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INTRAPERITONEAL INSEMINATION OF BIRDS.

G. C. VAN DRIMMELEN,
Bloemfontein.

Burrows and Quinn (1935, 1937 and 1939) by their method of obtaining semen rapidly and efficiently are largely responsible for the practical use of artificial insemination in modern poultry husbandry. Many earlier workers have obtained fertile eggs from artificially introduced semen in domestic fowls (Payne, 1914; Amantea, 1922; Warren and Kilpatrick, 1929; Ishikawa, 1930). The semen was deposited by instruments into the cloaca, vagina or uterus (Quinn and Burrows, 1936; Munro, 1938; Bonadonna, 1939; Hammond, 1940; Black and Scorgie, 1942; Warren and Gish, 1943). The object of the present communication is to describe a modified form of artificial insemination in which the semen is introduced by intraperitoneal injection. The study of the results of such operations is proceeding and some variations of technique are being tested.

Sufficient proof is already available to show that under optimum conditions, good fertility may be obtained by the intraperitoneal method of insemination in the domestic fowl.

TECHNIQUE.

Semen collection:

Fowl semen may be obtained in several ways but the methods described by Burrows and Quinn (1935, 1937) were used here. The semen was collected directly from live cocks after stimulation of ejaculation by manual manipulation of the cock and by "milking" the bulbous ducts. The semen was caught in a short wide test tube instead of the funnel with closed stem as recommended.

It is an advantage to select a protected site for the work and to confine the cocks near at hand in battery cages about 12 hours beforehand. For the best results the cocks should not be fed, handled, or in any way excited during this time, right up to the moment of collection. The period of starvation will decrease the chances of soiling of the semen with excreta. Preliminary training of male birds is generally recommended, before they are used for experimental purposes. (See figure I).

Fowl semen has a density of 250,000 to 10,200,000 with an average of 3,200,000 spermatozoa per c.mm. This is higher than in most farm animals. The volume varies with breed and age, being highest in cockerels of the light breeds. The volume of semen produced per

day, as well as the total number of spermatozoa ejaculated and the viability of the sperm, show a seasonal decline from highest in late winter to lowest in midsummer. At each collection 0·5 to 1·0 cc. of semen may be obtained, the range in volume being nil to about 2·25 cc. (Munro, 1938; Burrows and Titus, 1939; Wheeler and Andrews, 1943). During the moult there is a very marked ebb in semen production.

Motility of fowl sperms has been observed only up to the 15th day of storage at 2°-3°C. The average reported was 6·5 days with a seasonal, and a very marked individual variation. (Wheeler and Andrews, 1943). The normal pH has a range of 6·76-7·04. The semen of birds contains no accessory secretions (Munro, 1938; Hammond, 1940).

Fig. I. — Semen Collection: Cock placed on the operator's right knee. The head and neck rest on the left knee and the tail is folded over the bird's back by the palm of the left hand. The left thumb and index finger grasp the cloaca. The right index finger holds the test tube, and thumb and middle finger massage the abdomen.

Insemination:

A sterile glass syringe must be charged before the hen to be inseminated is picked up. She should be placed on her right side on the knees of the sitting operator, her head towards his body and her legs to his right. (See figure II). Disinfect an area situated on the left abdominal surface with 65% ethyl acohol over the anteroventral border of the pubic bone, just ventral to the subcutaneus muscles of the ilio-costal region. In light skinned birds these muscles may be seen through the skin. The alcohol will cause the collapse of feathers

and some may be plucked. (In the pigeon the obturator notch is the landmark used in order to avoid the large lateral abdominal air-sac).

A new, stout exploring needle, 80 mm. long and 1·50 mm. external diameter, is fitted to the syringe and introduced firmly through the skin. The point of the needle should be passed gently in an antero-medial direction towards the region of the ovary. The shaft of the needle must be maintained in a plane parallel to the vertebral column so as not to risk damage to the large bloodvessels. The ovarian region is reached by a penetratration of 6-8cm. depending on the size and conformation of the bird. It is better to underestimate the depth for fear of damaging the liver and the heart.

Fig. II. — Insemination of the hen: Hen held on the operator's knees by pressure with the left han. The abdominal feathers are parted by the left index finger. The right hand is free for manipulation of instruments.

A dose of 0·05 to 0·1 cc. is sufficient and may be discharged in one or several localities by slight movements of the needle in the region mentioned. On some occasions a little blood may be seen upon withdrawal. Rarely traces of yolk occur, proving that damage has been caused to one of the ripening ova.

The use of a trocar and canula with a special syringe with a 6 cm. long glass nozzle, has been successfully attempted and excludes these risks to a large extent. (See figure III).

Factors Affecting Results.

Transfer of semen:

The results to be expected depend on the influences to which the semen is exposed during transfer.

(a) Chemical injury: Spermatozoa are easily injured unless all utensils are given a final cleaning with 65% alcohol in water followed by rinsing with sterile distilled water and drying in dustfree air. Where desired, instruments may be rinsed with a phosphate buffer solution (pH 6·8) before use.

Paraffin wax or beeswax coating of the needle before use may be applied to avoid damage to the spermatozoa from contact with the products of metallic oxidation.

(b) Temperature Shock: This can be avoided by using warmed utensils, surroundings, and materials which have to come in contact with the semen. The temperature may be reduced gradually, warming again slowly before use.

(c) Dilution: If dilution is practised the diluent should be of the same temperature as the semen. Add the diluent slowly to the semen, drop by drop at first, continuously mixing during the process, to avoid dilution shock. Physiological saline, Ringer's solution, fresh egg albumen, or 50% egg yolk in phosphate buffer solution (pH 6·8) may be used.

(d) Storage: The best fertility on record, obtained from stored fowl semen, was with pure semen covered by liquid paraffin and kept at 55°-60°F. for one day (Warren and Gish, 1943). Lower temperatures, however, increase the survival time of sperm as judged by motility.

Selection of Hens:

(a) Intensity of Egg Production: Some workers (Lamoreux, 1940; Jones and Lamoreux, 1942) have shown that heavier egg production in the hen is favourable to good fertility. Good producers have maintained the highest degree of fertility for the longest periods. Obviously the production of very excitable birds will suffer from handling. This is most common in the light breeds.

(b) Health of the Hens: Birds must be free from pathological conditions of the genital organs. Although their resistance to peritonitis is naturally high, impure semen, dusty atmosphere and injury to internal organs must be avoided in the operation.

Experimental Findings.

A series of intraperitoneal inseminations has been carried out, along the lines described above, and the findings will form the basis of a communication that is in the course of preparation.

Some facts emerging from these investigations are:—

(1) During all seasons fowls were successfully inseminated by intraperitoneal injection, some repeatedly. Fertile eggs were obtained from 21 out of 23 fowls inseminated. Of the 75 inseminations with single doses, 64% were successful.

(2) The minimum time observed for the interval between artificial insemination and the laying of the first fertile egg was 19 hours. Nicolaides (1934) found a minimum of 19·50 hours, and Hammond (1940) described the length of the period as usually 30 hours.

(3) The first ovum liberated after insemination was fertile in 37 out of 48 successful inseminations; the second in five; the third and the fourth in two cases each; the fifth in one and the seventh in one. The fertility of eggs laid after natural insemination does not reach its maximum until the third to the fifth day after introduction of the cock into the pen (Hammond, 1940). Fifteen minute stud mating of hens taken from the trapnest after oviposition results in 60% fertility of first eggs and 30% fertility of second eggs laid after fertile copulation. (Nicolaides, 1934).

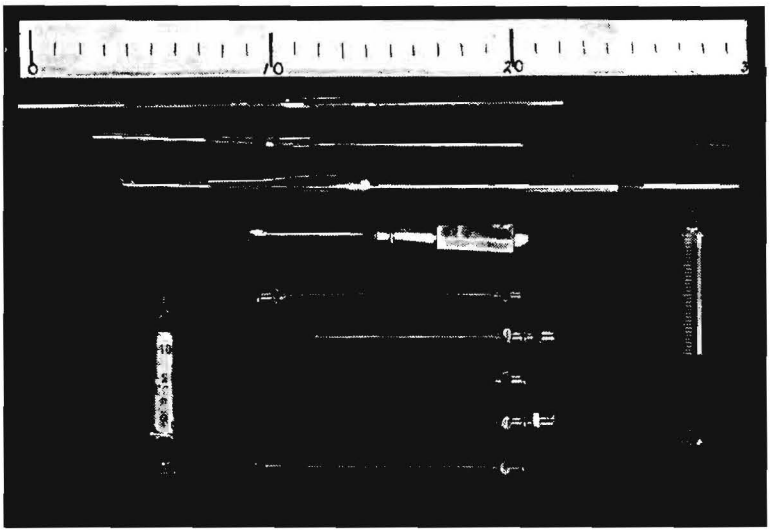

Fig. III. — Instruments for Intraperitoneal insemination of birds: Photo of special glass syringes made of thick glass capillary tube sweated to wider tube in a flame and fitted with a wood and cotton wool piston. All-glass syringes with metal needles and a bacterial glass pipette with side opening near blunt tip for use with the trocar and canula. Rule in centimetres.

(4) The duration of fertility after intra-peritoneal insemination varied from 2-25 days with an average of 10-20 days. Fertile eggs laid on the 32nd and 35th day after removal of the cocks have been reported for natural insemination (Crew, 1926; Nalbandov and Card, 1943).

(5) Hatchability was in isolated instances maintained to the 24th day, the average was 7·23 days. Hatchability has not been recorded

to last beyond the 19th day after the removal of cocks from the fowl pen. (Nalbandov et. al. 1943). The retention of *normal* fertilizing powers of fowl sperm, living in the female organs for a period of 552 hours, is thus placed on record.

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NOTES ON MODERN THERAPY.

H. O. MÖNNIG,
Onderstepoort.

1. *Sulphonamides.* It has been reported that the administration of sulphonamides simultaneously with antimony preparations increases the efficacy of the latter against certain internal parasites. Although the toxic effects may also be increased, it may be useful to test such simultaneous treatment for instance in cases of nagana and schistosomiasis.

