bearers for the next term of office were elected. The Chairman called for nominations as Chairman. DR. COLES suggested that in view of the Congress in Durban, he felt it was unwise to change horses in midstream and proposed that the whole

Committee be re-elected as constituted. This was accepted, and the Committee was therefore reconstituted as follows:

Chairman	Dr. L. C. Blomefield.
Vice Chairman ..	Dr. A. F. Tarr.
Secretary..	Dr. W. C. Viljoen.
Committee Members	Drs. A. R. Thiel, J. L. Dore, W. B. Hobbs, P. S. Snyman, and J. J. Zwarenstein.

General Business was then attended to as follows:

NEW MEMBERS: The following were proposed and accepted:

Drs. I. Wolleschak, J. G. Pienaar, D. E. Osborn, M. C. Robinson, G. R. Retief, P. P. Bosman, J. L. Pretorius, and S. D. Cilliers, Col. A. F. Harber was elected as an Hon. Life Member of this Branch.

RESIGNATIONS were accepted from Drs. R. Bothma, C. M. Breytenbach, E. B. Kluge, I. G. Horak and K. L. Malkin.

Apologies were received from Drs. L. Steele, G. Pfaff, J. A. Thorburn, W. G. Barnard, B. C. Jansen, R. Every, J. B. Quinlan, C. C. Wessels, R. Paine, K. Dalzell and M. C. Lambrechts.

DR. BISHOP read the minutes of the last Annual General Meeting which he compiled from memory as all his papers had been stolen when his car was broken into in Durban. DR. SNYMAN proposed and DR. TARR seconded that the minutes be adopted. This was agreed to.

Tea interval followed.

DR. R. ELSDON-DEW from the Amoebic Research Institute, Umbilo Durban delivered the first paper. He spoke on tapeworms particularly T. Solium and T. Saginata. *As it is hoped to publish the papers read at this Meeting in the S.A.V.M.A. Journal it is not proposed to give full detail here.* A very lively discussion followed in which several Members took part.

DR. S. G. TURNER next presented his paper on "*Equine Babesiosis*" which was very much enjoyed by members. Both the previous speakers and Dr. Turner were thanked by the Chairman. As Dr. Elsdon-Dew had other commitments he excused himself from the Meeting at this stage.

DR. H. P. STEYN then referred to the unfortunate incident that happened to a colleague in Natal and which, due to prompt action by Council and the fact that nobody applied for the post after an advert in the press, had been settled amicably.

The financial report was then presented and adopted. Lunch was served at Allerton.

Immediately after lunch DR. COLES gave a talk on "*Some diseases of Cage Birds*". In his talk he mentioned loss of voice by Canaries, Trichomoniasis in Pigeons, Toxoplasmosis etc., this talk was followed by a paper on Veterinary Education by DR. RENE DU TOIT. Both speakers were thanked by the Chairman.

A General discussion then followed in which Dr. Diesel suggested that all scientific papers read at this Meeting be forwarded for publication in the S.A.V.M.A. Journal. After discussion this was agreed to. Dr. Diesel also requested that the talk given by Dr. Coles be written up by him and forwarded for publication.

Dr. Tarr proposed that the usual Honorarium of R10 be paid to the secretary. This was agreed to.

At the suggestion of Dr. Dore, Dr. Diesel was requested to write to Mr. Beveridge of May & Baker explaining that due to his name being submitted late it was not possible to fit him into the program.

A general discussion on the Durban Congress followed and the Chairman requested all Members of this Branch to assist in making it the success all would like it to be.

CORRECTIONS

Vol. XXXII **2** (June 1961).

Sequence of authors names in Table of Contents to be corrected to that shown in the text on page 117.

Vol. XXXII **3** (September 1961).

The spelling of the name J. S. Harington should be corrected in the text on page 373 and in the Table of Contents.

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A SHORT REPORT ON THE EXHIBITS STAGED AT THE DURBAN CONGRESS

(Compiled by each firm separately)

GLAXO-ALLENBURYS (S.A.) (PTY.) LIMITED

A number of *new products* were featured, viz:

DAPSETYN: An intramammary presentation of chloramphenicol and dapsone, highly effective in resistant cases of bovine mastitis, especially those of staphylococcal origin.

BETNELAN: The most potent anti-inflammatory corticosteroid (betamethasone) yet available was developed by Glaxo Laboratories in England. Betnelan is approximately eight times more potent than prednisolone, has minimal side-effects, and has quickly found a place in small animal practice for the treatment of allergic skin conditions, shock, etc. It is the first entirely new corticoid to be introduced at prices considerably lower than other products of a like nature.

STREPTOPEN FOAMING PESSARIES: A mildly effervescent tablet each containing 0.5 gram streptomycin and 500,000 units procaine penicillin for broad-spectrum bactericidal effect. Particularly useful in preventing infection following parturition and to ensure easy removal of the afterbirth; for metritis and vaginitis.

OTHER PRODUCTS featured included *Fersamal Veterinary Granules* — an easy means of administering effective amounts of stable ferrous iron to correct anaemia following gallsickness, or redwater in cattle and biliary fever in horses; *I.C.D. Veterinary Granules* — iron, calcium and vitamin D for small animals; Canilin D and Canilin H — *the Glaxo vaccines* for prevention of distemper and hepatitis. A range of *Allenburys surgical instruments* was also shown.

WILD OF SOUTH AFRICA (PTY.) LTD.

For the 56th Veterinary Congress held in Durban during September, we had on show our now well-known Microscope models — *The M*20 *Research Model, the M*11 *(portable) model and the M*4 *and M*5 *Stereoscopic models.*

A new feature this year was the CROSS SLIDE STAGE available for the M11 microscope. This easily manipulated stage is particularly useful and appreciated in blood counts.

Another interesting addition to our range of scientific instruments which we were proud to show for the first time was the Spencer Microtome Knife Sharpener — a worthy stable companion for the universally acclaimed Spencer Microtome.

In addition, we were demonstrating for the first time the new Omag Pocket Microscope. This unique instrument, so reasonably priced, is proving highly successful for preliminary field examination where, because of its extreme portability and easy application, lends itself admirably to this type of work.

PROTEA PAN AFRICA PHARMACEUTICALS LIMITED

We were very pleased at the interest shown by members in our various products, in particular the great interest in our F.C.L. range of Corticoids, during the Congress. We distributed samples of our products, and are pleased to report that we made numerous friends, both socially and businesswise, as is attested by the orders subsequently received from far away places from Vets whom we are unfortunately not able to see regularly, but with whom we hope to renew friendship at the next Congress.

In conclusion we wish to thank all members for their interest and hope that at the next Congress the Trade Exhibit Tume will be extended.

I.C.I. SOUTH AFRICA (PHARMACEUTICALS) LIMITED

This firm staged, among others, the following exhibits:

"*Promintic*"—A new, safe treatment for parasitic gastro-enteritis in sheep and cattle. Administered by subcutaneous injection, is a major advance in the anthelmintic field. A single injection will ensure removal of practically all intestinal worms including their immature forms.

"*Fulcin*"—Ringworm.

"*Dictycide*"—Lungworm disease.

"*Dispolac*" *P. & P.S.*—Mastitis.

"*Sulphamezathine*"—Coloured blue—Available to the profession only in 2 litre bottles.

BURROUGHS WELLCOME & CO. (SOUTH AFRICA) LTD.

"NEOSPORIN"

"*Neosporin*" Antibiotic Ointment has recently been introduced for topical and ophthalmic use. This new preparation of three antibiotics, incorporated in a stable petroleum base for topical use, contains 5,000 units of "Aerosporin" brand Polymyxin B Sulphate, 400 units Zinc Bacitracin and 5 mg. Neomycin Sulphate in each gramme. This combination provides bactericidal action against virtually the whole range of bacteria likely to appear topically. Thus, it acts not only against primary pathogens, but as a guard against secondary invaders.

"*Neosporin*" Antibiotic Ointment is the true broad spectrum antibiotic ointment for use by the Veterinary Surgeon; it covers virtually all bacteria found in the ear, eye and skin. From experience, it has been found that, frequently when administering ointment to the eyes and ears of animals, much ointment of a large tube is wasted, so to facilitate use all tubes have been fitted with a special nozzle; in addition the ointment is obtainable in a 2 gm tube at the very low cost of 30 cents to the public.

"EPIVAX-PLUS"

"*Epivax-Plus*" is a freeze-dried vaccine prepared from a mixed suspension of a living egg-adapted strain of distemper virus and living contagious hepatitis virus adapted to grow in pig kidney tissue culture. Both viruses have been passaged until they have lost their virulence for the dog while retaining their ability to stimulate a high level of immunity against distemper, hard-pad disease and contagious hepatitis.

A single injection of "Epivax-Plus" stimulates lasting immunity against these diseases in susceptible dogs.

"Epivax-plus" is issued as freeze-dried material in a single-dose pack with diluting fluid.

HORMONES

"*Lutormone*"

"Lutormone" is a purified preparation of chorionic gonadotrophin. In the female, "Lutormone" initiates ovulation and the formation of corpora lutea, while in the male it is responsible for stimulating the interstitial tissue of the testes with consequent production of testosterone. Indicated in the treatment of infertility.

"*Protormone*"

"Protormone" is a solution of progesterone in ethyl oleate. Progesterone is responsible for the proliferative changes in the endometrium which are necessary for the implantation of the fertilised egg. It provides the conditions necessary for nidation and retention of the fertilised ovum.

Indicated for the maintenance of pregnancy in cases of mild luteal deficiency and for the treatment of cystic ovaries.

LIBAGRIC (PTY.) LTD.

The literary requirements of congress participants were well provided for by Libagric (Pty.) Ltd., who displayed a large variety of books on veterinary science and agriculture. This included the most recent publications in both fields, such as Veterinary Medicine (Blood and Henderson), Veterinary Applied Pharmacology and Therapeutics (Daykin), Regional and Applied Anatomy of Domestic Animals (Taylor), Animal Breeding Heresies (Fraser), and Soil, Grass and Cancer (Voisin). There was a good demand for all, and particularly for the new publications.

MERCK SHARP & DOHME INTERNATIONAL

Merck Sharp & Dohme re-entered the field of Veterinary Products in South Africa by displaying *Nicrazin* and *Amprol* for the treatment of coccidiosis in poultry. The action of *Amprol* is most interesting insofar as it causes a Thiamine deficiency in coccidia at thereapeutic levels without depriving the host of this vitamin.

A new broad spectrum and safe anthelmintic *Thibenëole R* brand of Thiabendazole was made available to the profession to be evaluated in field trials.

A. S. RUFFEL (PTY.) LIMITED

Full range of "*Rufus*" Veterinary Pharmaceuticals, Veterinary Instruments and Appliances.

Nitropen—for treatment of mastitis.

Inject-Tet—for treatment of Liver Fluke.

Socatyl—for treatment of coccidiosis.

Vecortenol—Prednisolone Trimethylacetate for anti-inflammatory and anti-toxic effect.

SMITH KLINE & FRENCH

The exhibit of SKF Laboratories (Pty.) Limited featured the nitrofuran products—"*Neftin*", "*Bifuran*", "*Furacin*" and "*Furadantin*".

"Neftin" (furazolidone) is a broad-spectrum antimicrobial, available as a feed supplement for the prevention or treatment of a wide range of poultry diseases, notably those caused by Salmonella bacteria. "Neftin" is also available in tablet form for the treatment of paratyphoid and bacterial scours in calves.

"Bifuran" (nitrofurazone plus furazolidone) is indicated for the prevention or treatment of enteritis in pigs and coccidiosis in poultry. It is presented as "Bifuran" Supplement for mixing in feed, or as "Bifuran" Soluble Tablets.

"Furacin" Soluble Ointment, which contains nitrofurazone in a polyethylene glycol base, is an antibacterial ointment for topical use. It has the advantage that, as a nitrofuran, it does not readily allow the development of bacterial resistance; it is soluble in wound exudates; and it remains effective in the presence of blood, pus and serum.

"Furadantin" is a nitrofuran specifically designed for the treatment of urinary tract infections. It is of particular value for the control of refractory infections that fail to respond to other forms of therapy. It is also indicated for the treatment of canine tracheo-bronchitis.

SOUTH AFRICAN CYANAMID (PTY.) LTD.