2. *Phenothiazine.* A summary of our knowledge on this drug was recently published in this Journal. I may briefly repeat that Phenothiazine is satisfactory against (a) strongyles in horses—dose 5 Gm. per day for 4-5 days, given in a small quantity of bran mash, which is taken readily; two treatments annually should suffice in most cases; against bots and ascarids carbon bisulphide has still to be given as well. (b) Ascarids in pigs—dose about 0·2 Gm. per pound, treating a few pigs at a time, all of the same size, and mixing their dose in a mash which is fed in a trough; the results are as good as those obtained with the quality of oil of chenopodium which is usually supplied in the Union of South Africa. (c) Worms in sheep —giving one dose annually just before the rainy season starts and then a large dose, i.e. 50 Gm. to an adult animal; for regular dosing, which is necessary under our conditions, the drug is too costly.

3. *Gesarol, later named D.D.T.* This drug will probably solve many of our major and minor veterinary-entomological problems. Of the major problems the following are receiving consideration:—

(a) *Ticks.* Tests so far indicate that engorged female ticks are not as readily killed as males and the younger stages. However, the results may be satisfactory if treatment would protect animals against infection for some time and this is now being investigated. The method of applying Gesarol to animals such as cattle has also to be investigated, as it will probably not be economical to dip the animals. At present an emulsified benzol solution of the insecticide is being used, but it may be necessary to add an ingredient which will cause the drug to stick better to the coat of the animal.

(b) *Sheep blowfly.* As a larvicide for third-stage blowfly maggots Gesarol has so far not been satisfactory. However, the young maggots are easily killed by the drug and its main use may be as a prophylactic against blowfly strike. When applied as an emulsified benzol solution, the water and benzol will evaporate while the Gesarol will dissolve

in the wool-grease and remain on the sheep. It does not appear to have any adverse effects on the sheep, although in general, solutions of the drug in vegetable and animal oils and fats are dangerous because they are liable to be absorbed. Sheep treated two months previously still resist artificial strikes and it is possible that such protection may last a few months. Field experiments are to be started immediately.

(c) *Tsetse flies.* There are two ways in which Gesarol might be used. Firstly for the treatment of the legs and lower abdomen of animals to kill the flies. A test is being made at the Umfolosi Reserve by Mr. Kluge and it was found that for several days tsetse engorging on a sprayed animal died soon thereafter. The tall grass and scrub through which the animals walk, however, tend to brush off the insecticide, and again there is the need for a substance which will cause the material to stick to the animal's coat. Such a treated animal may kill very many more flies than a trap.

Secondly there is the possibility of destroying tsetse flies by the aerosol method of spraying when they are concentrated in their permanent haunts during the dry season. This may be costly, but an expense of, say £10,000 to spray the Umfolosi Reserve compares very favourably with the amounts that have already been spent there without exterminating the fly.

In regard to other entomological problems one may think of parasites such as the horn-fly (*Lyperosia*) and the horse-fly (*Hippobosca*) which live in close contact with their hosts and could be very readily killed and in all probability exterminated by means of this insecticide. Sheep keds are killed by concentrations as low as 0·01%. If a flock of sheep is dipped in a Gesarol dip once annually after shearing it should be cleaned of all external parasites, because any ked pupae or nits of lice hatching within 2-3 weeks or longer would be killed by the drug still remaining in the fleece.

Intensive research on the practical uses of Gesarol have been started and we may look forward to interesting developments in the near future.

4. *Worms in cattle* have been on the increase and have caused severe losses particularly during the last few years. This is partly due to the difficulty of obtaining certain remedies.

Hookworms (*Bunostomum*) and the small *Cooperia* species are widespread. The latter especially may be overlooked at post-mortem, but their long, narrow eggs are easily recognised in faeces examination. They appear to be rather pathogenic. The immature paramphistomes have also caused losses in many parts of the Union.

For the treatment of cattle the ordinary anthelmintics recommended for sheep are suitable. In this connection a simple and cheap method of emulsifying tetrachlorethylene and carbon tetrachloride which we have recently developed might be mentioned. This avoids

the use of mineral oil and cuts tins, transport and handling costs by 50%, while the emulsions are swallowed by the animals without coughing and choking. Resin is dissolved in the remedy and is then saponified by strong caustic soda solutions in such a way that a clear, homogeneous mixture is obtained without the use of an accessory solvent. The product contains about 99% tetrachlorethylene or carbon tetrachloride and its cost is very little more than that of the drug itself. It readily emulsifies when shaken with water. The benzol used for Gesarol emulsions is treated in a similar way.

Case Report.

MILK FEVER IN A GOAT.

L. VON MALTITZ,
Keetmanshoop.

Since milk fever is apparently not frequently met with in goats, the following case in a nanny goat, which showed symptoms similar to those seen in milk fever of cows, and which responded very well to treatment with calcium gluconate, might be of interest.

A valuable Swiss nanny goat, about 3½ years old and yielding 8 pints of milk per day, gave birth to twin kids which were normal in every respect, strong and healthy.

24 hours later she refused food and water, appeared drowsy, took little interest in the kids and lay down frequently. Three hours later muscular inco-ordination was apparent, efforts to place the animal on its legs were unsuccessful, and very soon afterwards coma and loss of consciousness developed. The animal lay with the legs drawn in under the body, and the head and neck stretched towards the side, with the nose pointing towards the left flank. The eyelids were partially closed, the pulse was almost imperceptible, breathing slow but not laboured, and temperature subnormal.

At this stage, a tentative diagnosis of milk fever was made, and a solution of 7 gm. calcium gluconate, 1½ gm. boric acid and 45 ccs. water was slowly injected into the jugular vein. Improvement was noticeable after a few minutes, and 13 minutes after the injection was completed, the animal got on to its legs, took an interest in the kids, defaecated and urinated. Recovery was so rapid that inflation of the udder was no longer considered necessary. The owner was instructed not to milk the goat for two days, except to relieve the udder, and recovery was uninterrupted.

This history of this animal showed that twin kids were also born and successfuly reared by it about 10 months before, but that nothing abnormal occurred on that occasion.

CASE REPORT.

MORTALITY AMONGST CATTLE AND SHEEP CAUSED BY MANGELS.

S. L. SNYDERS,
East London.

History of Cases:

In July, 1943, Government Veterinary Officer de Wet, of Kokstad, was called out to the farm Fischerman's Bend, belonging to Mr. A. Miller, in East Griqualand, where three heifers had died suddenly. Smears and arsenic tests proved negative and a diagnosis of vegetable poisoning was made. It was known that mangels were being fed to these animals.

On the 9th September I accompanied Mr. Miller to the farm where five heifers and one ox had since died. After I had heard the full history I suspected mangels as the cause of the mortality.

According to the owner, two hundred dry merino sheep were running in a piece of land containing a big patch of oats. These sheep were perfectly healthy, were getting sufficient from the oats from 9-11 a.m. and never bothered to cross the stream to a field of mangels on the opposite side.

However the oats were gradually grazed off and sheep started going across to the mangels. Mortality started and two fat hamels died. The sheep were dosed with sulphur, but the next day more sheep crossed and two more died. Another two deaths occurred on the following day, but still the owner did not suspect the mangels as it is a feed well known to all farmers in East Griqualand.

By that time there were very few pickings to be had from the oats and the sheep were left in the mangel field throughout the day. The evening at 5 p.m. eight hamels were found dead, one apparently on the point of dying and two sickly. The latter two also died but the sick one recovered after a dose of castor oil.

The mangels were then immediately pulled out and gathered in a heap near the homestead.

One morning the owner gave fifteen heifers a large cart load full of these mangels at about 9 a.m. The heifers consumed them all and were driven off at 12 noon in order that four milkcart oxen might be fed. These animals were given two wheelbarrow loads full.

That evening the heifers were not seen and the oxen appeared normal. The next morning one cart ox and five heifers were dead.

Post-mortem held by me that same morning revealed the following main pathological findings:—

(1) general cyanosis,
(2) advanced hyperaemia and oedema of the lungs,
(3) subepicardial petechiae,
(4) acute catarrhal abomasitis.

The rumens were filled with masticated mangels but contained no gas.

Nothing abnormal could be noted about the mangels, which were still fresh, and three bags of them were then forwarded to Onderstepoort for feeding experiments.

I was informed that another complaint about mangel feeding to stock was referred to the Director of Veterinary Services by Mr. G. R. Bouchier, Komgha, East London, whose total loss was seventeen.

Drs. D. G. Steyn and S. J. van der Walt of the Toxicology Section, Onderstepoort, conducted the following feeding experiments: The results are hereby recorded by their kind permission.

(a) *SPECIMENS* 11422-25. 16.9.43. *BETA VULGARIS L.*

Submitted by Mr. Miller. The mangels which were fresh were minced and administered to sheep as follows per stomach tube:—

(1) SHEEP 64549 (6-tooth, 31·9 Kg.) received 2·4 Kg. of the mangels in the course of seven hours.

Symptoms: The animal died overnight on the day of drenching.

Post Mortem: Slight p.m. changes. General cyanosis; slight hydrothorax; hydropericardium; hyperaemia of mucous membrane of trachea and bronchi; hyperaemia, oedema and emphysema of lungs; subepicardial petechiae; slight regressive changes of the myocardium; regressive changes of the liver and kidneys; hyperaemia of the abomasum and small intestine; stasis of the contents of large intestine.

(2) SHEEP 66631 (6-tooth; 34·1 Kg.) received 7·2 Kg. of the mangels in the course of four days.

Result: Negative.

(b) *SPECIMEN* 11540. 16.9.43. *BETA VULGARIS L.*

Submitted by Mr. G. R. Bouchier. The mangels which were fresh were minced and administered to sheep as follows per stomach tube:—

SHEEP 66692 (6-tooth. 31·9 Kg.) received 13·2 Kg. of the mangels in the course of five days.

Result: Negative.

Summary.

Altogether A. M. Miller lost eight heifers, one ox and sixteen sheep and R. G. Bouchier a total of seventeen head of cattle; one sheep died in the feeding experiments.

Discussion.

According to Marshall (1942) mangels may under certain circumstances contain abnormal quantities of nitrates so that deaths following the feeding of mangels may be due to nitrate poisoning. Unfortunately the nitrate content of the above specimens of mangels could not

be determined. Marshall also states that poisoning can be avoided by lifting and storing the roots for two months before use.

If the mangels contained a poisonous principle and this was responsible for the death of sheep 64549, then one would have expected sheep 66631 and 66692 also to have been poisoned. It is therefore considered probable that sheep 64549 died, not as a result of poisoning, but as a result of acute digestive disturbances following on the excessive consumption of mangels. The mortality described in cattle and sheep would consequently appear to be due to over-eating. It is common knowledge that over-eating of maize, wheat, etc., may cause mortality.

ACKNOWLEDGEMENTS.

I wish to express my sincere appreciation to Drs. D. G. Steyn and S. J. van der Walt for conducting the feeding experiments and recording the detailed post mortem findings.

My thanks are also due to Mr. A. M. Miller who furnished me with the valuable history.

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FIELD RESULTS WITH AVIRULENT ANTHRAX VACCINE.

MAX STERNE, Onderstepoort. J. NICOL East London. and M. C. LAMBRECHTS. Umtata.

Two years ago we published the results of active immunization in South Africa from 1925-1941 [Sterne, Nicol and Lambrechts (1942)]. Stress was laid on the anti-anthrax campaign in the Transkei, once the most heavily infected part of the Union. The present article is a brief follow-up of the earlier paper.

We wish to emphasize that the figures for the Transkei and Natal are very reliable indeed. Because of the War a proportion of the Transkei cattle were only inoculated once in two years. A flare-up of anthrax was not anticipated as so many of the Transkei districts had been clean for several years. The anthrax position continues to show a steady improvement. It is interesting to compare the incidence of anthrax in England and South Africa. In 1943-4 (for 11½ months) there were 275 confirmed outbreaks in England (Vet. Rec. 56, No. 2, 1944) as compared with 188 in South Africa for 12 months. Not so many years ago the Union was regarded as a seriously infected country. Between 1937-9 about half the vaccine used was the avirulent uncapsulated type, and since 1939 all the vaccine has been made from these avirulent strains.

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Comparison of Anthrax in the Transkei, Natal and in the Rest of South Africa

Area	*Year*	*Cattle Population*	*No. of Smears Received*	*No. of Cattle Inoculated*	*No. of Anthrax Outbreaks*	*No. of Anthrax Deaths*
Transkei	1941-2	1,589,800	299,129	1,585,300	13	13
	1942-3	1,501,907	198,199	485,150	6	6
	1943-4	1,481,920	206,758	932,000	2	2
Natal	1941-2	2,944,427	431,059	555,568	53	135
	1942-3	2,919,309	387,363	510,906	39	81
	1943-4	2,916,399	431,059	540,399	24	35
Rest of * South Africa	1941-2	Approximately 8 millions	190,000	3,000,000	274	1,151
	1942-3		155,000	3,500,000	221	695
	1943-4			3,250,000	162	447

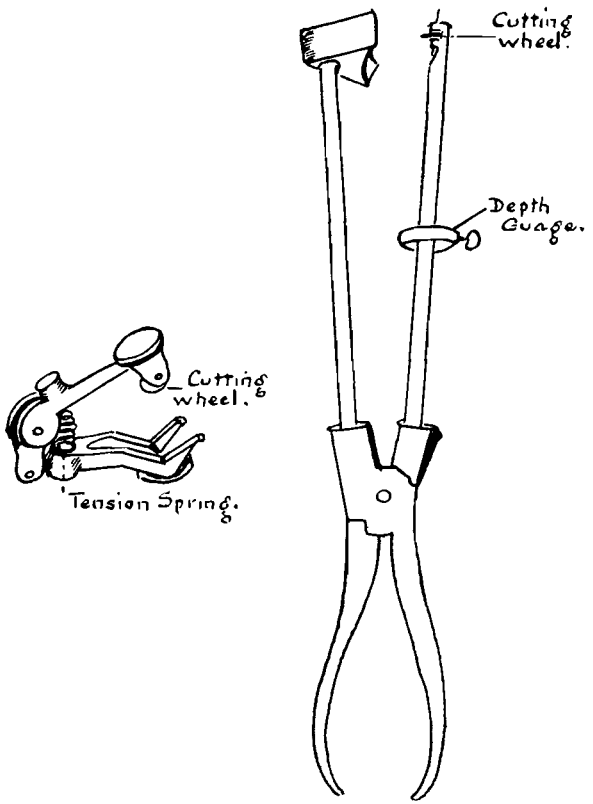
* The figures for the Rest of South Africa are reasonable approximations; but are not as reliable as those for Transkei and Natal. This is obvious from a comparison of the number of smears received with the total population.

A USEFUL HOME MADE GLASS ROD OR TUBE CUTTER.

L. HILL,
Allerton, Pietermaritzburg.

In most laboratories the necessity often arises for cutting various sizes of glass tubing or test tubes, but so far no single glass cutting instrument has been found to fulfil this purpose entirely.

Owing to the war with the consequent shortage of glassware it has been found necessary to try and utilize old discarded tubing and test tubes that have been broken at the lips. There are instruments on the market for the cutting of glass tubing and the two most commonly used are shown in a drawing attached. The smaller of the two is used for cutting tubing externally, while the second, with the thin steel arm and an adjustable sliding gauge, is utilized for cutting tubing internally.



Two kinds of glass cutter.

Both these instruments are useful for cutting small amounts of tubing or small numbers of tubes. They have, however, some disadvantages, the cutting wheel of the small instrument soon loses its edge and has to be frequently sharpened or replaced by a new wheel. Enough glass must be left on each side of the cut to enable the operator to obtain a firm grip to make the break. If not, the cut tube does not break cleanly. This results in breaking off more glass than is necessary from an already short test tube.

In the case of the second glass cutting instrument, the arm is usually too long and the diameter of the test tube or glass tubing too small for inserting the cutting arm.

The necessity for cutting down chipped test tubes and blood collecting tubes for B.W.D. testing became so urgent that the apparatus now to be described was designed.

It can cut almost any type of glass rod or test tube no matter what the diameter is and it is now in daily use at Allerton Laboratory. The apparatus, as at present constructed, will cut tubing up to 9½ inches in length, but by increasing the length of the baseboard, any length can be obtained.

It was constructed from odd pieces of wood, flat iron, strap iron and copper. The only part that had to be purchased was the diamond. A medium grade glazier's glass cutting diamond is necessary. The diamond pencil used for marking smears is too soft and is not embedded firmly enough in the holder. The price of the glazier's diamond is 25/-.

It is easy to use and once the technique of cutting is mastered, an assistant can cut from 1,500 to 2,000 tubes a day.

Description of Apparatus.

The apparatus is made up as follows:—

A (figure 1) is the baseboard and to its back edge is screwed a piece of wood B against which a longitudinal strip of metal C fits. This strip of metal is slotted along almost its entire length and the end nearer the diamond is bent up at right angles. The strip of metal can be moved forwards or backwards according to the length of tube required to be cut. Once the desired length has been obtained it is fixed by means of a wing nut.

A thin metal plate known as the Sheath Adaptor (fig. 2) is now rivetted with four small rivets to the right angled bend of metal C and the four flanges bent inwards, to form slots for the easy insertion of one of the sheaths (fig. 3 and D in fig. 1).

There are four sheaths and to each a section of piping is soldered. These sections of piping vary in diameter in order to accommodate the varying sized tubing to be cut, and to prevent any side to side

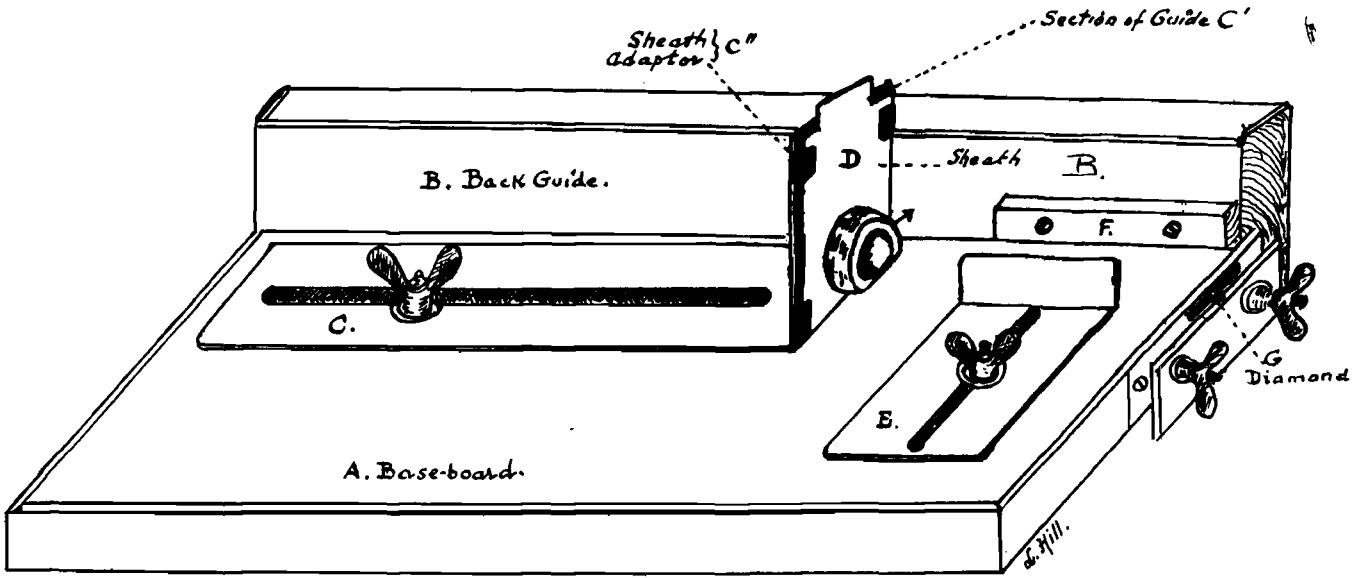


Fig. 1.