The theme of this exhibit was a three-way control programme against Mastitis in Dairy Cows, for Veterinarians. Three products, sold only to Veterinarians were featured:—

Staphylococcus Aureus Toxoid, Slanetë Strain No. 7

A whole broth chemically killed culture of Staphylococcus Aureus, Slanetz Strain No. 7, containing toxoids derived from the Alpha, Beta and Delta toxins produced by these cultures and aluminium hydroxide adjuvant. This product has proved successful as an economical aid in the prevention of Staphylococcal mastitis. Available in 50 dose (5 c.c.) multi-dose vials for intramuscular injection.

Targot Mastitis Ointment

A free flowing ointment containing Aureomycin, Neomycin and Dihydrostreptomycin.

Variëyme Streptotsinase—Human Plasminogen

Streptodornase, an enzyme combination specially designed to ensure liquification of viscous exudates, fibrin and clotted blood in inflammatory processes in all species of animals. Available in 12,500 unit and 125,000 unit vials.

WINTHROP LABORATORIES (S.A.) (PTY.) LTD.

The Winthrop exhibit featured *pHisohex*, an antibacterial detergent containing 3% Hexachlorophene, which is outstanding as a pre-operative scrub and for cleansing the operative site. Regular washing with pHisohex deposits a residual film on the hands with prolonged anti bacterial activity. "pHisohex" is also of value in eczematous and pruritic conditions, and has been described as "*closest to the ideal skin antiseptic.*"

Other products on display were "*Zephiran,*" a cationic detergent disinfectant, "*Levophed*" for emergency treatment of shock, particularly operatively and post-operatively, and "*Novalgin.*" "Novalgin" is the most effective non-narcotic analgesic available, and has wide indications in the relief of pain, especially in arthritic conditions. It is available both in tablet and in injectable form.

CHAS. F. THACKRAY (S.A.) (PTY.) LTD.

On display were a range of Thackray's Surgical Instruments; "*Chance*" All Glass and *Atlas Nylon Syringes*—Record fitting; *Davis & Geck Luer Lok Syringes: "Silver Stal"* Swedish Stainless Steel Ware; *Hoptix* Pocket Rechargeable Torches with attachments for Diagnostic Instruments; Intrument Sterilizers; Centrifuges and occupying a place of prominence *Davis & Geck Sterile Sutures in the new Plastic Strip Pack.*

All the above products are held in stock by the above firm at their offices in Johannesburg, Cape Town and Durban.

MAYBAKER (S.A.) (PTY.) LTD.

The Veterinary products displayed by Maybaker (S.A.) (Pty.) Ltd. at the S.A.V.M.A. Congress Durban Trades Exhibition were all restricted to use by Veterinarians only. The following three products were the subject of major featuring:—

"*Flaxedil*"—A medium-acting muscle relaxant available now in a special veterinarian packing. "Flaxedil" which is the M. & B. brand of gallamine triethiodide, is presented as a 4% solution in boxes of 10 x 1 ml. ampoules. It is indicated in small animal anaesthesia for:

(*a*) *Dogs*—intra-abdominal and intra-thoracic surgery, endoscopies and reduction of dislocations;

(*b*) *Cats*—as for dogs and in addition to provide suitable conditions for atraumatic intubation;

(*c*) *Pigs*—for intubation.

"Flaxedil" should only be used when facilities for securing an effective airway and providing controlled respiration with adequate oxygenation are available.

Large animal presentations for use in the immobilisation of game will shortly be made available.

"*Strinacin*"—A well tried and proven agent for the treatment of bacterial enteritis in all species of farm and domestic animals. A unique formulation of triple Sulphonamides and Streptomycin provides the benefits of a 24 hour dosage regime with both systemic and local gut action. "Strinacin" is presented both as granules and tablets of 5 gramme strength to meet whichever mode of therapy is preferred by the veterinarian. The cost per treatment is modest whilst the ratio of successful treatment is spectacular.

"*Vallergan*"—the phenothiazine derivative, trimeprazine tartrate, which provides both a central nervous action together with a very powerful anti-histamine effect. Presentations of "Vallergan" are now available for both large and small animals and its properties allow for the selective use of both "Largactil" and "Vallergan", according to the patient and its condition. "Vallergan" has proved to be more predictable in effect in large animals where its potent anti-histamine property is of considerable value.

"Vallergan' is available in sugar coated tablets of 10 mg and 25 mg strength, in 10 x 1 ml. and 10 x 5 ml. ampoules of a 1% solution and 10 x 5 ml. ampoules of a 5% solution.

MILBORROW & CO. (PTY.) LTD.

Milborrow and Company (Pty.) Limited exhibited their usual range of specialised instruments, there being few technical developments during the last year. A notable exception was an improved all metal valve system which has been added to the wellknown "*Ultramatic*" syringe. Notable also was the natural emergence of new plastic products including the

"*Bay*" lambing instrument which costs only R2.20 and *Rototags*, a new simple and revolutionary system of marking sheep and cattle. There was also a renewed interest among veterinarians for accurate convenient dosing equipment to handle the many new anthelmintics which were discussed at the Congress.

PFIZER LABORATORIES LIMITED

The following is a short description of our exhibit at the recent Veterinary Congress.

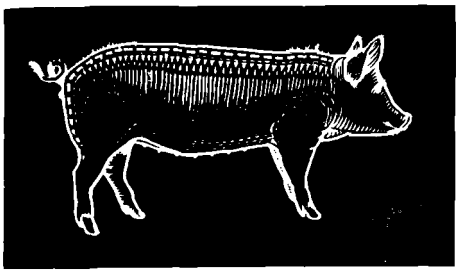
The main feature of the stand this year was the *Injecto-meter* whereby 5 cc. of expired *Terramycin Injectable Solution* was drawn up in a syringe, the attached needle was then pushed through a "cow's skin", and the "marksmen" then endeavoured to shoot as much Injectable Solution as possible into a graduated test-tube, placed some 30 in. away. A contest was run with a prize of R20.00 worth of Terramycin products which was won by Dr. G. Retief of Mooi River with an amount of $2\frac{1}{2}$ cc. Other features included the new oral Vitamin A for Dosing backed up by the complete range of Pfizer's proven products.

AFRICAN OXYGEN LIMITED

Messrs African Oxygen exhibited the closed-circuit anaesthetic equipment which had been devised and accommodated for use in animals by themselves and Messrs Imperial Chemical Industries Ltd., working in collaboration with two Johannesburg veterinarians. The apparatus comprises a Rotameter into which oxygen from the cylinder is led. Here the flow is measured and then passes through a vapouriser (or a series of vapourisers) containing a volatile anaesthetic like Fluothane, and the mixture then enters a breathing bag from which it travels through a rubber hose, equipped with a one-way breathing valve to a Magill endotracheal tube into the animal's trachea.

As the animal exhales, the expired air returns through the endotracheal tube and the portion of the rubber hose beyond the one-way valve, to a carbondioxide absorber. The purified anaesthetic mixture supplemented by inflow from the rotameter and vapouriser, is re-cycled.

The two Johannesburg veterinarians have built into the rebreathing system a radio amplifier to amplify the sound of the one-way valve. Any irregularity in breathing is therefore immediately audible.



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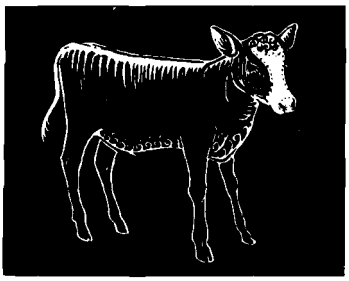

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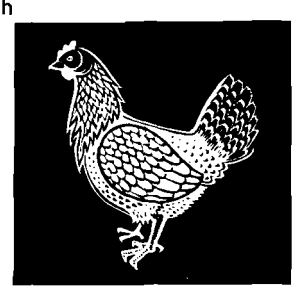

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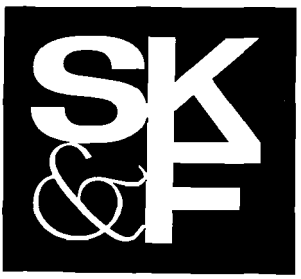

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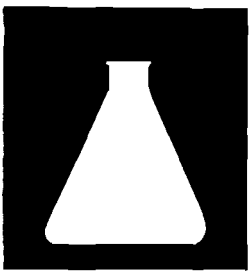

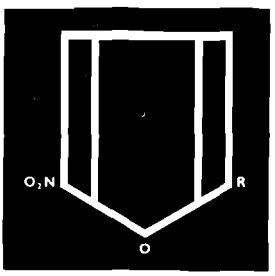

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COMPARISON OF EFFICACY OF DIFFERENT TETRACYCLINE ANTIBIOTICS AND DIFFERENT FORMULATIONS OF THESE ANTIBIOTICS IN THE TREATMENT OF HEARTWATER

II COMPARISON OF FOUR LIQUID TETRACYCLINE FORMULATIONS IN THE TREATMENT OF HEARTWATER IN SHEEP

(Received for Publication September, 1961)

J. D. H. Poole P.O. Box 7552 Johannesburg.

Summary

Two hundred and thirty-eight highly susceptible Merino sheep were infected with heartwater blood, and one hundred and seventy-five of the subsequent reactors were divided into five equal groups. The different groups were treated as explained below and the different treatments were placed in the following order of efficacy according to the average number of treatments required in each group to bring body temperature back to normal.

(1) Chlortetracycline Hydrochloride Suspension in Oil: 2 mgms per pound body-weight intramuscularly. Average number of treatments required per sheep was 1.94.

(2) Pyrrolidionomethyltetracycline Suspension in Oil: 2 mgms per pound body-weight intramuscularly. Average number of treatments required per sheep was 2.114.

(3) Oxytetracycline Solution: 2.5 mgms per pound body-weight intravenously.
Average number of treatments required per sheep was 2.41.

(4) Oxytetryclacine Solution: 2 mgms per pound body-weight intramuscularly.
Average number of treatments required per sheep was 2.43.

(5) Oxytetracycline Suspension in Oil: 2 mgms per pound body-weight intramuscularly.
Average number of treatments required per sheep was 2.575.

Experimental Method

Two hundred and thirty-eight mature Merino hamels were infected with heartwater blood obtained from a supply at the State Laboratory of the Division of Veterinary Services in Grahamstown. The strain used was the Ball-3 strain.

This group of sheep was newly introduced from a heartwater-free area. One hundred and seventy five of the reactors in this group of sheep were used for the purposes of this experiment.

Temperatures; Rectal temperatures were taken and recorded on the 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th and 16th days after infection. The minimum rectal temperatures at which treatment was carried out were as follows:—

Warm sunny days	8 a.m. to 10 a.m.....	104°F.
	10 a.m. to 11 a.m.....	104.5°F.
Cold and/or overcast days.....		104°F.

These minimum temperatures were the same as were used in a previous experiment of this nature.[1]

Experimental Groups:

Group I—Chlortetracycline Hydrochloride Injectable Suspension in Oil at a dosage of 2 mgms per pound body weight, administered intramuscularly.

Group II—Pyrrolidinomethyltetracycline Suspension in Oil at a dosage of 2 mgms per pound body weight administered intramuscularly.

Group III—Oxytetracycline Injectable Solution at a dosage of 2.5 mgms per body weight administered intravenously.

Group IV—Oxytetracycline Injectable Solution at a dosage of 2 mgms per pound body weight administered intramuscularly.

Group V—Oxytetracycline Injectable Suspension in Oil at a dosage of 2 mgms per pound body weight administered intramuscularly.

Allotment of Sheep to Experimental Groups; Only those sheep which had temperatures over the minima mentioned above were allocated to experimental groups each day. Coloured plastic eartags with numbers were used for identification purposes.

As the sheep reacted, they were allotted to each of the groups in turn so that each group had equal numbers of reactors allotted to it on each day.

By the twelfth day after infection each of the five groups had its full complement of 35 sheep.

Treatment and Dosage; In all groups except Group III treatment was given intramuscularly because formulations with oil vehicles cannot be used intravenously. In all groups receiving intramuscular treatment the dosage used was approximately 2 mgms. per pound body weight.

In Group III Oxytetracycline Injectable Solution was used intravenously at a dosage of approximately 2.5 mgms. per pound body weight. This higher dosage was used for the intravenous group because 2.5 mgms per pound has been found to be the optimum dosage for tetracyclines administered by this route.[2, 3].