Drawing of apparatus showing different parts.

movements while cutting is in progress. Two further additions to prevent side movements are found in the strip of wood F (fig. 1), which is screwed to the back rest B (fig. 1), and a slotted strip of metal E (fig. 1), which also fulfils a similar function to metal C (fig. 1), viz. it can be adjusted according to the diameter of the tube to be cut and at the same time hold it. The small piece of wood F (fig. 1) is necessary in order to allow for the spacing between the outer edge of the soldered piece of piping on the sheath and the back rest B (fig. 1).

The glazier's diamond, unscrewed from its handle, is held in position at the edge of the board by means of two metal plates which are closed by two wing nuts. The diamond point projects slightly above the level of the base board. The height at which the point should be set can only be arrived at by trial and error. The whole apparatus can be screwed permanently in position on a bench or held firmly by means of clamps.

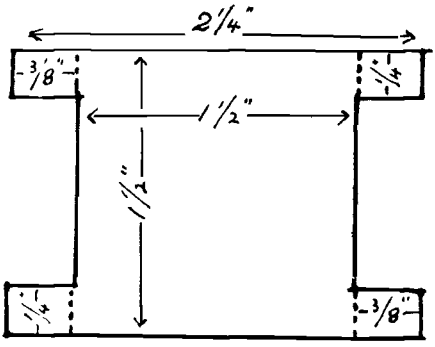


Fig 2. Sheath Adaptor Bend at dotted lines

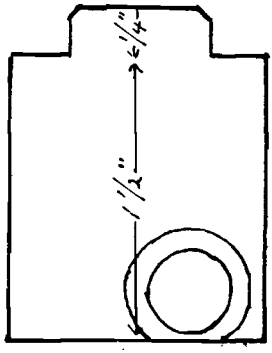


Fig 3. Sheath With Section of piping soldered in position.

CONSTRUCTION OF THE APPARATUS.

The baseboard is made from a piece of hardwood, such as oak, jarrah, etc., 12" long x 7" wide x ¾" deep. The front and side edges are slightly bevelled to prevent the wood splintering with use, and to give the whole apparatus a more finished appearance.

The back-guide B is made from similar wood, and measures 12" x 1½" x ⅞".

The metal strips C and E are made from any suitable flat iron (strap iron being used in the apparatus described). This is 1½" wide x 1/16" thick.

A longer strip C should be cut to a length of 9¾", the end being bent up at right angles to give an upright of 1¾". A slit wide enough

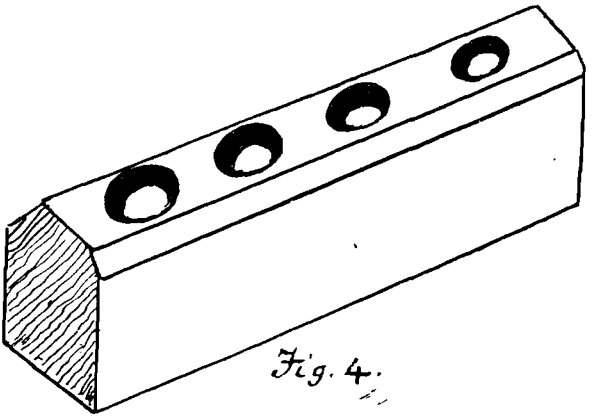
to accommodate a quarter-inch bolt is now cut along the entire length to allow of its being moved forwards and backwards as required, and is held in position by a wing-nut.

A second piece of thin sheet iron measuring approximately 2¼" x 1½" is cut as shown in fig. 2, leaving four flanges each ⅜" x ¼".

A shorter strip of metal or guide E is cut to a length of 4", and the turn up portion to a depth of 1". This is slotted along its length in the same way as C and is also held in position by a bolt or wing-nut.

The sheaths (fig. 1D and fig. 3) are cut from thin sheet metal and should be 1¾" high, and kept slightly under 1½" in width, to permit sliding freely in the grooves of the sheath adaptor.

They should be cut as shown in fig. 3, leaving ¼" projecting at the top to form a grip enabling them to be inserted and withdrawn with comparative ease.



Block of wood with holes for breaking small pieces of glass.

On the face of each sheath, at the lower right hand corner, is soldered a small section of piping of various inside dimensions, varying from ⅜" to ⅞" in diameter, and approximately ⅜" deep. The lower rim is then filed flat to allow of its resting squarely on the surface of the baseboard.

For holding the diamond, two metal plates 2" long x ¾" wide x ⅛" thick are now cut. In the one plate, two small holes are drilled near the outer edges to accommodate wood screws. Both plates are drilled with a 3/16" hole at ½" from each end, leaving a space ¾" between the holes.

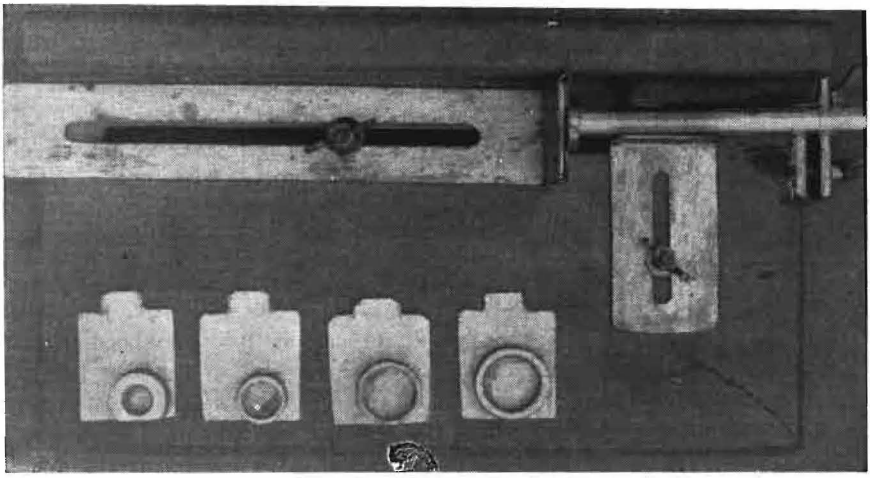
The edge of the baseboard is chiselled out to receive the one plate. Insert two bolts 1¼" long x 3/16" thick through the holes already drilled. Countersink the baseboard to accommodate the bolt heads and

screw this plate firmly in position to bring it flush with the surface of the board (see fig. 1).

The second plate is now slipped over the bolts and wing-nuts screwed on to keep it in position.

Method of using the Glass Cutter.

The end of the tube or piece of tubing to be cut is inserted into the lead tubing on the sheath and the strip metals C and E adjusted to the correct distances. The diamond has been adjusted so that it just touches the glass. The glass is now rotated by the finger over the diamond point without much pressure being exerted on it. This produces only a very faint mark over the whole circumference of the glass. This is to ensure a clean break. Too much pressure against the diamond point produces a deep opaque mark with the result that when the glass is broken a jagged edge is left.



Showing apparatus and parts with glass tube being cut.

Where a tube is already short and it is desired to remove only a broken lip by cutting below the break there is too little glass beyond the cut to grip with the fingers to make the break.

To obviate this difficulty a piece of hard wood 4″ long x 1″ wide x 1½″ high was cut and bevelled. Along the top edge holes are drilled one inch apart and of varying diameters (fig. 4). The edges of the holes are carefully sandpapered to remove any rough fragments of wood caused by the drilling.

The tubing or the tube is inserted up to the cut mark into the hole which corresponds nearest to the diameter of the tube or tubing. A break is made and in about 80% of the cases the break will be a clean one. The broken glass left in the hole in the wood must be pushed out.

AN OUTBREAK OF SEVERE STOMATITIS IN CATTLE.

W. J. WHEELER, Piet Retief. J. H. B. VILJOEN, Vryheid. and E. M. ROBINSON, Onderstepoort.

Early in June, 1943, one of us (W.J.W.) described cases of a peculiar form of stomatitis which he had encountered on some farms in the Piet Retief area. In these cases the mucosa of the tongue came away when handled, leaving a raw granulating surface and in some cases necrotic lesions were seen on the lips as well. No vesicle formation was observed and it was noticed that in some cases the horns became detached when the animals were caught by them. At a post mortem on one animal a haemorrhagic enteritis was described by the local stock inspector. Some form of corrosive poisoning was suspected, but no suspicious material could be found that might have been the cause.

About the middle of June one of us (J.H.B.) reported a similar condition on a farm in the Paulpietersburg district and as he wished to exclude the possibility of foot and mouth disease a visit was made to the farm with him to carry out the necessary tests.

At the time of this visit there were seven cattle affected. Six of these were heifers about eighteen months to two years old and one was an adult cow. The owner had noticed symptoms of salivation in some of the animals four days previously and on the day before our visit had reported the condition to the Government Veterinary Officer, Vryheid. On examining the cases it was found that in four of them there was an extensive erosive condition of the mucous membrane of the tongue extending from the tip along the roof of the organ to the pharnyx. The mucous membrane was liable to become detached when the tongue was handled, leaving a granulating surface. The general appearance of the upper surface of the tongue was of yellowish patches of necrotic epithelium interspersed with irregular granulating surfaces. In two cases there was erosion of the mucous membrane of the interdental space. In the other cases the tongue was very smooth, glistening and difficult to grasp but no actual erosion could be seen. The papillae appeared to be absent. It was impossible to say of these latter cases whether they were incipient or recovered ones.

All the animals showed marked salivation and some showed slight stiffness of gait, but no evidence could be seen of any lesions in the foot region. As stiffsickness occurs on this farm and neighbouring ones, one could not be certain that the stiffness was associated with

the disease under investigation. The temperatures of all the affected animals were taken but only one was up to 103°F the rest having temperatures under 102°F.

In two cases the horns came away when the animals were being handled for examination. No inflammatory condition of the nasal mucous membrane could be seen.

The animals were scarcely able to eat and the owner had been feeding them by drenching. The condition seemed to be improving and the animals were apparently recovering.

An inspection of all the other cattle on the farm was made by the local stock inspector and the check inspector. There were about 200 cattle on the farm but only one showed a small tongue lesion which was obviously due to an injury.

Guineapigs were inoculated intradermally with material from the tongue lesions, into the pads of the hind feet, but no lesions developed within seventy-two hours. An inspection of the farm for possible poisonous plants was fruitless and the water supply, which was a dam used for breeding carp and black bass, could not be incriminated. As the result of the guineapig inoculation was negative, scrapings from the tongues were taken in saline buffer solution and blood in citrate solution for further experimental work.

On the third day after the first visit to the farm Col. van Heerden, Assistant Director of Veterinary Services, and Mr. Neser, Senior Veterinary Officer, Transvaal, saw the cases and expressed the opinion that foot and mouth could be excluded.

At the time of this visit to the Paulpietersburg outbreak, another one was reported from Piet Retief district and the farm was visited by us. The findings were very similar to those in the previous outbreak. The farm was situated in the middle of a wattle plantation, as are many others in this area. Eight animals were affected, in most cases two-year-old cattle. One animal was in a very weak state and probably did not survive. It is unnecessary to describe the mouth lesions as they were essentially the same as those seen on the other farm. Here again the looseness of the horns was noticed and in two animals there was a distinct reddening of the nasal mucous membrane. The temperatures of all the animals were taken but none was over 102°F. Two animals showed a stiffness of gait but no foot lesions were seen.

A further outbreak of this condition was investigated on a farm close to Vryheid. The symptoms and lesions were again identical with those previously seen. All the cases were in two-year-old animals, the cows and calves not being affected. In one case a horn came off when the animal was caught for examination. The tongue lesions were very severe and were found to be present in all animals showing salivation. The cattle were all running in a large camp which had

been ploughed up and contained a number of mealie stalks and a lot of weeds. No plants could be found which might have been in any way associated with the causation of the disease. The owner offered to sacrifice an animal and a well developed case was selected for post-mortem. No changes could be found in any of the internal organs. The lesions on the tongue extended to the pharynx, which showed erosions with a yellowish deposit of necrotic material on them. The lesions extended down the oesophagus to the cardia, but the rumen showed only slight erosive changes at the entrance of the oesophagus. There was marked hyperaemia of the nasal mucous membrane and of the lining of the paranasal sinuses, but no erosion. Material was taken from the tongues of some of the animals and citrated blood for further experimental work.

Attempts were made to transmit the condition by scarifying the tongues of two-year-old cattle and rubbing in material from the tongues. Blood was inoculated into cattle and sheep. The results of these experiments were completely negative.

The possibility of some erosive poison having been associated with the condition was considered but no trace of any such substance could be found on the farms concerned. One would have expected lesions of the cheeks and palate in such a case.

One common factor on the three farms visited was the presence of wattle trees, most of them heavily infected with bag worms. The eating of either wattle leaves or bag worms has never been known to produce any symptoms in cattle and no tests were made with them. A further small outbreak, involving two cattle, was investigated in the Heidelberg district of the Transvaal about the same time. The two animals showed typical lesions as seen in the previous cases. There were no wattle trees in the neighbourhood.

According to reports other outbreaks occurred in the Northern Natal, Piet Retief, and Volksrust areas, but the disease soon subsided

Differential Diagnosis.

As this is the first time this particular condition has been encountered in South Africa, a brief summary of the symptoms and lesions encountered in cattle diseases characterized by stomatitis will be given from the point of view of differential diagnosis. The diseases in question are: (1) foot and mouth disease; (2) blue-tongue; (3) erosive stomatitis; (4) peeling tongue disease and (5) miscellaneous conditions such as actinobacillary ulcers, non vesicular lesions, wounds and abrasions.

(1) *Foot and mouth disease.* Vesicles occur on the gums, lips, cheeks, palate and tongue, and may be up to the size of a hen's egg. The fluid is clear at first, then yellowish, finally becoming cloudy. When the vesicles rupture an intensely red, raw, moist, painful area

is left. In a few days new epithelium forms, leaving yellowish brown spots. The lesions may extend to the muzzle but the cornea is rarely affected. There is lameness and the coronary bands, the skin of the interdigital space and the heels are inflamed for a few days before vesicles form. The vesicles rupture very readily and brown scales or crusts form, under which there is a raw, red, moist surface. Vesicles sometimes occur on the udder.

(2) *Bluetongue.* Bekker, de Kock and Quinlan (1934) describe the following symptoms and lesions in cattle: There is usually well marked frothing at the mouth and salivation. In mild cases there is a localized stomatitis with necrosis on the dental pad, borders of the lips and under the apex of the tongue. The epithelium is yellow and is usually partially attached to the underlying tissues; if detached a red and bleeding surface is left.

In more severe cases the lips, nose, muzzle, tongue and dental pad are all affected, showing hyperaemia and swelling. There is usually a marked nasal discharge, catarrhal, muco-purulent or muco-haemorrhagic. The lips are red and swollen, with necrotic lesions along the borders and on the inner surfaces. The tongue is red and swollen, even bluish sometimes, and may protrude from the mouth. Extensive necrotic lesions may be seen on the ventral surface of the apical portion. Sometimes there are deep seated and extensive necrotic lesions on the tongue, usually on the dorsal and lateral aspects of the body of the organ. When necrosis on the dental pad is extensive it is usually confluent with similar lesions on the upper lip. Lesions may be seen on the gums and in the interdigital space. The breath is offensive. Healing commences after three to four days. On the muzzle a thick scab forms, which peels off leaving a clean surface. The deep seated ulcers take some time to heal. Teat lesions occur sometimes, in which case a thick scab forms which peels off in a few days, leaving a fresh, clean surface. In very severe cases skin changes may occur in the form of an acute dermatitis with reddening of the unpigmented skin. The skin is swollen and painful especially along the back, with a small amount of straw coloured exudate which dries and mats the hair. Hard crusts and scabs form.

(3) *Erosive stomatitis.* Mason and Neitz (1940) describe the lesions seen in this condition, which was encountered during the outbreak of foot and mouth disease in Natal in 1938. Lesions were seen which had a faint resemblance to old foot and mouth erosions. They were flatter than healing cuts and were covered with a greyish material which on being scraped away, left a papilliform, non-bleeding surface. In rare cases only did the lesion resemble those of foot and mouth disease. In one case there was a tongue lesion almost completely circular 4 to 5 cm. in diameter and 0·8 cm. deep, with a regularly papilliform and even base, and clean-cut and regularly circular edges. The mucous membrane of the mouth was unchanged and there

were no foot lesions and no clinical symptoms. Within a few days the lesion had become almost filled with a pseudomembranous deposit, which when scraped away left a uniform reddened base. Sixteen days later only a circular scar 3 cm. in diameter was seen. On the first day, salivation was seen, but no further symptoms. Transmission to guineapigs was unsuccessful but succeeded with cattle.

(4) *Peeling tongue disease.* This condition has been described as occurring in Great Britain, in cattle from Northern Ireland. Brownish coloured markings appeared on the tongue and a thin layer of surface epithelium was found to be peeling off in patches from the tongue and also from the lips in some cases. The corium was not exposed and there were no vesicles or soreness. No foot lesions were seen and the mouth lesions were only seen when the mouth was opened. The cattle were quite normal to all appearances and had no fever. The condition was not communicable to pigs or sheep.

The lesions of the tongue commenced as brownish to dark brown spots on the mucous membrane, circular in shape up to the size of a sixpence, anywhere on the dorsum of the tongue. They might increase in size but were only slightly raised. No vesicle developed and there was no fluid under the spot. The epithelium gave way and was removed in flakes. The spots might become confluent and large flakes come away. The condition could be transmitted experimentally to other cattle.

A condition which was probably the same as peeling tongue disease was seen in cattle in the Dundee district of Natal in 1938. The lesions were essentially the same as those seen in peeling tongue disease and the condition was only noticed by chance, as no symptoms were shown.

(5) Other odd conditions may occasionally be met with. In actino-bacillosis, ulcers of the tongue and buccal mucous membrane are frequently seen. In such cases a bacteriological diagnosis should decide the issue. The ulcers are generally in the form of fairly regular ruptures of the mucous membrane through which granulating tissue protrudes giving a somewhat cauliflower-like appearance. Other non-vesicular lesions may be seen occasionally and it is quite common in cattle in South Africa to encounter various types of tongue injury. These usually take the form of small cuts but portions of mucous membrane may be detached. These injuries usually heal very rapidly.

The condition described in this article would appear to be quite different from any of the diseases mentioned in the differential diagnosis. Foot and mouth disease was excluded by guineapig inoculation and the fact that the disease could not be transmitted would differentiate it from bluetongue and from the erosive stomatitis described by Mason and Neitz. It would appear that the condition is a new one and further investigation should be carried out should further outbreaks occur.

SUMMARY.

A peculiar condition in cattle characterized by the occurrence of a severe diffuse erosive stomatitis is described.

Attempts at transmission were unsuccessful and the cause of the condition could not be discovered.

REFERENCES.

BEKKER, J. G., DE KOCK, G., and QUINLAN, J. B. (1934). Onderstepoort J. Vet. Sci. 2(2) 393.

MASON, J. H., and NEITZ, W. O. (1940). Onderstepoort J. Vet. Sci. 15 (1 and 2) 159.

SUCCESSFUL TREATMENT OF A CASE OF STRYCHNINE POISONING WITH MORPHIA AND NEMBUTAL.

J. R. FREAN,
Rustenburg.

I was recently called out at noon to a case of suspected strychnine poisoning in a dog, a young cross-bred Alsatian, and rushed there with a syringe and morphine tablets. I found a typical case of acute strychnine poisoning and immediately administered Grs. i of morphine sulphate, distributing the dose over several points to obtain rapid absorption. Within ten minutes emesis occurred and the vomit contained sliced fresh raw meat and mealie meal porridge, whereas the owner had fed him only mabela porridge and milk that morning.