Repeat injections were given only if the temperatures remained above the minimum for 48 hours or if they again rose above the minimum after more than 48 hours. At no time were injections given less than 48 hours apart. (In a previous experiment injections were repeated after 24 hours but it was observed that temperatures may take longer than a day to return to normal after one effective treatment.[1])

Results and Discussion

Clinical Efficacy:

The number of treatments, at the dosage levels mentioned above, required to reduce the temperature below the prescribed minima was the criterion used to judge efficacy.

Table I lists the different treatments in order of efficacy and gives the total number of treatments required by each group and the average number of treatments required per sheep.

Table I

Group	*Treatments (In order of efficacy)*	*Number of Sheep in Group*	*Total** Treatments Required*	*Average Number of Treatments Per Sheep*
1.	Chlortetracycline Hydrochloride Suspension in oil 2 mgm/lb I.M.	35.	68.	1.94
2.	Pyrrolidinomethyl-Tetracycline Suspension in Oil 2 mgms/lb. I.M.	35.	74.	2.114
3.	Oxytetracycline Solution 2.5 mgms/lb. I.V.	35.	84.	2.41
4.	Oxytetracycline solution 2 mgm./lb. I.M.	35.	85.	2.43
5.	Oxytetracycline Suspension in Oil 2 mgm./lb. I.M.	35.	90.	2.575

Minimum significant differences between treatment totals:—

At 1% level..... 12.93

At 5% level..... 9.84

In a previous experiment the results indicated that one injection of Chlortetracycline Injectable Suspension in Oil at 2 mgm. per pound body weight is usually sufficient.[1] However, it can be seen from Table II that under conditions where more highly susceptible sheep and/or more virulent infection is encountered, one injection at this dosage would not suffice.

Table II

Per cent of Sheep Requiring 1, 2, 3, and 4 Treatments Respectively

Group	Treatment	Number of Treatments 1 %	2 %	3 %	4 %
1.	Chlortetracycline Injectable Suspension in Oil 2 mgm/lb. I.M.	17.1	71.4	11.4	0
2.	Pyrrolidinomethyltetracycline Suspension in Oil 2 mgm/lb. I.M.	6	77	17	0
3.	Oxytetracycline Solution. 2.5 mgm/lb. I.V.	0	60	40	0
4.	Oxytetracycline Solution. 2 mgm/lb. I.M.	6	45.7	48.6	0
5.	Oxytetracycline Suspension in Oil. 2 mgm/lb. I.M.	8.57	34.3	48.6	8.57

Ease of Application:

All the preparations were found to be extremely easy to use, although the Oxytetracycline Suspension in Oil is less free-flowing than the other preparations and this presents a little difficulty particularly in cold weather. Intravenous administration to sheep in Group III was more time-consuming and cumbersome.

Pain and Irritation at Site of Injection:

The three oil suspensions were very well tolerated by intramuscular injection; no pain and very little swelling was observed. The Oxytetracycline Solution is, however, very irritating and most animals receiving this preparation intramuscularly showed signs of pain and a large percentage exhibited lameness of 2 or 3 days duration.

Cost of Treatment:

The cost per dose of each preparation as well as the average cost per sheep in this experiment is given in Table III. The figures are based on current prices in South Africa.

TABLE III

Drug	*Cost per Dose*	*Approximate Average Cost per Sheep in this Experiment*
Chlortetracycline Injectable Suspension.....	33.3 cents	64.6 cents
Pyrrolicinomethyltetracycline Suspension.....	44 cents	93 cents
Oxytetracycline Solution. 2.5 mgm/lb.	43.5 cents	105 cents
2 mgm/lb.	34.8 cents	84.5 cents
Oxytetracycline Suspension in Oil.....	—	—

Conclusions:

In this report and in the previous one[1] there is ample evidence of the superiority of chlortetracycline over other tetracyclines in the treatment of heartwater in sheep.

The fact that the causative organism of heartwater bears some relationship to the psittacosis-lymphogranuloma group[4] indicated that chlortetracycline may be more effective because it has shown superior activity against other organisms of this group.[5]

The importance of the effect of formulation on the clinical efficacy of tetracyclines cannot be overlooked. The difference between Chlortetracycline Injectable Suspension in Oil and the Chlortetracycline Soluble Powder formulations in the first experiment illustrates this point[1]. For this reason all available formulations of the different tetracyclines were used in these tests.

It is interesting to note that there was no difference in efficacy between the intravenous and intramuscular administration of Oxytetracycline Solution in spite of the higher dosage used in the intravenous group.

NOTE.—For brevity of reporting the actual temperature charts of individual sheep in the above experiment are not included in this report. However, they will be made available to interested readers upon request to the writer.

ACKNOWLEDGEMENTS

The writer wishes to thank the following gentlemen for their co-operation:—
Dr. L. W. Rossiter, Senior State Veterinarian, Grahamstown.
Mr. O'Neil and Mr. Kramer of the State Veterinary Office, Grahamstown.
Mr. A. Nel, the owner of the sheep.
Mr. van Eck, the farm manager.
Mr. R. Prew, who assisted with the experiment.
Mr. A. W. P. Coleby, who carried out the statistical analysis.

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J. S. Afr. vet. med. Ass. XXXII (4), 1961

VOLKMANN'S CONTRACTURE IN THE DOG: TWO CASE REPORTS

C. F. B. Hofmeyr, — Department of Surgery, Faculty of Veterinary Science of the University of Pretoria, P.O. Onderstepoort

INTRODUCTION

Three cases of Volkmann's contracture, due to interception of the arterial blood flow and resultant necrosis, fibrosis and shortening of muscles of a limb have been described by the author in the dog apparently for the first time.[3] In that publication the condition in man was briefly reviewed.

The following two recent cases are described to re-emphasize the fact that at least some of the manifestations are not uncommon in dogs.

Case 1

A mongrel of about eight months old, presented an ununited fracture of the femur that had occurred a few weeks before. Open reduction had to be performed to liberate the fracture-ends from fibrous tissue. Shortening of the leg had taken place and, in order to avoid stretching the blood vessels (a cause of arteriospasm), the femur was shortened to allow pinning without tension. A light cast was applied to prevent rotation of the leg. After a few days, when it was clear that there was no post-operative complication or pressure from the cast, the patient was discharged, and the owner cautioned not to allow any exercise. It was brought back after about 14 days in a very bad state of neglect. The plaster cast had apparently moved and caused a deep line of pressure necrosis high up inside the thigh. This must have happened at least seven days previously.

The case was rehospitalized and treated, but the contractility of the muscles below the wound was almost completely lost. The wound healed eventually and the pin was removed. Alignment of the femur was almost perfect, but the limb was in a state of semi-flexion with no possible movement whatever, except in the hip. The thigh muscles felt hard and dead. Euthanasia was then carried out. It is suggested that in this case the edge of the plaster cast had pressed upon the femoral artery for a sufficient period of time to cause muscular necrosis, fibrosis and contraction.

Case 2

This was an Alsatian (see fig. 1), with both humeri badly traumatized. He had been attended to elsewhere; a communited fracture, involving the lower half of the right humerus, had been wired. He developed sinuses in both the arms and was referred to the Faculty Hospital for further

treatment. Both limbs were operated upon in order to explore and curette the sinus passages. A bone sequestrum was removed from the left humerus. As shown in the photograph, there was marked thinning of the left forearm. This atrophy was relatively more pronounced than that of the muscles of the arm, so that disuse could not have been solely responsible. In addition, the flexors and extensors of the metacarpus were found to be hard and of limited contractility. As can be seen from the photograph, the patient could not fully extend the carpus. It was felt that surgical intervention, to make normal carpal extension possible, would not be justified. Hence no special therapy was directed at the comparatively mild contracture.

FIG. 1

DISCUSSION

All three previous cases had been associated with fractures, as in the present series. In case No. 1 of this series, however, pressure from the edge of a plaster cast was held responsible. In man a light plaster cast is not regarded as a common cause of Volkmann's contracture, but the tourniquet has been implicated, unless it was very broad like a pneumatic cuff.[2, 3]

This condition has important surgical as well as medico-legal aspects, also for the veterinarian, and merits inclusion in comprehensive works on veterinary orthopaedics.

SUMMARY

1. Ischaemic contracture—the causes and manifestations, are discussed in man and in the dog in the light of published work.

2. Further cases are reported in the dog.

ACKNOWLEDGMENT

The author is indebted to the Director of Veterinary Services for permission to publish this paper and to the Section of Pathology for the photo.

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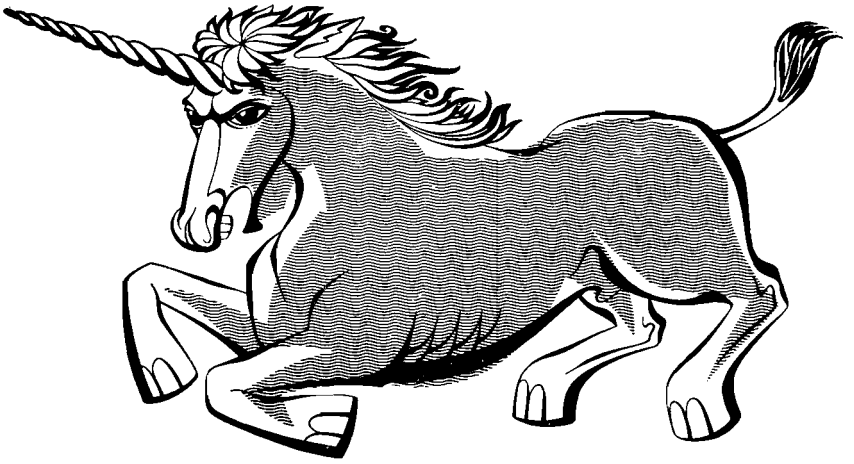

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is a monster with a horrible howl, with a horse-like body, with feet like an elephant, and with a tail like a stag's. A horn sticks out from the middle of its forehead with astonishing splendour to a distance of four feet, so sharp that whatever it charges is easily perforated by it. Not a single one has ever come alive into the hands of man, and, although it is possible to kill them, it is not possible to capture them"

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MEDALJES, PRYSE EN BEURSE UITGELOOF EN LENINGS BESKIKBAAR GESTEL AAN VOOR- EN NAGRAADSE STUDENTE IN DIE VEEARTSENYKUNDE

H. P. A. de Boom Departement Anatomie, Ondestepoort. Voorheen Sekretaris van die Fakulteit Veeartsenykunde, en A. M. Diesel, Sekretaris, S.A.V.M.V., Strubenstraat 279, Pretoria.

Net soos in ander vertakkings van die hoëre onderwys het die toenemende aanvraag vir opgeleide mannekrag en die stygende koste van onderwys gelei tot die daarstelling van aansporings en belonings vir studente aan die Fakulteit Veeartsenykunde van die Universiteit Pretoria. 'n Oorsig oor medaljes, pryse, beurse en lenings, aan voor- en nagraadse veeartsenystudente beskikbaar gestel, sal die beroep, asook liggame en individue met 'n sin vir algemene welsyn, in die geleentheid stel om die huidige toestand na waarde te bepaal en vas te stel waar tekortkominge, indien enige, bestaan. Dit sal ook enersyds die welwillendheid jeens die veeartsberoep hier te lande beklemtoon en andersyds die nodige openbare erkentlikheid van die beroep vir daardie welwillendheid toon. Tenslotte sal dit as inligtingsbron dien vir voornemende studente in die veeartsenykunde wie se geldelike bronne beperk is.

A. MEDALJES, PRYSE EN BEURSPRYSE

1. *Die Sir Arnold Theiler-medalje.* Die Suid-Afrikaanse Biologiese Vereniging, in 1908 gestig as die „Transvaalse Filosofiese Vereniging," het hierdie medalje ingestel ter ere van die nagedagtenis aan Arnold Theiler, een van sy stigterslede en eerste president. Die medalje word

jaarliks vir „Vlyt en Verdienstelikheid" aan die voortreflikste student toegeken, wat gradueer in dié fakulteit waarvan Sir Arnold die eerste

dekaan was. Persoonlikheid en karakter word in ag geneem by die toekenning, wat deur die Biologiese Vereniging op aanbeveling van die Fakulteit Veeartsenykunde gemaak word. Hierdie pragtig ge-engraveerde medalje van egte silwer is die hoogste toekenning waartoe 'n veeartsenykundige student in Suid-Afrika kan strewe en die gepastste huldeblyk aan 'n groot figuur.