The narcotic affect of the morphine was taking place, but the spasms continued although with somewhat diminished violence. An attempt to remove him to a quiet spot on an improvised stretcher, accentuated the spasms, so it was decided to leave him undisturbed for the time being, with strict instructions to ensure complete quiet. I returned in an hour (2 p.m.) and learnt that the spasms had continued uninterrupted the whole time. The animal was in an extremely exhausted condition and I despaired of being able to save him, and felt that he must obtain relief, and that if he died during the intended course of treatment he would, at any rate, pass out easily. I then injected Grs. iii nembutal which stopped all spasms, but an attempt to move him, brought on a violent one, so I injected a further Grs. iss which produced complete anaesthesia. At 2.30 p.m. we moved him to a quiet room: at 5 p.m. he had not moved and did not react to a tap on the nose. At 6.30 he was awake but had no spasms and showed no inclination to move. At 9 p.m. he was up, somewhat dazed, and had only partial

control over his hind limbs — the typical appearance of a dog recovering from nembutal anaesthesia, but there were no signs of spasms or of nervous irritability. He took small drinks of milk and was then covered for the night, and I left with instructions to call me upon the slightest sign of return of spasms, but my night was undisturbed.

The following day the owner brought the dog to me. He was in the best of spirits and I could detect no sign of his being any worse for his ordeal of the day before.

From previous experience I feel assured that without the augmentation of the morphine with a comparatively small dose of nembutal the patient would have died. Furthermore, a far larger dose of nembutal alone would have been required to produce the deep anaesthesia obtained with a combination of the two drugs, and nembutal alone would not have produced the emesis that usually follows injection with morphine.

STEPHEN LEACOCK ON VETERINARY EDUCATION.

(From *Here are my Lectures,* by Stephen Leacock. Published by John Lane. The Bodley Head).

"Unless we go through the organized compulsory curriculum of a school and college we can't get the legal qualification to enter a profession. In order to be a dentist we must first know what a logarithm is, and in order to be a horse doctor you have to learn Latin. The idea is that any man who has tackled a Latin irregular verb has no trouble with the inside of a horse. Sometimes it works. Last summer up at the little place I call my farm I sent for a veterinary surgeon to come over and see what was wrong with my old horse. He came and looked puzzled and said he guessed the horse was in a sort of decline. A few days later I fetched him again, but still all he could suggest was that the horse had fallen into a decline. When he came and gave the opinion the third time, I said: 'Ah, now, that's the third declension. I know all about that.'"

MOVEMENTS OF OFFICERS.

Mr. J. R. Frean from Rustenburg to Potchefstroom, 30th December, 1944.

Mr. G. P. Bishop from Malmesbury to Dundee, 3rd January, 1945.

Messrs. P. G. Joubert and L. W. van der Heever have been appointed as temporary government veterinary officers from 3rd January, 1945, with headquarters at Pretoria.

OBITUARY.

MAJOR G. T. CANNON.

Major G. T. Cannon passed away at Bethal, Transvaal, on 8th October, 1944, and his death removes yet another link with pioneers of veterinary practice in South Africa and particularly the Rand. The late G. T. Cannon graduated in London in 1889. He then took up practice at Bicester, Oxfordshire, and at a later date at Worthing. Cannon was always of an adventurous turn of mind and wanted to see new fields, so it was not surprising that he enlisted in the Army Veterinary Dept. at the outbreak of the Anglo-Boer War. He was sent to different countries in connection with the purchase and transportation of remounts. After the cessation of hostilities he was appointed Government Veterinary Officer at Standerton. He resigned his Government appointment in 1904 to take up practice in Johannesburg. He served in the 1914-18 War as A.D.V.S. in South West Africa, and later with the Union Expeditionary Force in East Africa in a similar capacity; he held the rank of major throughout, and was mentioned in dispatches.

Cannon was of a kind and genial disposition, and he endeared himself to a host of friends. He was of a practical and inventive turn of mind, and the writer is aware of the fact that one of his inventions is operating on the gold mines to-day, viz. the Cannon Automatic-Grip release appliance used in the coco-pan haulage system.

He was seventy-seven years of age. His wife predeceased him in 1932. W.A.D.

CHARLES FREDERICK HINDS.

(1884 — 1945).

All those who have worked at Onderstepoort or who have in any way been connected with it, learned with deep regret of the death of Charles Hinds which occurred so suddenly on the 13th March, 1945, at Cape Town. No administrative officer in the Division of Veterinary Services was better known than Mr. Hinds, and he was a very close friend of a large number of veterinarians. He started as a junior clerk in the Veterinary offices in Salisbury with the late C. E. Gray, with whom he was associated from 1896 — 1905.

During 1905 he followed Mr. Gray to the Transvaal, and commenced duty in the office of the Principal Veterinary Surgeon during that year. In 1907 he joined the staff of the late Sir Arnold Theiler at Daspoort, and when the Laboratory was transferred from Daspoort to Onderstepoort Mr. Hinds accompanied him. In 1930 he became the Principal Clerk at Onderstepoort, and in 1936 was promoted to Chief Clerk. On the 30th of June, 1943, he retired on pension from the activities at Onderstepoort.

Since he left Onderstepoort he has been associated with low temperature Research in Cape Town, and as a result of his experiences during his long association with Onderstepoort, he rendered sterling services and was particularly useful in organising the Dehydration and Cold Storage Laboratory.

For more than forty years Mr. Hinds was associated with the organisation and administration of Veterinary Services, first in Southern Rhodesia, and finally in South Africa. Both the late Mr. Gray and Sir Arnold Theiler recognised his sterling qualities and organising ability. They were most fortunate in finding amongst the ranks of the clerical division a man so fully capable of assisting them in their pioneer efforts to establish Veterinary Science in Southern Africa. All his work was done with rare efficiency and he became in an increasing degree a mainstay in the Veterinary organisation. He was indeed one who by his personal qualities came to occupy an important place and as the years passed he became a tradition. He was fully acquainted with every branch of the Onderstepoort Institute, and the multifarious tasks demanded of an Institution of this nature.

Charles Frederick Hinds.

He has helped to guide the activities through many difficult years, particularly during the World War in 1914 to 1918 and especially during present hostilities. In spite of almost unsurmountable difficulties Mr. Hinds maintained a supply of equipment and other urgent requirements. He was well-known to all the firms responsible for these supplies, and as a result of his personality and his persuasive manner he was able to assist the Division to carry on its activities and to serve the farming community to the best of his ability. He always considered the interests of the farming community.

We extend to Mrs. Hinds, his daughter and sons and other relatives our sincere sympathy. We feel the loss of a well-loved friend.

GILLIES DE KOCK.

NGAMILAND CATTLE DISEASE.

PRELIMINARY REPORT ON A NEW DISEASE, THE ETIOLOGICAL AGENT BEING PROBABLY OF AN INFECTIOUS NATURE.

U. VON BACKSTROM,
Maun, Ngamiland.

Introduction

This preliminary report is given in the hope that other veterinarians may have noted the same condition, and that it may induce them to publish their findings, to further the investigations and discover the etiological agent.

Definition

A disease of cattle, which is characterised by lameness, leg swelling, skin nodules and a generalised acute lymphadenitis. There is severe loss in condition and secondary complications are common.

History and Incidence

Since October, 1943, and at regular intervals during the last fifteen months, a large number of reports have been made of the occurrence of the disease. Hundreds of cattle have been affected and a dozen or more outbreaks have been investigated and confirmed.

In the writer's knowledge the condition has not previously been described, and it is confined to the Bechuanaland Protectorate. It was first reported from Makalamabedi on the Botletle River, but this was not confirmed, although the description leaves no doubt that it was the same condition that the writer first saw in May, 1944, at Rakops, south-west of the Makarakari Lake. In the meantime it had appeared as far north as the Chobe. Since then it has spread to all parts of Ngamiland.

It has been investigated extensively and intensively, and these investigations are still being pursued.

Epizootology

The epizootology of the disease is peculiar in that it first appeared as isolated cases in widely-scattered herds. During the first six months of 1944, due to an outbreak of foot and mouth disease, no movements of cattle were allowed in Ngamiland, but notwithstanding this, the disease spread rapidly. The outbreaks continued to be sporadic for

some time, but gradually a larger and larger number of cattle were affected in each herd. During the last two months it has spread widely, and is still advancing.

Etiology

The history and epizootology seem to indicate that the etiological agent is of an infective nature. The spread of the disease in spite of prohibition of movement of all stock from January to June, 1944, seems to show that it is probably infectious, and very contagious too, as is proved by the rapid spread in a herd. It is suggested by the epizootology that the etiological agent has become gradually more and more virulent and highly infectious.

The nature and symptoms of the disease seem to corroborate this circumstantial evidence, but in the investigations other possible causes have not been overlooked.

Pathogenicity

The disease has been reported only in bovines, of which all breeds, sexes and ages are susceptible. The morbidity is from 50—100%, but the mortality rate is low ($\frac{1}{2}$—1%). Full-grown cattle succumb more easily and rapidly if in poor condition (10% died in one poverty-stricken herd). Calves are more severely affected and usually show the "typical" picture.

Symptoms

It is difficult to classify the various ways in which Ngamiland cattle disease manifests itself, for the one type merges so imperceptibly into the others. For the purpose of clarification an arbitrary classification has been made:—

(a) Leg-swelling form.
(b) Skin-nodule form.
(c) Coronary swelling and skin necrosis.
(d) Complications.

The leg-swelling form invariably precedes the second form and these two forms are probably successive stages of the same disease. Similarly, the various complications observed are probably secondary or atypical manifestations caused by the same etiological agent.

The coronary-swelling form may be associated, or may be an entirely separate condition. The indications are that it is related, but this aspect requires further investigation before a definite opinion can be expressed. It is sometimes seen concomitantly with the skin form, but is more frequently seen by itself.

(a) *Leg-swelling Form*

Frequently the first symptom is that of severe swelling of one (rarely two) of the limbs, accompanied by middle to high-grade lameness. The degree and extent of the swelling varies a great deal.

Sometimes it extends only as far as the knee, but more commonly the whole shoulder is also involved. Occasionally the neck is involved, and several cases have been seen in which the throat and head were affected. The degree varies from a slight oedema to an extensive phlegmosis and very painful generalised oedema. When it involves the foreleg and shoulder only, the worst swelling is over the prescapular lymph-gland.. It then appears, at first sight, like a dislocation of the joint. When a hind limb is affected, the popliteal, precrural and superficial inguinal glands are similarly swollen from three to four or even eight times their normal size. The same applies to the sub-parotid, submaxillary, and retro-pharyngeal glands in those cases in which there is spread to the head.

(b) *Skin-nodule Form*

Sometimes appearing simultaneously with the leg-swelling, but more often following upon it, or in many instances, especially latterly, being unassociated with it, skin "nodules" are seen. The term "nodules" will give a wrong impression, for the skin lesions are more in the nature of the "plaques" of dourine, varying in size from 1 to 3 cm. in diameter. They are multiple, appearing all over the body with no particular predilection site. These "plaques" are *in* the skin, are sharply defined with flat surfaces, are raised from 1 to 2 mm. above the surface, and upon palpation prove to be quite hard. The hair over them is erected, and in the later stages is easily pulled out. Later still, the "plaques" may become necrotic, the whole area sloughing and a festering sore or chronic ulcer resulting. Often these lesions disappear without leaving any sign, before developing into open sores, etc.

This skin-form usually appears concomitantly with a generalised lymphadenitis. The leg-swelling form appears most commonly in adult animals, the skin-form in calves.

Very rarely the skin lesions appear as long wheals instead of plaques.

(c) *Coronary Swelling and Skin Necrosis*

This has been seen in association with both the forms previously described, and is regarded by the writer as another form of the same disease. This form, more so than the preceding two, appears more frequently as a separate complex. Unlike the other two, it appears to be seasonal, being most common during and after the rains.

One or more feet are affected. It commences with severe lameness, followed by swelling of the coronet, which may extend to above the fetlock. The rest of the limb is usually not swollen to any extent. After a while, circular areas of skin between the shoulder and hoof become necrotic. This latter process commences at the periphery and forms a perfect circle up to half-a-crown in size. The necrotic piece

falls out, leaving an open wound with a slight discharge, or, more frequently, an ulcer which heals very slowly.

(d) *Complications*

1. Chronic ulceration.
2. Chronic phlegmosis.
3. Deep-seated abscessation affecting the glands, most commonly the popliteals. It may be single or multiple.
4. Peri-glandular oedema and induration, which, in the throat region may lead to a number of further complications.
5. Pyæmia or septicæmia.
6. Joint affection with, sometimes, permanent ankylosis resulting.
7. Internal abscessation, etc.

Course

Ngamiland Cattle Disease usually lasts for about fourteen days. The temperature is variable, but is usually above normal. The affected animal is obviously ill, feeds badly, and loses condition rapidly. During the course a loss of 50 to 150 lbs. and more, in adult animals, is common. When uncomplicated, recovery is complete. If complications set in, recovery can be very protracted, in some instances for two to three months. Permanent lesions may result, as will readily be seen from the list of complications.

To give a fairly comprehensive picture, the most prominent lesions of a typical case in a calf of five months autopsied on 7.12.44 is given. This calf was running with its mother and approximately twenty trek-oxen, and became naturally infected. All of the oxen and the cow were also affected.

Ante-mortem Examination

"Right foreleg swollen from hoof to above shoulder joint. No external wounds anywhere on body. Swelling firm and very painful to just above knee; from there to shoulder, softer, more oedematous and less painful. Swelling covers whole anterior and lateral surface of shoulder joint."

All lymph glands had increased enormously in size and were easily palpable.

Multiple skin plaques distributed over whole body.

Post-mortem Changes

Right fore limb. — "Surrounding the tendons and sheaths from the hoof to the middle of the carpus is a dense opaque yellowish layer of tissue 0·5 to 1·5 cm. in thickness. This is firmly adherent to both the skin and the underlying tendons, sheaths and fascia. On section yellowish-white fibres form a dense network in the stroma.

This same tissue overlies the right prescapular lymph gland and entirely surrounds it. In some places it is from 4 to 5 cm. thick.

Between the knee and the shoulder joint the musculature is covered with a translucent dirty-yellow jelly-like exudate, from 1 to 2 cm. in thickness. On section it appears homogenous and structureless."

Skin. — " The nodules, previously described, prove to be 2 to 5 mm. thick on section. They are sharply defined. The deeper layers of the skin are mainly affected. The structure is of dense light-yellow layers."

Lymph Glands. — These are all enlarged. On section they are moist and glistening, with a dirty-yellow colour. There is a considerable clear transudate. Very little or no demarcation between cortex of the medulla. In some glands the bloodvessels are very prominent. Some idea of the increase in size will be conveyed if the following measurements are compared with the normal measurements :—

	Gland	*Diseased Calf*	*Normal Adult Animal*
L.	Prescapular	8 x 4·5 x 3·5 cm.	7—10 x 3 cm.
R.	„	10 x 4·5 x 3·5 cm.	
L.	Precrural	5·5 x 2·5 x 1·5 cm.	3 x 2 cm.
R.	„	6 x 3 x 2 cm.	
L.	Superficial Inguinal . .	5·5 x 3·5 x 2 cm.	7—8 x 5—6 cm.
R.	„	5·5 x 3 x 2 cm.	
L.	Popliteal	4·5 x 3 x 2 cm.	3—4 x 2—3 cm.
R.	„	5 x 3 x 1·5 cm.	

Retropharyngeals similarly affected. Number of small abscesses in left retropharyngeal. Periportal, bronchial, and mediastinal glands all enlarged with similar disappearance of medulla.

Liver. — Degenerative changes.

Kidneys. — Degenerative changes.

PATHOLOGICAL ANATOMICAL DIAGNOSIS

" *Bunostomum phlebotomum, Paramphistomum cervi.* Skin nodules. Tumor hepatis. Lymphadenitis diffusa. Endocarditis valvularis verrucosa. Myocardial degeneration. Phlegmosis and oedema of right foreleg and shoulder."

Specimens and smears of all affected organs were submitted to Onderstepoort for microscopical, pathological and bacteriological examination. The results were —

"(a) Numerous micro-organisms (cocci and bacilli) in smears of left retropharyngeal lymph gland.
(b) Chronic dermatitis.
(c) Degenerative changes in liver and kidney, and
(d) Generalized acute lymphadenitis."

Differential Diagnosis

(1) *Three-day Sickness* (*Ephemeral Fever*): There are one or two symptoms in common, but the course and so many other symptoms prove the dissimilarity.

(2) *Snotsiekte* (*Malignant Catarrh*): Many symptoms in common, e.g. gland swellings, exanthema, skin sores, emaciation. The course is, however, short (three to five days) and in the Ngamiland cattle disease no eye, nose, or intestinal symptoms were ever observed, all fairly typical of snotsiekte.

(3) *Rinderpest*: Some points in common, but the epizootology, post mortem and especially the absence of intestinal symptoms in the Ngamiland disease show the difference.

(4) *Foot-and-mouth Disease*: Besides obvious differences it may be mentioned that most cattle in Ngamiland had foot-and-mouth disease or were immunised between January and June, 1944.

(5) *Panaritium*: This is usually sporadic. No hoof symptoms have ever been seen in Ngamiland.

(6) "A skin condition probably associated with Photosensitization." Quin and Dore (1943).

The differences are many and obvious.

Discussion

(1) Evidence as to whether the disease was ever seen before October, 1943, is very contradictory. Various witnesses professed to have seen cases for some years prior to 1943, and if this is correct the disease must still have been in its sporadic form.

(2) Like foot-and-mouth disease, Ngamiland cattle disease is of considerable economic importance. The mortality rate in itself causes but a small direct loss, but the rapid emaciation, possible interference with export and adverse effect on the growth of calves are serious enough to cause grave concern.

(3) Export cattle, in Ngamiland, have to travel from 250 to 500 miles to railhead. Should the disease appear in such animals, it might disrupt trade to a considerable extent.

(4) In only one or two cases have skin wounds been observed on the distal part of a limb. From the symptoms, and if the causative agent is infective, one would expect such infection to enter via the dermis.

(5) A number of blood smears and gland-puncture smears have been examined, but so far with negative results. Examinations of abscess material have shown only non-specific cocci and bacilli. It was thought at one time that the necrosis bacillus might be responsible, but special staining has failed to show its presence.

(6) Transmission experiments to guinea-pigs and to susceptible cattle are being carried out. Further investigations on other aspects of this disease are also being pursued, and it is hoped to publish more definite information in the near future.

Summary

(1) A new disease, provisionally called Ngamiland Cattle Disease, is described.

(2) The etiology has not yet been traced, but the cause seems to be infectious in nature.

(3) The disease first appeared fifteen months ago as sporadic outbreaks affecting individual cattle, but has since spread to all parts of Ngamiland, to the Chobe, and to some areas outside Ngamiland.

As far as is known, it is confined to the Bechuanaland Protectorate.

(4) So far, only cattle have been affected. In adult animals it appears to affect mainly the limbs, and in calves the skin. In both, a prominent symptom is an acute lymphadenitis with rapid loss in condition.

(5) The course, without complications, is usually fourteen days.

(6) Some post-mortem lesions are fairly typical, e.g. the skin lesions and leg affection, especially when associated with acute generalized lymphadenitis.

(7) The morbidity varies from 50 to 100 per cent in an affected herd, the mortality from $\frac{1}{2}$ to 1 per cent, except in poverty-stricken animals where it may rise to 10 per cent.

(8) The main importance of the disease lies in the economic loss.

Acknowledgments.

I wish to thank Mr. Hay, Principal Veterinary Officer, Bechuanaland Protectorate, for permission to publish this article, and Dr. P. J. du Toit, Director, and Dr. G. de Kock, Deputy Director of Veterinary Services, Union of South Africa, for the interest taken in these investigations and for the examination of the specimens. I also wish to acknowledge the help given by Mr. Scholtz, Agricultural and Livestock Officer, Maun, in the collection of the data.

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KNOPVELSIEKTE.

A. D. THOMAS and C. v. E. MARÉ
Onderstepoort. Mafeking.

Introduction

The above name has been coined recently for convenient reference to a disease of cattle apparently new to the Union. This disease was reported early this year from several farms in the Bushveld of the Marico District in the Western Transvaal, and from all accounts none of the farmers there had heard of, or seen anything like it before.