Medalje-houers;

Sir Arnold Theiler-medalje

1938:	P. R. Mansvelt.	1951:	P. L. Louw.
1941:	F. J. Veldman.	1952:	J. Bosch.
1943:	K. E. Weiss.	1953:	H. F. Strydom.
	B. C. Jansen.	1954:	M. M. Smuts (mej.)
1944:	L. W. van den Heever.	1955:	A. H. Pettigrew.
1945:	H. N. Botha.	1956:	G. M. H. Shires.
1946:	B. H. Pappin.	1957:	S. J. van Rensburg.
1948:	H. J. J. Terblanche.	1958:	W. L. Jenkins.
1949:	R. Every.	1959:	H. G. Purchase.
1950:	H. O. Flanagan.	1960:	H. E. Scholtz.

2. *Die Kliniese Medalje.* Op aanbeveling van prof. C. F. B. Hofmeyr, destyds 'n private praktisyn, lid van die Witwatersrandse tak van die Suid-Afrikaanse Veterinêr-Mediese Vereniging, het hierdie tak 'n silwer medalje beskikbaar gestel vir jaarlikse toekenning aan die graduandus

wat die beste presteer het in die kliniese vakke (Chirurgie, Geslagskunde, Geneeskunde en Infeksiesiektes). Aanbevelings word deur die Fakulteit gemaak en toekenning geskied deur die voorsitter van die Witwatersrandtak. Op hierdie wyse het dié liggaam bygedra tot die aanwakker van belangstelling in die kliniese vakke en in private praktyk.

Medaljehouers:

Die Kliniese Medalje:

1945:	H. N. Botha.	1953:	P. J. Schutte.
1946:	B. H. Pappin.	1954:	P. A. Basson.
1947:	A. K. Doré.	1955:	J. van Niekerk.
1948:	J. M. W. le Roux.	1956:	C. H. B. Marlow.
1949:	K. Every.	1957:	S. J. van Rensburg.
1950:	H. O. Flanagan.	1958:	M. A. J. Azzie.
1951:	J. M. M. Brown.	1959:	I. F. H. Purchase.
1952:	P. J. Meyer.	1960:	H. E. Scholtz.

3. *Die Farmer's Weekly-medalje.* Die Farmer's Weekly het reeds geruime tyd medaljes toegeken aan voortreflike stoettelers, daarna aan studente aan die landboukolleges.

Die oorlogs- en na-oorlogse jare het treffende bewys gelewer van die afhanklikheid van die boer van die wetenskaplik opgeleide deskundige, en dit het die redakteur, mnr. Ian I. Barr, laat oorweeg hoe die Farmer's Weekly universiteitstudente kan aanmoedig om hul beste te lewer en hoe hulle vir voortreflike werk eer te betoon. Die diens aan Suid-Afrika gelewer deur Onderstepoort en die Fakulteit, tenspyte van ernstige moeilikhede, het mnr. Barr laat besluit om 'n medalje aan die Fakulteit te skenk

vir jaarlikse toekenning. Dit is met dank aanvaar en daar is besluit dat die medalje toegeken sal word aan die vierdejaarstudent wat die beste gepresteer het in die vakke wat in die departement Soötegnologie gedoseer word: Soötegniek, Diereversorging, Voedingsleer en Weiveldbeheer.

Medalje-houers:

1959:	H. E. Scholtz.	1960:	A. G. Lademann.

4. *Die I.C.I.-pryse vir Geneeskunde en Chirurgie.* Die navorsing wat onderneem is en die middels wat gevolglik ontwikkel is in die belange en ter bevordering van veeartsenykunde deur die firma „Imperial Chemical Industries Limited" het noodsaaklikerwys tot noue samewerking gelei tussen Onderstepoort en die Fakulteit enersyds en die firma se filiaal (I.C.I. South Africa (Pharmaceuticals) Limited) andersyds. Die voorstel om pryse aan veeartsenystudente uit te loof is deur laasgenoemde by die moederfirma aan die hand gedoen en entoesiasties deur die destysde hoof van die Veeartsenydepartement, mnr. D. D. Ogilvie, M.R.C.V.S., aanvaar.

Twee pryse van R21 elk word jaarliks op aanbeveling van die Fakulteit aan graduandi toegeken wat die beste gepresteer het in Geneeskunde en Infeksiesiektes, en in Chirurgie en Geslagskunde.

Die I.C.I.-pryse vir Geneeskunde en Chirurgie:

Pryswenners:

Chirurgie en Geslagskunde	*Medisyne en Infeksiesiektes*
1951: J. F. W. Grosskopf.	1951: W. A. J. du Plessis.
1952: P. B. Winterbach.	1952: P. G. Howell.
1953: P. D. de Wet.	1953: R. D. Bigalke.
1954: T. W. Naude.	1954: C. L. Craig.
1955: P. B. Botha.	1955: J. T. R. Robinson.
1956: W. P. R. Eschenburg.	1956: P. V. A. Davies.
1957: S. J. van Rensburg.	1957: A. N. Day.
1958: Mej. I. Wolleschak.	1958: L. W. L. Jenkins.
1959: H. G. Purchase.	1959: B. de B. Baker.
1960: P. C. Belonje.	1960: N. C. Owen.

5. *Die Maybakerprys (Klinies).* In ooreenstemming met die gebruik van kollega's in die Verenigde Koninkryk om pryse aan suksesvolle studente in verskeie beroepe te skenk, het die firma Maybaker S.A. (Edms) Beperk besluit om 'n prys aan studente aan die Fakulteit Veeartsenykunde te bied as teken van waardering en as welwillendsgebaar ter erkenning van die noue en vriendskaplike betrekkings wat tussen hierdie firma en o.a. die veeartsenykundige beroep bestaan het.

Die prys, 'n pragtige instrumentetas, word jaarliks aan die graduandus toegeken wat, na die mening van die Fakulteit, die beste verbetering in die kliniese vakke as gevolg van deursettingsvermoë en toewyding getoon het, ook as gevolg van eienskappe van „karakter" wat hoogs waarskynlik sy sukses as veearts sal verseker.

Die Maybakerprys (Klinies):

Pryswenners:

1955: T. Robson.	1958: L. F. Naudé.
1956: G. E. Thompson.	1959: I. F. du Toit.
1957: I. G. Horak.	1960: P. A. Boyazoglu.

6. *Die Pfizer-prys.* Die firma Pfizer Laboratories South Africa (Proprietary) Limited (Veeartseny- en Landboukundige Afdeling) skenk jaarliks bogenoemde prys, 'n leer medisynetas met gegraveerde silwerplaat en 'n aantal Veeartsenykundige Doseervorms (Pfizer), as blyk van waardering van die goeie persoonlike en wetenskaplike betrekkings met die Fakulteit. Dit geskied op Fakulteitsaanbeveling aan die graduandus wat, na mening van die kliniese dosente, die beste aanleg en praktiese bedrewenheid in die kliniese vakke aan die dag lê, maar wat nie in staat was om in die teoretiese aspekte die hoogste puntetelling te behaal nie.

Die Pfizer-prys:

Pryswenners:

1956: A. J. J. Maree.
1957: H. J. Venter.
1958: C. T. McDonald.
1959: P. P. Bosman.
1960: L. J. Kritzinger.

7. *Die Agricura-prys vir Patologie.* Om deeglike studie aan te moedig deur 'n mate van meedinging onder die bekwaamste studente te prikkel in 'n vak wat, van alle finalejaarsvakke, seker die wydste veld dek en die meeste basiese betekenis het, is bogenoemde prys deur die firma Agricura-Laboratoria Beperk ingestel.

Die prys van R50 word jaarliks slegs op meriete volgens aanbeveling van die dosente van die departement Patologie toegeken aan die graduandus wat die beste in die vak (oor die laaste drie jaar) gepresteer het, met klem op die akademiese prestasie van die laaste studiejaar.

Die Agricura-prys vir Patologie:

pryswenners:

1957: J. C. Pienaar.
1958: H. G. J. Coetzee.
1959: H. G. Purchase.
1960: B. J. Erasmus.

8. *Die A. S. Ruffel-prys.* Die direkteure van die firma A. S. Ruffel (Pty.) Limited het 'n jaarlikse toekenning aan die Fakulteit gebied as blyk van waardering vir die gewillige en waardevolle medewerking wat hulle van die kant van die Afdeling Veeartsenydiens sinds oprigting van die firma ervaar het.

Die prys van R40 word jaarliks uitgeloof vir die beste vierdejaarstudent in die vakke Farmakologie en Toksikologie. Behoeftigheid word in ag geneem slegs ingeval daar 'n student is wat reeds etlike ander pryse verorwer het.

Pryswenner:

1960: J. J. Marnewick.

9. *Die Optical Instruments-beursprys.* Die firma Optical Instruments (Pty.) Ltd. as Zeiss-agente, het besluit om soos elders ter wêreld verdienstelike gevalle van jong veeartsenystudente aan te moedig deur middel van

beurspryse. Twee pryse van R50 elk word jaarliks op aanbeveling van die Fakulteit beskikbaar gestel aan die beste student in die tweede en in die derde studiejaar. Een prys is aanvanklik in 1959 deur die firma self toegeken (aan C. W. du Buy).

Beurspryshouers:

Tweede jaar		*Derde jaar*	
1959:	H. B. Lambrechts.	1959:	A. C. Lademann.
1960:	E. Young.	1960:	Mej. G. H. Gerdes.

B. VOORGRAADSE BEURSE OP BEPAALDE MERIETE TOEGEKEN

Die volgende beurse word op bepaalde meriete toegeken:—

1. *Die Duncan Hutcheon-beurs (Scholarship).* Ter nagedagtenis van Duncan Hutcheon, alombekende en beminde veearts in diens van die eertydse Kaapkolonie en kragtige pioniersfiguur in die veeartsenykundige geskiedenis van Suid-Afrika, het die „Central Farmers' Association" en die „Western Province Agricultural Society" in 1908 'n fonds ingesamel. Volgens instruksies van dr. P. J. du Toit, destyds Direkteur van Veeartsenydiens, is die rente op die fonds deur die trustees, „The South African Association for the Administration and Settlement of Estates," aan mev. Hutcheon uitbetaal tot datum van haar oorlye, t.w. 26 Julie 1935. Daarna is die inkomste bestee aan bogenoemde beurs, wat vir een jaar slegs aan finalejaarstudente aan die Fakulteit Veeartsenykunde toegeken word. Die Fakulteit keur 'n aantal kandidate—geen aansoek word deur hulle gedoen nie—op grond van prestasie (50%), afkomstigheid van die Kaap (25%) en behoeftigheid (25%) lê die name aan die Landbou-unie van Kaapland voor en die Uitvoerende Komitee kies finaal die beurshouer.

Die Duncan Hutcheon-beurs (Scholarship);

Beurshouers:

1937:	E. B. Kluge.	1948:	Mej. A. M. McLoughlin.
	J. L. Doré.	1949:	C. J. Muller.
1938:	J. L. Muller.	1950:	H. O. Flanagan.
1939:	A. A. L. Albertyn.	1951:	P. J. Posthumus.
1940:	G. P. Bishop.	1952:	P. H. le Roux.
1941:	S. L. Snyders.	1953:	A. J. Snyders.
1942:	R. J. Heydenrych.	1954:	Mej. M. Smuts.
	C. M. T. Meldal-Johnsen.	1955:	D. F. Wege.
1943:	D. J. Louw.	1956:	G. M. H. Shires.
1944:	B. C. Jansen.		S. K. Bakker.
1945:	J. A. Schutte.	1957:	G. C. Steyn.
1946:	J. Schuss.	1958:	C. T. McDonald.
1947:	A. K. Doré.	1959:	R. C. Rous.
		1960:	P. C. Belonje.

2. *Die Maud Bales-Gedenkbeurs.* Dr. Maud Bales van Johannesburg het in 1946 aan die Fakulteit Veeartsenykunde gekwalifiseer. Ten spyte van swak gesondheid sinds haar skooljare en tengerige liggaamsbou, het sy haar veral in die kliniese studiejare en na graduering met ongekende toewyding op haar taak toegespits. Veral perde was haar liefhebbery en dit was vir haar geen moeite om nagte by 'n siek dier in die stel te waak nie. Haar gees het te veel vir haar liggaamskragte geblyk en sy is op 16 Desember 1947—byna 'n jaar presies na kwalifisering—oorlede. Haar moeder, mev. Edith May Bales, het tot haar nagedagtenis 'n trustfonds geskep, die rente waarvan vir beursdoeleindes gebruik word. As kurator tree op "The Metropolitan Board of Executors Limited."

Die hoofdoel van die beurs is om studente bystand te verleen, wat dit andersins moeilik of onmoontlik sou vind om die kursus te voltooi. Aansoeke van studente van enige studiejaar van die veeartsenykundige kursus word jaarliks deur die Raad van die Suid-Afrikaanse Veterinêr-Mediese Vereniging op gronde van (*a*) skool- en akademiese prestasie; (*b*) behoeftigheid; (*c*) karakter en persoonlikheid gekeur.

Die beurs kan onder twee of meer studente verdeel word. 'n Student wat 'n Maud Bales-beurshouer was, sal in die daaropvolgende jaar voorkeur geniet indien hy anders nie die kursus om finansiële redes sou kon voltooi nie. Die kurator het finale seggenskap.

Beurshouers:

1950:	R. Banks.	1955:	A. N. Day.
	H. van Niekerk.		I. W. Rousseau.
1951:	D. C. L. Wacher.	1956:	J. M. O'Grady.
1952:	A. J. Snyders.	1957:	A. N. Day.
	I. S. Canham.		L. F. Naudé.
1953:	A. J. Snyders.	1958:	L. Naudé.
	H. C. Theron.		R. R. van der Veen.
	R. Wege.	1959:	C. S. Nicholson.
1954:	L. van Wyk.	1960:	A. J. Richardson.
	S. K. Bakker.		C. P. van der Merwe.
	D. F. Wege.	1961:	R. D. Sykes.
			J. W. Van der Vyver.

3. *Die Boekfondsprys.* Die Suid-Afrikaanse Veterinêr-Mediese Vereniging het terwille van gerief van sy lede en kadetlede (studente van die Fakulteit) 'n boekbestellingskema, die Boekfonds, in die lewe geroep. Die winste is belê en die rente is gebruik om 'n jaarlikse beurs aan studente uit te loof. Aanvanklik was die bedrag R20, later is dit verhoog tot R40. Alhoewel die skema self as gevolg van betere toevloei van boeke deur gewone handelskanale en kleinere winsgrense gestaak is, bly die beursprys bestaan. Dit word vir een jaar op aanbeveling van die Fakulteit toegeken aan een of meer studente gesamentlik van die derde of vierde studiejaar. Behoeftigheid is die belangrikste oorweging, mits akademiese vordering bevredigend is.

Beurshouers;

1938:	G. P. Bishop.	1950:	R. C. Tustin.
1939:	F. J. Veldman.	1951:	R. D. Bigalke.
1940:	D. J. Louw.		H. F. Strydom.
	J. A. R. van Blerk.	1952:	Mej. M. Smuts.
1941:	B. C. Jansen.	1953:	D. F. Wege.
1942:	H. N. Botha.		H. C. Theron.
	W. H. B. Buhr.	1954:	L. Langlands.
1943:	W. E. Pearson.		P. U. A. Davies.
	J. P. van der Merwe.	1955:	A. N. Day.
1944:	J. J. H. Stevens.	1956:	R. F. O. Visser.
1945:	B. H. Pappin.		L. F. Naudé.
	J. Schuss.	1957:	A. P. Schutte.
1946:	C. Maree.	1958:	B. J. Erasmus.
1947:	H. O. Flanagan.		H. E. Scholtz.
1948:	J. M. M. Brown.	1959:	J. J. Marnewick.
	P. L. Louw.	1960:	C. A. Wilkins.
1949:	Mej. J. H. Verdurmen.		J. J. van der Watt.

C. NAGRAADSE BEURSE IN VEEARTSENYKUNDE

1. *Agricura Nagraadse Beurs.* Die firma Agricura Laboratoria Beperk het vir 'n aantal jare twee beurse van R150 elk vir M.Sc.-studente in chemie aan die Universiteit Pretoria toegeken. Weens gebrekkige belangstelling in die afgelope tyd is deur persoonlike belangstelling van die besturende direkteur, prof. H. O. Mönnig, deur die direksie besluit om een beurs van R600 per jaar vir nagraadse opleiding, as voorbereiding vir navorsing in die basiese (nie-kliniese) vakke van veeartsenykunde, beskikbaar te stel. Die gespesialiseerde studie kan te Onderstepoort of verkieslik oorsee onderneem word, binne vyf jaar na behaling van die eerste graad.

Die beurs word toegeken deur die Universiteit van Pretoria op aanbeveling van 'n komitee bestaande uit verteenwoordigers van Agricura Laboratoria Beperk, die Fakulteit Veeartsenykunde en die Suid-Afrikaanse Veterinêr-Mediese Vereniging. Indien daar nie aansoeke is nie, is die direksie bereid om die bedrae vir die beurs tot drie jaar op die firma se boeke te laat akkumuleer.

Die eerste beurshouer was dr. D. W. Verwoerd, aan wie die beurs in 1960 toegeken is. Hy studeer tans in Biochemie onder prof. Butenandt te München. Geen toekenning is in 1961 gedoen nie.

2. *„Cooper Fellowship" in Veeartsenykunde.* Die firma „Cooper en Nephews, S. Af. Pty. Ltd." het, as gevolg van samesprekings tussen dr. H. S. Purchase en wyle prof. Herman Graf, besluit om 'n nagraadse „Fellowship" in veeartsenykunde in te stel. Die betrokke firma maak reeds skenkings aan 'n Engelstalige universiteit en die wens het ontstaan om 'n Afrikaanstalige Universiteit ewe-eens te begunstig.

'n Bedrag van R400 word jaarliks vir vyf jaar agtereenvolgens vanaf 1 Januarie 1960 deur die firma aan die Universiteit Pretoria beskikbaar gestel, teneinde onlangs gekwalifiseerde veeartse in staat te stel om hul kennis op 'n bepaalde gebied van hul eie keuse te verdiep. Die studieperiode moet oor 'n periode van nege maande deurlopend strek, verkieslik aan 'n goedgekeurde oorsese instituut. Die bepaalde studieveld in Veeartsenykunde word nie beperk nie, maar is onderhewig aan goedkeuring deur die keurkomitee. Die „Fellowship" is aan enige houer van die B.V.Sc.-graad van die Universiteit Pretoria beskikbaar mits hy/sy nie langer as sewe jaar gelede die graad behaal het nie. Dit word verder verwag dat die „Cooper Fellow" na die studieperiode vir minstens twee jaar sy beroep in Afrika sal beoefen.

Die Keurkomitee bestaan uit die Rektor van die Universiteit van Pretoria, die President van die S.A.V.M.V. en die Voorsitter van die Direksie van Cooper & Nephews, S.Af. (Pty.) Ltd. of hul genomineerdes.

Die Keurkomitee ken een of meer „Fellowships" toe uit beskikbare fondse, en kan na goeddunke 'n bestaande Fellowship hernuwe. Indien geen toekenning in 'n bepaalde jaar geskied nie, sal die geld deur die Universiteit vir toekomstige toekennings belê word.

Die eerste „Cooper Fellow" is dr. J. R. Philip, wat hom aan die „Kansas State University" op hoendersiektes gaan toelê het. Geen toekenning is in 1961 gemaak nie.

Albei bogenoemde beurse kan tegelykertyd met ander beurse gehou word. Aansoeke moet die Registrateur, Universiteit Pretoria voor 15 Januarie van elke jaar bereik.

D. BEURSE EN LENINGS NIE BEPERK TOT STUDENTE IN DIE VEEARTSENYKUNDE NIE

1. *Staats- en Staatsbeheerde Beurs/Lenings.* Hulle word so genoem afhangende van die uiteindelike toetrede van die houer daarvan tot die Staatsdiens al dan nie. In laasgenoemde geval is die gelde terugbetaalbaar, sodat dit dan as lening beskou word, anders geld dit as 'n beurs.

Die beurslenings is beskikbaar vir studie in nie minder as drie-en-vyftig vakrigtings nie. Finansieel is hulle die ruimste en het verreweg die grootste rol in ondersteuning van veeartseny-studente gespeel. Die gelde vir ondersteuning in laasgenoemde geval word verkry uit staatsfondse of fondse deur verskeie Beheerrade, wat belang het by die veeartsenykunde, vir dié doel ter beskikking van die Staat gestel.

Die aantal beurse jaarliks beskikbaar hang hoofsaaklik af van die aantal beurse wat deur houers as gevolg van graduering vrygestel word, asook van die geskiktheid van applikante. Op die oomblik is daar sewe-en-twintig beurshouers onder die huidige honderd-en-sewe studente (tweede tot vierdejaars).

Besonderhede omtrent die beurse word jaarliks, gewoonlik in Augustus of September, in die Staatskoerant gepubliseer en kennisgewings hieromtrent geskied ook in die gewone pers. Aansoeke moet die Sekretaris, Staatsdienskommissie, Noord-Vaalgebou, Vermeulenstraat, Pretoria gewoonlik voor 31 Oktober van elke jaar bereik. Bedrae van R200 tot

R600 word beskikbaar gestel; gewoonlik word beurse van R400 aan veeartsenystudente toegeken, wat alle klas- en koshuisgelde net dek.

Die belangrikste oorwegings by toekenning van hierdie beurslenings is (*a*) skolastiese bekwaamheid en prestasie, (*b*) karakter en persoonlikheid, en (*c*) behoeftigheid.

Formele kontrakte moet met die skenker-liggaam aangegaan word. Die belangrikste bepalings is (*a*) bevredigende akademiese vordering, (*b*) toetrede tot die Staatsdiens indien aangestel binne ses maande na voltooiing van die kursus, (*c*) voltooiing van 'n bepaalde aantal diensjare afhangende van die totale uitgekeerde bedrag. Indien laasgenoemde twee voorwaardes nie nagekom word nie, moet die uitgekeerde bedrag, plus tien persent rente vanaf datum van uitkering, binne ses maande terugbetaal word. Die beurs word dan in 'n lening omgeskep.

Aangesien studente by toelating tot die tweede studiejaar onderworpe is aan keuring, word hierdie beurse selde in die eerste studiejaar toegeken.

Soortgelyke beurse word deur die Administrasie van Suid-Afrika toegeken.

2. *Fritz Visserbeurse.* Hierdie beurse word vir studente in landbou en veeartsenykunde beskikbaar gestel uit 'n fonds nagelaat deur wyle mnr. Fritz Visser, 'n gesiene boer van Oos-Kaapland. Die administrasie van die fonds, sowel as die toekenning van beurse geskied deur private instansies en is geheel-en-al onafhanklik van die Universiteit en die Fakulteit. Deur hierdie fonds is reeds uiters waardevolle hulp aan studente in die veeartsenykunde verleen, veral aan verdienstelike persone wie se begeerte dit was om buite die Staatsdiens 'n loopbaan te vind.

Besonderhede omtrent die beurse is verkrygbaar van die Sekretaris, Fritz Visser-Landboubeursfonds, Siebertstraat, Humansdorp, K.P.

3. *Die Langelerbeurs.* Die Gerard Herman Langeler Trust bied 'n beurs van R200 vir vyf jaar vir eerstejaarstudente in die veeartsenykunde. Wat veeartsenystudente betref word die beurs op aanbeveling van die Universiteitsowerhede toegeken. Die beurs sal eers in 1964 weer beskikbaar wees. Die beurs is vir die eerste keer in 1961 toegeken en wel aan L. P. Theron.

4. *Ander beurse deur die Universiteit van Pretoria ge-administreer.* Aansoeke om die volgende beurse is ook oop vir veeartsenystudente, alhoewel daar uit die aard van die saak met groter getalle meegeding moet word. In etlike gevalle is die voorwaardes baie beperkend. Alle aansoeke moet die Registrateur, Universiteit Pretoria op of voor 15 Januarie van elke jaar bereik. Toekenning geskied deur die Universiteitsowerhede tensy anders vermeld:

(*a*) *Algemene Universiteitsbeurse:*

(i) Vier-en-twintig beurse van R20 elk vir een jaar is vir eerstejaarstudente, wat in die eerste klas gematrikuleer het, beskikbaar; toekenning geskied volgens verdienstelikheid en behoeftigheid.

(ii) Ses beurse van R100 en ses van R60 elk word jaarliks toegeken aan eerstejaarstudente op uitslag van die Matrikulasie-eksamen. Die beurse word toegeken aan studente wat onderneem om minstens drie jaar lank ononderbroke aan die Universiteit te studeer.

(iii) Die Universiteitsraad stel jaarliks vyf beurse van R50 elk aan aspirant-eerstejaars sowel as aan studente van enige studiejaar beskikbaar. Akademiese en sportprestasies kom in aanmerking.

(*b*) *Die Ernest Oppenheimer Memorial Trust:* Hierdie fonds is in die lewe geroep deur mnr. H. F. Oppenheimer ter nagedagtenis van sy vader, wyle Sir Ernest Oppenheimer. Vier beurse word jaarliks aan verdienstelike, behoeftige studente vir voorgraadse studie in enige fakulteit deur die Trust op aanbeveling van die Universiteitsowerhede toegeken. Slegs applikante van wie die vaardigheid en voorgestelde studie van die hoogste gehalte is, kom in aanmerking.

(Sien ook nagraadse beurse).

(*c*) *Die Willem de Hoog-beurs:* Ter nagedagtenis aan haar eggenoot is 'n bedrag van £6,000 deur wyle mev. Ina de Hoog aan die Universiteit van Pretoria bemaak, met die bepaling dat die rente op hierdie bedrag aangewend moet word vir 'n beurs of beurse aan manlike studente wat finansiële hulp nodig het. Studente in enige fakulteit kan vir die beurs aansoek doen. 'n Verdere bepaling is dat die beurs alleenlik aan studente van Protestantse geloof toegeken mag word.

(*d*) *Shell-beurse:* Die volgende beurse word deur die Shell Maatskappy van Suid-Afrika beskikbaar gestel:

Een voorgraadse beurs van R400 vir drie jaar. 'n Applikant moet reeds een jaar suksesvol voltooi het aan 'n Suid-Afrikaanse Universiteit.

(Sien ook onder Nagraadse beurse).

(*e*) *Reyersbach-beurse:* Hierdie beurse is in 1919 deur mnr. Louis Reyersbach van Londen ingestel en bedra R140 per jaar vir drie of vier jaar na mekaar, na goedvinde van die Raad, en word *al om die ander jaar* toegeken.

(*f*) *Malan-beurs:* Prof. A. I. Malan stel jaarliks 'n bedrag van R100 beskikbaar aan gebore Malan-studente van die Universiteit van Pretoria. Die beurs staan bekend as die Avril Frieda Malan-Beurs.

(*g*) *Koopkrag Beperk-beurse:* Koopkrag Beperk stel jaarliks vier beurse van R60 elk beskikbaar vir studente van die Universiteit van Pretoria. Applikante of hulle ouers moet vir minstens 2 jaar kopende lede van Koopkrag Beperk gewees het.

By die toekenning van die beurse sal akademiese prestasies sterk in oorweging geneem word en voorkeur sal gegee word aan persone wat geen ander beurse ontvang nie. 'n Persoon aan wie 'n beurs toegeken word, sal bekend staan as 'n Koopkragbeurshouer.

Toekenning geskied deur die Universiteitsowerhede in oorleg met die Direksie van Koopkrag Beperk.

E. BEURSE DEUR LIGGAME BUITE DIE UNIVERSITEIT GEADMINISTREER

Hierdie beurse word in die Jaarboek van die Universiteit Pretoria vermeld. Daar bestaan ongetwyfeld etlike ander sodanige beurse.

1. *Stadsraad van Pretoria:* Beurse is beskikbaar vir persone of hul kinders wat tenminste vyf jaar lank inwoners van Pretoria was. Aansoeke moet gerig word aan die Stadsklerk, Nuwe Stadsaal, Pretoria, en moet hom nie later as 25 Januarie bereik nie.

2. *Afrikaanse Hoër Seunskoolbeurs:* 'n Beurs van ongeveer R30 per jaar uit die Jannie de Kock-fonds word jaarliks aan 'n verdienstelike seun wat 'n oud-leerling van die Afrikaanse Hoër Seunskool is, toegeken om vir akademiese opleiding aan die Universiteit van Pretoria te gebruik.

Besonderhede is van die hoof van die skool verkrygbaar. Toekenning geskied deur die skool.

3. *„The Henry Denton South African Universities Trust"-beurs:* Die beurs bedra R600 per jaar vir drie jaar.

Die applikante moet seuns wees van die Joodse Geloof en onder die ouderdom van 25 jaar en moet in Natal gebore wees of tenminste 10 jaar aldaar woonagtig gewees het. Nadere besonderhede is verkrygbaar van: Die Sekretaris, Posbus 746, Durban.

F. NAGRAADSE BEURSE — ALGEMEEN

1. *Die Ernest Oppenheimer Memorial Trust:* Vier nagraadse beurse tot 'n maksimum van R2,000 elk vir een jaar aan enigiemand maar veral Universiteitspersoneel wat hul studies in die buiteland wil voortsit, navorsing wil gaan doen of 'n opknappingskursus wil volg.

Toekennings sal alleenlik gemaak word aan applikante van wie die vaardigheid en voorgestelde studie van die hoogste gehalte is.

Toekenning geskied deur die Trust op aanbeveling van die Universiteitsowerhede.

2. *H. B. Webb-beurs:* Die beurse bedra tussen R300 en R700 per jaar vir twee jaar en word toegeken aan gegradueerdes in enige fakulteit. Aansoeke, wat op die voorgeskrewe vorm gedoen moet word, moet die Registrateur jaarliks voor 30 November bereik.

3. *African Explosives and Chemical Industries Ltd.-beurse:* Navorsingsbeurse ten bedrae van R1,000 vir universiteitsdosente o.a. vir navorsingswerk in die buiteland, beurse vir nagraadse studie ten bedrae van R600 per jaar, en beurse vir kinders van werknemers ten bedrae van R500 per jaar, word jaarliks deur hierdie maatskappy beskikbaar gestel. Nadere besonderhede is van die Registrateur verkrygbaar.

4. *Shell-beurse:* Een nagraadse beurs van R400 vir vier jaar. 'n Applikant moet reeds in besit wees van 'n eerste graad. Volledige besonderhede is van die Registrateur verkrygbaar.

5. *Buitelandse beurse:* Deur bemiddeling van die Departement Onderwys, Kuns en Wetenskap stel etlike oorsese lande—die Statebond, Nederland, België, Duitsland, Switserland, Frankryk, Italië — beurse vir gegradueerdes beskikbaar. Hierdie beurse beloop meesal rond R600–R1,200 per jaar (met of sonder retoerpassaat) en vrystelling van klasgelde.

Basiese inligting kan van die Sekretaris, Departement Onderwys, Kuns en Wetenskap, Vanderstelgebou, Pretoria verkry word, met verdere aanvullende besonderhede van die betrokke ambassade of gesantskap.

G. LENINGS

I. *Vir studente in die veeartsenykunde:*

Die Suid-Afrikaanse Veterinêr-Mediese Vereniging bied onder spesiale omstandighede finansiêle hulp aan studente in die vorm van lenings. Aansoeke moet aan die Sekretaris, S.A.V.M.V. gerig word. Dit is die beleid van die Vereniging om sodanige hulp tot vierde- en vyfde jaarstudente te beperk en slegs onder buitengewone omstandighede derde- of tweedejaarstudente te help.

II. *Algemeen*

1. *Studenteleningsfonds.* Deur bemiddeling van Die Nasionale Bank, tans Barclays Bank, wat in 1923 'n geldsom aan die T.U.K. geskenk het vir lenings aan studente, het hierdie fonds deels tot stand gekom.

'n Beperkte aantal lenings is soos volg beskikbaar vir behoeftige studente om hulle te help om hulle universiteitskursus te voltooi:—

(*a*) Aan studente in hulle finale jaar (in die geval van studiekursusse van meer as 3 jaar): R100.

(*b*) Aan derdejaarstudente wat gereeld geslaag het: R80.

(*c*) Aan ander studente: R60.

(*d*) Geen applikant wat 'n gemiddelde persentasie van minder as 55% in sy jongste eksamen behaal het, sal in aanmerking geneem word nie.

Toekenning geskied deur die Universiteitsowerhede.

2. *Stadsraadlenings:* Aansoeke moet gerig word aan die Stadsklerk, Nuwe Stadsaal, Pretoria, en moet hom nie later as 25 Januarie bereik nie.

3. *Pretoria Vriendekring Studie-lenings:* Die Pretoria-Vriendekring, bekend as die Vriendekring, stel jaarliks uit sy eie fondse een of twee lenings van R60 elk beskikbaar aan studente van die Universiteit van Pretoria. Voorgenome applikante moet op die voorgeskrewe vorm, wat by die kantoor verkrygbaar is, aansoek doen, en aansoeke moet die kantoor van die Universiteit voor 15 Januarie van elke jaar bereik. Slegs studente wie se ouers in die Pretoriase omgewing woonagtig is kom in aanmerking vir die beurse. Nadere besonderhede is van die Registrateur verkrygbaar.

Toekenning geskied deur die Universiteitsowerhede in oorleg met die Bestuur van die Pretoriase Vriendekring.

4. *E. J. Grobbelaar Versekeringsmaatskappy-lening:* Bogenoemde maatskappy stel jaarliks 'n bedrag van R400 beskikbaar vir vier lenings van R100 elk per jaar vir toekenning aan ingeskrewe studente van die Universiteit Pretoria. Applikante of hul ouers moet reeds vir ten minste een jaar lede van hierdie Maatskappy gewees het.

5. *Helpmekaar Vereniging-lenings:* Die Universiteit stel jaarliks 'n bedrag van R300 beskikbaar vir lenings aan studente wat deur die Helpmekaarvereniging aangewys word.

Die voorwaarde waaronder die lenings toegeken word is dieselfde as die van die Studenteleningsfonds. (Par. (1) hierbo).

Toekenning geskied deur die Universiteitsowerhede op aanbeveling van die Helpmekaar Vereniging.

Die Veeartsenykundige beroep in Suid-Afrika kan hom trots en gelukkig ag dat hy, inagnemende die relatief groot getal medaljes en pryse vir veeartsenystudente, so 'n hoë agting geniet. Die gees waarin die skenkings gedoen is, blyk uit die bewoording van die briewe wat ontvang is van die verskillende skenkers op navraag van die skrywers oor die ontstaan van sodanige skenkings. Van die inhoud van hierdie antwoorde is dankbaar gebruik gemaak by die opstel van hierdie stuk.

By gebrek aan enige bepaalde standaarde, kan geen wetenskaplik gefundeerde antwoord gegee word op die vraag of die aantal beurse voldoende is om verdienstelike maar behoeftige aspirantstudente aan te lok nie. Bloot op empiriese grondslag is dit die mening van die skrywers dat daar besliste behoefte bestaan aan:—

(*a*) Beurse van R200 en R400 per jaar vir vyf jaar vir voorgraadse veeartsenystudente wat nie 'n Staatsloopbaan verkies nie.

(*b*) 'n Leningsfonds wat studente binne 'n betreklike kort periode na aansoek kan bystaan. So dikwels gebeur dit dat 'n student opeens finansiële steun moet ontbeer deur onverwagte siekte, ongeluk of dood van die gesin se broodwenner, of deur besigheids- of boerderyteenslae. Alle eer kom die owerhede van die Universiteit Pretoria toe vir die wyse waarop hulle in sodanige gevalle studente tydelik bygestaan het, mits dit 'n bona fide geval was en die betrokke student betyds sy probleme aan die owerhede voorgelê het. Tog word gevoel dat daar nie uitsluitlik en altyd staat gemaak behoort te word nie op universiteitsfondse wat 'n baie groot algemene studentegetal moet voorsien.

Deur een van ons (H. P. A. de B.) is na beraming die huidige tekort aan veeartse in Suid-Afrika teen die huidige opleidingstempo teen 1965 op 200 geskat. As belangrikste oorsaak hiervoor is gestel die onvoldoende vergoeding wat die veearts kan verwag juis op dié gebiede en in dié streke waar sy dienste, gesien vanuit landsbelang, die nodigste is. Hier sal van allerweë opgetree moet word. Aan die ander kant is gevind dat met die huidige keuring van studente en toelating van dertig per jaar tot die studie, daar gevaarlik op die rand van room en wei geskep word. Dus sal daar ook onder andere deeglik gesorg moet word dat geen potensieel goeie student vanweë behoeftigheid hom nie vir die kursus aanmeld nie.

DANKBETUIGING

Benewens erkentlikheid teenoor die verskillende skenkers vir hul medewerking met verskaffing van inligting — soos in die teks vermeld — is dank aan die owerhede van die Universiteit Pretoria verskuldig vir inligting deur hulle verstrek en aan die Direkteur van Veeartsenydiens vir die vergunning aan een van die skrywers verleen vir publikasie van hierdie artikel.

SUMMARY

The authors in compiling a list of the medals, prizes, bursaries and loans, which are available to students and graduates who take Veterinary Science as their career, recognise these measures of assistance as complementary to those usually arranged for the promotion of higher education.

This compilation of awards, they feel, should afford opportunity to the profession, and to bodies and individuals with a sense of public welfare, to appreciate and evaluate them. They hope it will encourage and stimulate further assistance for veterinary advancement, as well as of being a source of information to prospective students and others.

The names of the successful candidates are recorded under each award and a tabulation is given of the medals, prizes and scholarships available, to those requiring financial assistance and encouragement.

The authors list five sources from which loans are available, including one, viz. the South African Veterinary Medical Association, where veterinary students can be assisted.

It would be a colossal task to list all possible sources of assistance which are available, inter alia, to aspirant veterinarians, in the Republic alone. The South West Africa Administration too has sources of assistance to offer to veterinary students, veterinarians and others.

SUMMARY OF MEDALS, PRIZES, SCHOLARSHIPS AND FINANCIAL ASSISTANCE AVAILABLE TO STUDENTS AND GRADUATES IN VETERINARY SCIENCE

TABLE I

AWARDS AND BENEFITS AVAILABLE TO VETERINARY STUDENTS

Award	Donated By	In Recognition of	Available to	Stipulations
1. SIR ARNOLD THEILER MEDAL (*Silver*) (available annually since 1938)	S.A. Biological Society	Arnold Theiler, a foundation member and First President of the Society	Final year students	The most industrious student who graduates from the Faculty of which Sir Arnold Theiler was the First Dean.—viz. University of Pretoria.
2. THE CLINICAL MEDAL (*Silver*) (available annually since 1945)	Witwatersrand Branch of S.A. Veterinary Medical Association	To encourage advancement in clinical veterinary practice in South Africa	Final year students	The most diligent student in the clinical subjects (Surgery, Genesiology, Medicine and Infectious diseases)
3. THE FARMER'S WEEKLY MEDAL (available annually since 1959)	The Farmer's Weekly, P.O. Box 245, Bloemfontein	The services rendered by the Veterinary Profession and the Veterinary Faculty in South Africa	Fourth year students	The most promising student in the department of Zootechnics —including Animal Management, Animal Nutrition and Veld Management.
4. THE I.C.I. PRIZES for Medicine and Surgery. *Two prizes each to the value of* R21.00 (available annually since 1951)	I.C.I. South Africa (Pharmaceuticals), Limited, P.O. Box 11270, Johannesburg	Research and its application to chemotherapy and anaesthesia in South Africa	Final year students	The student showing the greatest progress in: (1) Medicine and Infectious Diseases; (2) Surgery and Genesiology.
5. THE MAYBAKER PRIZE (*Clinical*). *An instrument case* (available annually since 1955)	Maybaker (S.A.) (Pty.) Ltd., P.O. Box 1130, Port Elizabeth	In appreciation of their intimate association with the Veterinary profession in South Africa	Final year students	The student showing the greatest improvement in the clinical subjects through persistence and devotion to his studies.
6. THE PFIZER PRIZE. (*Instrument Case* (available annually since 1956)	Pfizer Laboratories South Africa (Pty.) Ltd., P.O. Box 7324, Johannesburg	In appreciation of the cordial personal and scientific relationship with the Veterinary Faculty	Final year students	The student showing the greatest practical application of the clinical aspect of Veterinary Medicine and who was not considered for the highest marks in the theoretical aspect.

7. THE AGRICURA PRIZE FOR PATHOLOGY R50.00 (available annually since 1957)	Agricura Laboratoria Ltd., P.O. Box 55, Silverton, Pretoria	To encourage promising students in a subject which, in the final year of study possibly covers the widest field, and has the greatest basic significance	Final year students	The most industrious student in Pathology assessed over the last three years, but particularly in the last year of study.
8. THE A. S. RUFFEL PRIZE. (R40.00) (available annually since 1960)	A. S. Ruffel (Pty.) Ltd., P.O. Box 7824, Johannesburg	In appreciation of the generous and valuable co-operation afforded by the Division of Veterinary Services since the existence of the firm	Fourth year students	The most promising student in Pharmacology and Toxicology.
9. THE OPTICAL INSTRUMENTS PRIZES. *Two prizes each to the value of* R50.00 (available annually since 1959)	Optical Instruments (Pty.) Ltd., P.O. Box 1561, Johannesburg	To encourage deserving students in Veterinary Science	(*a*) Second year students (*b*) Third year students	The most promising student in each year.
10. THE DUNCAN HUTCHEON SCHOLAZSHIP. *Between* R800 R120 *per annum* (available annually since 1937)	The Central Farmers Association and the Western Province Agricultural Society	In commemoration of Duncan Hutcheon, the well-known and esteemed Chief Veterinary Surgeon of the Cape Colony	Final year students	Selected by the Cape Province Agricultural Union in consideration of diligence (50%), of Cape Province origin (25%) and need (25%).
11. THE MAUD BALES MEMORIAL BURSARY. *Amount varies from* R200.00 *to* R240.00 *in terms of interest available* (available annually since 1950)	Mrs. Edith May Bales, mother of the late Dr. Maud Bales, through the Maud Bales Memorial Trust, administered by the Metropolitan Board of Executors, Johannesburg	In commemoration of the late Dr. Maud Bales who qualified at the Onderstepoort Faculty in 1946 and died a year later	Students in any study year	On recommendations of applicants by the Council of the S.A.V.M.A., to the trustees, the bursary is available to one or more students showing scholastic and academic diligence, need, character and personality.

12. THE BOOK FUND PRIZE. R40.00 (available annually since 1938)	S.A.V.M.A.	Encouragement to Veterinary students	Third and Fourth year students	Donated to the most deserving student or students recommended by the Faculty.
13. STATE SCHOLARSHIPS. R400.00 *per annum for* 4 *years* (available every year or every other year, since 1910)	Department of Agricultural Technical Services, Private Bag 116, Pretoria, as authorised by the Public Service Commission	National veterinary needs	Second year students	To be applied for as advertised from time to time in the Government Gazette; successful applicants to serve in the State Service for a stipulated period.
14. FRITZ VISSER SCHOLARSHIPS	The late Mr. Fritz Visser an esteemed farmer of the Eastern Province	National Agricultural and Veterinary needs	Deserving students in Agricultural and Veterinary Sciences	To be applied for to the Secretary, Fritz Visser Landboubeursfonds, Siebert Street, Humansdorp, Cape.
15. LANGELER SCHOLARSHIP. R200 *per annum for* 5 *years* (available since 1961)	Gerard Herman Langeler Trust	—	First year students	—

TABLE II

OTHER SCHOLARSHIPS FOR WICH VETERINARY STUDENTS CAN COMPETE

Name of Scholarship	Administered by	Qualifications
(i) *Twenty-four Scholarships of* R20.00 *each tenable for* 1 *year.* (Available annually)	University of Pretoria	First year students with First Class Matriculation passes who are in need of assistance.
(ii) *Six scholarships of* R100.00 *and six of* R60.00. (Available annually)	University of Pretoria	First year students who undertake to study uninterruptedly at the University for 3 years.
(iii) *Five Scholarships of* R50.00. (Available annually)	University of Pretoria	Proposed first year students and students of any study year. Academic and sporting attainments are considerations.
(iv) THE ERNEST OPPENHEIMER MEMORIAL TRUST. *Four Scholarships available annually*	University of Pretoria on account of H. F. Oppenheimer in commemoration of his father	Deserving undergraduates in any Faculty who are of the highest integrity and pursuing a subject of the greatest importance.
(v) WILLEM DE HOOG SCHOLARSHIP.....	The University of Pretoria instructed by the late Mrs. Ina de Hoog in commemoration of her husband.	Male students in any faculty needing financial aid and being of Protestant belief.
(vi) SHELL COMPANY OF SOUTH AFRICA. *One scholarship of* R400.00 *tenable for* 3 *years*	University of Pretoria on account of the Shell Company of South Africa	Successful applicant must have completed one year at a South African University.
(vii) REYERSBACH SCHOLARSHIP. R140 *per annum tenable for* 3 *or* 4 *successive years.* (Available from 1919 and to be applied for every second year)	University of Pretoria on account of Louis Reyersbach of London	Available from the Registrar, University of Pretoria.
(viii) AVRIL FRIEDA MALAN SCHOLARSHIP. R100 *available annually*	Professor A. I. Malan	Available to students born with the name of Malan attending the University of Pretoria.
(ix) KOOPKRAG LTD. SCHOLARSHIP. *Four scholarships of* R60	University of Pretoria on behalf of Koopkrag Limited	Available to students of the University of Pretoria, whose parents were members of Koopkrag for at least 2 years. Preference is given to non-scholarship holders, and academic merit is taken into account.
(x) CITY OF PRETORIA. *Available annually* and to be applied for before 25th January of each year	Town Clerk, Pretoria	Persons or their children who have resided in Pretoria for at least 5 years.
(xi) AFRIKAANS HIGH SCHOOL FOR BOYS. *One of* R30.00 *p.a.*	Die Prinsipaal, Afrikaans Hoërskool, Pretoria	To a deserving boy of the Afrikaans Hoër Seunskool for academic study at the University of Pretoria.
(xii) HENRY DENTON SOUTH AFRICAN UNIVERSITIES TRUST SCHOLARSHIP. R600 *per annum tenable for* 3 *years*	The Secretary of the Henry Denton Trust, P.O. Box 746, Durban	Boys of the Jewish faith under 25 years of age, born in Natal or having resided there for at least 10 years.

TABLE III

SCHOLARSHIPS FOR POST-GRADUATE VETERINARY STUDY

Name of Scholarship	Administered by	Qualifications
1. AGRICURA POST-GRADUATE SCHOLARSHIP. *One scholarship of* R600	University of Pretoria on behalf of Agricura Laboratoria, Silverton, Pretoria, assisted by the Veterinary Faculty and the S.A.V.M.A.	Graduates of not more than 5 years standing desirous of pursuing a veterinary research career, to qualify them for intensive application of this aspect of veterinary work. The studies to be undertaken preferably at an overseas university or institute.
2. COOPER FELLOWSHIP. R400 *per annum tenable for 5 years, augmented as may be recommended by the Selection Committee.* (Available from January 1960)	University of Pretoria on behalf of Messrs. Cooper & Nephews S.Af. (Pty.) Ltd., assisted by the President of the S.A.V.M.A., the Rector of the University and the Directorate of the firm	Graduates of the University of Pretoria who have been qualified for not more than 7 years and who wish to further the studies of their own choice, for a period of 9 months preferably at an overseas university. Successful applicants to be available for employment in the State Service under specified conditions.

TABLE IV

POST-GRADUATE SCHOLARSHIPS FO WHICH VETERINARIANS MAY COMPETE

Name of Scholarship	Particulars
1. ERNEST OPPENHEIMER MEMORIAL TRUST	Four Post graduate Scholarships of *a maximum of* R2,000 *each for one year*, available to anyone, but particularly University personnel who wish to further their studies overseas and which studies are of the highest quality. Applications must be made to the Registrar, University of Pretoria.
2. H. B. WEBB SCHOLARSHIP.....	Scholarships of *between* R300–R700 *per annum for* 2 *years*, to graduate in any faculty. Applications to be directed to the Registrar, University of Pretoria before 30th November.
3. AFRICAN EXPLOSIVES CHEMICAL INDUSTRIES LTD.—SCHOLARSHIPS	*Research Scholarships of* R1,000 for University lecturers, who wish to pursue research overseas. *Post-graduate scholarships of* R600 *per annum* and *scholarships of* R500 *per annum for children of employees* are granted annually by this company. Further particulars can be obtained from the Registrar of the University of Pretoria.
4. SHELL SCHOLARSHIP.....	One post-graduate scholarship of R400.00 *tenable for* 4 *years* to graduates. Full particulars can be obtained from the Registrar, University of Pretoria.
5. OVERSEAS SCHOLARSHIPS.....	The Department of Education, Arts and Science arranges scholarships for overseas study, on behalf of certain overseas countries such as the United Kingdom, the Netherlands, Belgium, Germany, Switzerland, France, Italy, etc. These scholarships range from R600 *to* R1,200 *per annum*. Full particulars can be obtained from the Secretary, Department of Education, Arts and Science, Pretoria.

A SHORT REVIEW

ALLOWANCES FOR PROFESSIONAL WITNESSES ATTENDING COURT

A. M. Diesel, Secretary, S.A. Veterinary Medical Association, P.O. Box 2460, Pretoria

Veterinarians are from time to time subpoenoed or requested to appear as professional witnesses, to give expert evidence in the Magistrate's and Superior Courts.

The allowances payable to such veterinarians are laid down by law and apply equally to all courts.

The Registrar of the Supreme Court, Pretoria, has kindly supplied the information contained in this short review:—

IN CRIMINAL CASES

The Minister of Justice, for purposes of Regulation 1 (*b*) of Government Notice No. 2261 dated 22nd October, 1948, as amended, has approved the following classes of professional witnesses:—

Accountants and Auditors.
Actuaries.
Advocates.
Architects.
Attorneys.
Chemists and Druggists.
Commissioned Officers of the Army, Navy and Air Force.
Conveyancers.
Dentists.
Engineers (Civil, Electrical, Mechanical and Mining).
Law Agents.
Medical Practitioners.
Midwives.
Notaries Public.
Nurses.
Professors of Recognised Universities or Colleges.
Surveyors (Land and Quantity).
Veterinary Surgeons registered in terms of Section 11 of the Veterinary Act (Act No. 16 of 1933).

The Tariff of Allowances

These are laid down in Regulation 1 (*b*) of Government Notice No. 2261 dated 22nd October, 1948, as amended which prescribes the following rates:

(*a*) £1. 1s. (R2.10) per day for witnesses residing 5 miles or less from the Court.

(*b*) £1. 10s. (R3.00) per day for witnesses residing over 5 miles from the Court, whether night accommodation is hired or not.

These fees are only payable to duly qualified and practising members of the approved professions and other witnesses giving expert evidence.

Any member who ceases to practice is paid at the rate usually applicable to his race.

Transport Allowance

Government Notice No. 1920 of 13 December, 1957 lays down a mileage allowance of 6d. (5 cent) per mile for cars. This is payable in respect of distances more than 5 miles from the Court.

Where a witness is a Registered Medical Practitioner or an Intern, mileage allowances at public service rates may be paid.

Where Government transport is available witnesses are supplied with warrants and are expected to use this form of transport.

Where exceptions are made in this regard, the mileage charges payable will not exceed those of the official form of transport.

The above quoted Government Notices are framed in terms of the authority conveyed by Section 218 of the Criminal Procedure Act, 1955 (Act No. 56 of 1955).

IN CIVIL CASES

The Tariff of Allowances

This is set out in Government Notice No. 1113 of 19 May, 1950, framed in terms of Section 25 (*c*) of the Administration of Justice Act, 1912 (Act No. 27 of 1912) as amended by Section 1 of Act No. 54 of 1949.

An allowance of £1. 10s. (R3.00) per day, irrespective of whether a night's accommodation is hired, is payable to medical practitioners and other witnesses attending court to give expert evidence, who are members of professions approved from time to time by the Minister of Justice, residing within or beyond 5 miles from the Court.

European witnesses not giving expert evidence are paid 10/- (R1.00) per day and 17/6 (R1.75) a day respectively depending on whether they hire accommodation for the night.

Transport Allowances

A mileage allowance of 6d. (5 cent) per mile for a motor car is payable to witnesses residing more than 3 miles from the Court. This is paid in respect of both the forward and return journey.

Government Notice No. 113 of 19 May, 1950 sets out the allowances and explains the rates applicable.

A Magistrate or Registrar of the Supreme Court may vary these tariffs in extraordinary or exceptional cases.

Government Notice No. 1612 of 29 June, 1951, framed in terms of the provisions of Section 25 (*c*) of the Administration of Justice Act, 1912 (Act No. 27 of 1912) as amended by Act No. 54 of 1949 authorises the payment of fees to witnesses giving material professional evidence, whether they have been particularly subpoenoed to attend Court or have been accepted as witnesses by the Court.

STATE VETERINARIANS are paid subsistence and transport allowances by the Departments in which they serve. They should nevertheless make use of the authority to travel supplied by the Court or by the South African Police as this will then not form a debit against the vote of their Department.

Fees normally payable to State Veterinarians in Civil Cases must be paid into Revenue and cannot be accepted by the individual as he receives a subsistence and travelling allowance.

MUNICIPAL VETERINARIANS should consult the Town Clerks of the local authority which employs them as each case is dealt with on its merits.

PAYMENT OF CONDUCT MONEY

Any Veterinarian subpoenoed to appear in Court as a witness will be granted *Conduct Money* by the Court or by the South African Police, and is entitled to receive this both in respect of subsistence and transport allowances when he responds to the demands of the subpoena.

PUBLIC RELATIONS SERVICE

NEWS OF MEMBERS

PROMOTIONS

Congratulations are extended to Professor van Drimmelen on attaining special advancement and to Dr. Dan Smit on his promotion to the post of Sub-director of Veterinary Services (Research).

PRESENTLY OVERSEAS

Dr. W. Malherbe writes to say he is still enjoying his stay at the School of Veterinary Medicine, University of Pennsylvania and will be sorry when he has to leave it, but will be glad to be back in South Africa.

Professor H. P. de Boom writes very cheerfully about his sojourn at the New York State Veterinary College, Cornell University, and has the impression that it will be tough going to fit in all the studies within a year.

Dr. H. Kleeberg has now left for the United States where he will study Tuberculosis at the Tradeau Laboratory, P.O. Box 670, Saranac Lake, New York State. He will be away for a year on a bursary from C.S.I.R.

We wish these three colleagues "happy studies" and fruitful endeavours.

DIRECTOR AND DEPUTY DIRECTOR (FIELD) SPEND THE WEEKEND IN LONDON

The Director and Deputy Director (Field) are to be admired for their close application to duty in their endeavours to suppress the serious outbreaks of Foot and Mouth Disease, New Castle Disease and Rabies.

If the weekend in London afforded them the opportunity of enjoying theatrical entertainments, this they surely deserved.

EXTENSION OF GOOD WISHES

Dr. E. T. Clemow who retired some twenty years ago is in the Provincial Hospital, Port Elizabeth. His health is deteriorating. Sympathy is extended to him and it is trusted that his condition will improve.

Prof. M. Henning is now making satisfactory progress after his recent operation. We wish him a speedy and uninterrupted recovery.

Two New Books

SCHALM:

Veterinary Hematology

by Oscar W. Schalm, D.V.M., M.S., Ph.D., *Professor of Clinical Pathology, School of Veterinary Medicine, University of Davis, California.*

Soundly based on Original Data and Exhaustive Research. From his extensive work in this field, Dr. Schalm has been able to draw on an immense quantity of original data obtained from the examination of approximately 30,000 blood samples in the 10-year period immediately preceding publication of this book. The text is, therefore, based upon previously unpublished knowledge and on the results of intensive searching of the English language medical literature for data on blood morphology in the common domestic animals.

Blood morphology in health and disease is presented for the dog, cat, cow, sheep, goat, horse and pig. Normal values in each animal species is followed by a presentation of fundamental concepts of the responses of both erythrocytic and leukocytic cell series to various disease processes. Interpretation of the changes in the blood picture in disease is dealt with in detail, and attention is directed to the differences in response to disease among the common domestic animals as reflected in blood morphology. Numerous tables of original data are included. An Appendix contains 27 case histories from the Davis veterinary clinic which are referred to throughout the book in order to clearly demonstrate fundamental concepts of the responses of the hematopoietic tissues to disease.

386 *pages.* 24 *Illustrations and* 10 *Plates,* 58 *Tables.*

Price 75s.

Postage 2s. 9d.

CARLSON:

Veterinary Radiology

by William D. Carlson, D.V.M., M.S., Ph.D., *Radiologist, College of Veterinary Medicine, Colorado State University, Fort Collins, Colorado.*

The only book of its size and scope now available

This book is directed primarily to the practicing veterinarian but applies equally to the veterinary student in clinical training. In addition, the veterinary student is strongly considered in several chapters in which basic background material is included for easier mastery of the subject. The entire field of veterinary radiology is included.

It covers the entire field of veterinary radiology. Part I, Radiographic Technique, includes positioning for radiography; special techniques; dark room procedures; basic needs for starting radiography in a veterinary practice; descriptions of X-ray machines, radiographic detail, density and contrast; and the formation of a technique chart for animals. Part II, Radiographic Interpretation, includes, in *atlas* form, a detailed coverage of the pathological anatomy which is radiographically demonstrable. Emphasis is on radiographic appearance and associated differential diagnosis. Part III covers basic fundamentals and use of radiation therapy. Nuclear medicine is covered briefly.

474 *pages.* 1091 *Illustrations,* 592 *Engravings,* 1 *in Colour.*

Price 135s.

Postage 2s. 9d.

Prices quoted are published prices in U.K.

Baillière, Tindall & Cox

7 & 8 Henrietta Street London . WC2

VERSLAG VAN UITBREKINGS VAN GEPROKLAMEERDE SIEKTES VIR DIE TYDPERK SEPTEMBER—DESEMBER 1961.

REPORT OF OUTBREAKS OF NOTIFIABLE STOCK DISEASES FOR THE PERIOD SEPTEMBER—DECEMBER 1961.

Siekte/Disease.	Distrik/District.
B.W.D.—B.W.D.	Bloemfontein. Clocolan. Kroonstad.
Brandsiekte-skaap. Sheep Scab.	Barberton. Carolina.
Episootiese Limfangitis. Epizootic Lymphangitis.	Uitenhage.
Gonderiose—Milde Bees Gonderiosis—Benign bovine.	Mahlabatini Msinga. Nongoma. Nqamakwe. New Hanover. Piet Retief. Umzinto. Vryheid.
Gonderiose—Kwaadaardige Buffel. Gonderiosis—Cyncerine (Malignant)	Hlabisa.
Hoendertifus. Fowl Typhoid.	Bloemfontein. Brandfort.
Hondsdolheid. Rabies.	Boshoff. Bloemfontein. Camperdown. Dewetsdorp. Entonjoneni. Ermelo. Hoopstad. Hlabisa. Inanda. Ingwavuma. Kuruman. Letaba. Lower Umfolozi. Marico. Ngotshe. Nongoma. Pietermaritzburg. Piketberg. Posmasburg. Richmond. Sibasa. Soutpansberg. Theunissen Ubombo.. Virginia. Vryburg Vryheid. Wolmaranstad.

Siekte/Disease.	Distrik/District.
Knopvelsiekte. Lumpy Skin Disease.	Eshowe. Kakamas. Ladybrand. Mafeking. Marico. Parys. Swellendam. Vryburg. Worcester.
Miltsiekte. Anthrax.	Bloemhof. Bloemfontein. Bergville. Delareyville. Entonjaneni. Ermelo. Hoopstad. Johannesburg. Klerksdorp. Kingwilliamstown. Kroonstad. Ladybrand. Mahlabatini. Ngotshe. Nkandhla. Pilgrimsrest. Potchefstroom. Richmond K. Reitz. Stutterheim. Tulbagh. Theunissen. Ventersburg. Ventersdorp. Warrenton.
Newcastle Siekte. Newcastle Disease.	Pretoria.
Pappagaaisiekte. Psittacosis.	Pretoria.
Slapsiekte. Dourine.	Bultfontein. Boshof. Kuruman. Mt. Ayliff. Potchefstroom. Tarkastad. Theunissen. Vryburg.
Skurfte. . . . . Bok/Goat. Mange.	Butterworth. Elliotdale. Engcobo. Idutywa. Kingwilliamstown. Kentani. Middeldrift. Mquanduli. Qumbu. Stutterheim. Umtata. Willowvale.

Siekte/Disease.		Distrik/District.
	Perd/Equine.	Msinga. Port Shepstone. Tsomo. Umtata.
	Vark/Porcine.	Hay. Kimberley.
Tuberkulose.	Bees/Bovine.	Durbanville. Eshowe Inanda. Koppies. Piet Retief. Potchefstroom. Port Elizabeth. Stellenbosch. Umvoti. Welkom.
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