The same condition, however, was encountered in Northern Rhodesia some years ago by Dr. P. L. le Roux, who was good enough at the time to provide us with a description of the gross lesions and a preserved specimen of affected skin. The disease there is referred to as "Pseudo Urticaria" or "Lumpy Disease." It is now known also that the same disease occurs extensively in the northern part of the Bechuanaland Protectorate, where it is being studied under the name "Ngamiland Cattle Disease."

The addition of yet another name to the two or three already given, seems justifiable on the grounds (a) that a simple descriptive term like "Knopvelsiekte," which is the Afrikaans equivalent of "Lumpy Skin Disease," is less liable to be misinterpreted than the other two; (b) its use can be retained even when the aetiology is known; (c) farmers in the Union would almost certainly give the disease a name or several names if a suitable one is not offered immediately.

The description which follows is based on very limited material and experience and is therefore merely a preliminary announcement. Its early publication in this incomplete form was deemed advisable in order to acquaint our colleagues with the main features and appearance of the disease, which will enable them to recognise it should it spread further afield within the Union.

Short Description

Knopvelsiekte is an acute febrile, infectious disease, the main lesions of which affect the skin, the mouth, nostrils, pharynx, larynx and trachea, eyes and lymphatic glands. So far only cattle are known to be affected. Animals of all breeds and ages and of both sexes are susceptible. Infectivity is apparently very variable, but may be high under certain conditions as yet not understood. The cause of the disease has not yet been discovered, although there are indications that a virus may be responsible. The mode of infection or trans-

mission is still unknown. The mortality rate so far has been low; reliable figures are not available, but it is probably less than 10 per cent. Apart from this, there may be considerable indirect loss to the stock owner in the form of loss of milk production, severe loss of condition in slaughter stock, often with very slow recovery, loss of work (trek oxen), damage to skins, loss of time and material spent in treatment and hand-feeding of sick animals over a period of recovery, which may be long.

Course

The clinical appearance and course of the disease are roughly as follows: In the early stages there is lachrymation accompanied by a moderate remittent type of fever ($\pm$ 105°F). The animal feeds badly or not at all. It shows disinclination to move and walks with a stiff awkward gait. Sometimes it prefers to lie down. The hairy coat

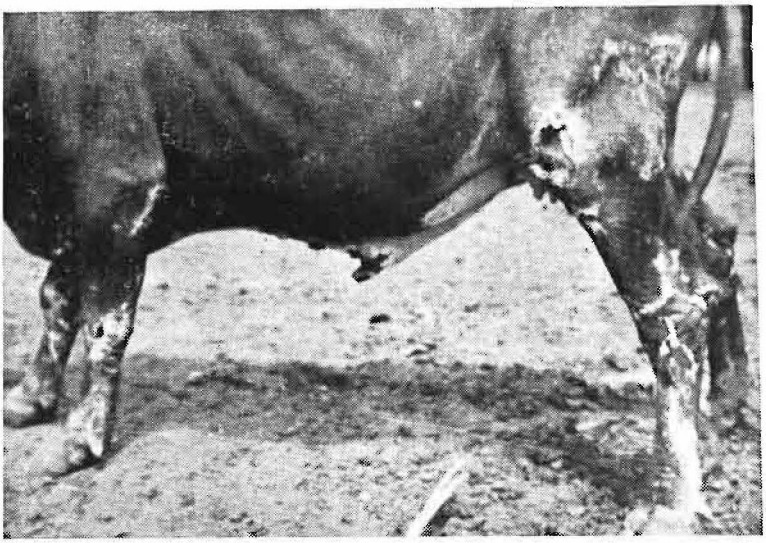

Fig. 1.
Recovery case, showing sloughing of skin.

may be ruffled and erect as is usual with very sick animals. Some animals have a slight glairy nasal discharge. Dribbling at the mouth is common, and there may be an occasional cough. Loss of condition may be very rapid and marked and persists until the animal has completely recovered, which may take anything from four to twelve weeks.

Shortly after the onset of the fever, sometimes apparently without fever, peculiar and very characteristic lumps appear on the skin over the whole animal. The lumps are very conspicuous on a short-haired, smooth-skinned animal, not only because they stand out visibly and

can be felt above the surface, but also because the hair over the lump tends to stand up erect, thus accentuating their prominence. Such an animal may look as if it had received a shotgun charge of buckshot. In long, soft-haired animals the lumps develop just the same, but may be invisible to a casual observer. By palpation, however, there is usually no difficulty in feeling them among the hair. These lumps are round, firm swellings in the skin and vary in diameter from 0·5 to 3 cm., occasionally as much as 5 cm. Their elevation above the skin surface may be slight, the top being flattened (plaque-like) or it may be considerable and rounded (nodular).

The number and distribution of the lumps is very variable. In typical cases they are uniformly scattered over the whole body, head and limbs. On some animals they may be rare, a dozen or less; on others they may be confined to the legs only, or legs and lower part of abdomen. In bad cases they may be so numerous and close together that in places they appear to merge into large lumpy masses.

A certain proportion of affected animals develop oedematous swellings of the limbs, brisket, and dewlap. The oedema may develop at the same time as the lump or it may arise later (possibly from secondary infection or circulatory interference). There is reason to believe that some animals may become infected and undergo a very mild fever reaction, in which skin lesions, if present, pass unnoticed.

When dribbling is marked it is usual to find lesions in the mouth These start as round, slightly-raised, greyish plaques, the surface of which macerate early and erode, leaving shallow erosions or deeper ulcers. Similar necrotic plaques arise at the entrance to, and within the nostrils. They also macerate and eventually slough off, but in the meantime often pack with drying nasal discharge, which may interfere considerably with breathing.

The discharge from the eyes persists and becomes more mucoid and cakes round the eyes and down the face. The conjunctiva is swollen and red, and corneal opacity may develop, which in a few cases may progress to ultimate blindness. Erosions and patchy sloughing may be seen on the eyelids in severe cases. A constant feature in the more advanced stage is a great enlargement of all the lymphatic glands. The superficial groups, e.g. prescapular and precrural, can be felt quite easily and quite often a distinct skin bulge can be seen over the gland region. Swelling of the udder is seen in some cases — both lactating and non-lactating. The skin of the teats may show lumps, and one of the first symptoms seen in cows may be tenderness of the udder.

Recovery and Complications

In mild cases of the disease the animal may be off food only for a day or two, and loss of condition may not be noticeable. In the majority of cases, as soon as the animal starts to feed again it may

be considered well on the way to recovery, even if it takes several weeks for the unsightly lumps and " sitfasts " to clear up.

During recovery the lumps subside and become more or less necrotic, leathery discs of skin or " sitfasts." If necrosis is advanced and complete, the entire " sitfast " gradually separates from the healthy skin and in time drops off like a plug, leaving a granulating bed which heals up under a scab.

Usually, however, necrosis is only partial and not sufficient for sloughing to take place. Either the whole or part of the disc of skin then organises and heals up. The hair may fall off from the whole disc or only from a ring around the edge of the " sitfast." New hair grows again, but for some time these patches are still distinguishable.

Fig. 2.

Case showing swelling of dewlap and hind leg.

In some cases the disease ends in death or drags on for weeks with the animal emaciated, weak and covered with ugly, evil-smelling sores. Many farmers have had to destroy such cattle to put them out of their misery. Secondary infection often sets in, causing deep suppurating wounds and even abscesses in the regional lymphatic glands. In one or two animals evidence of suppuration along the coronet, with partial detachment of the claw, points to exungulation as a possible sequel.

The severe oedematous swellings sometimes seen may lead to mortification and mummification of big patches of skin and underlying tissue, which partially slough off. Such animals may have great

difficulty in getting up or lying down and in moving about, on account of hideboundedness and dry, leathery patches of skin.

Secondary infection probably also plays a part in complicating the internal lesions in the nostrils and pharynx. Interference with breathing with consequent lung affections would be a natural fatal sequel in such cases — as has been reported by farmers. In one cow seen personally there was very severe dyspnœa, due apparently to swelling of the pharyngeal and laryngeal tissue and possibly also to pressure by the enlarged retropharyngeal glands. The cow was reported to have died the same day (presumably from suffocation).

Main Lesions

(a) *Skin.* — A typical "lump" has the following appearance on section. The whole cutis is thickened locally to form a tough, firm mass of tissue having a slightly mat, creamy-grey colour as compared to the skim-milk colour of the adjoining fibrous cutis. Occasionally there may be a distinct firm or soft caseous nodule in the depth of the lump. The subcutis around the lump is also thickened and resembles granulomatous tissue. It is often reddish-grey and infiltrated round the outer edges with serous fluid. In about ten days the lumps tend to subside. The centre piece or disc may reorganise and heal up with or without loss of hair, or it may dry up slowly and shrink, becoming darker in colour and finally dropping off, leaving a small almost healed-up crater which closes up rapidly into a smallish scar. Others again show beads of moisture round the lifting edge of the sitfast, and later a purulent discharge may ooze out, the part becoming inflamed and swollen, until pieces of skin and tissue slough off and the lesions granulate.

The local hard swelling produced by subcutaneous inoculation of infective material presented a somewhat different appearance. The swelling was thick, firm, and painful and involved the underlying muscles as well. On section there was extensive serous infiltration of the areolar tissue, with hæmorrhage near the lesion. The firm central portion showed beginning mortification with a line of demarcation around it. The cutic, subcutis and muscles (of neck) were set into a firm mass having a greyish marbled appearance. It consisted of necrotic tissue pervaded with fibrin, and much perivascular organisation.

Histological Changes

From the limited study undertaken it is fairly evident that the skin lumps are the result of a combination of several factors.

(a) The most obvious one is the tremendous local proliferation of histiocytic and fibroblastic elements. This takes place throughout the cutis and subcutis in the region of the "lump," or locally in any tissue into which infective material may have been inoculated artifici-

ally. The proliferation is primarily associated with the smaller blood vessels, arterioles, venules and even capillaries, around which a thick mantle or cuff is thus formed. Such proliferation in parts may coales.e to produce an almost solid mass of new cells.

(b) The presence in histiocytes and epithelial cells of peculiar "inclusions," which by their large size and numbers undoubtedly augment the volume of the cells. These inclusions are often equal in size to the nucleus of the containing cell and vary down to one-tenth of that or less. They are intracytoplasmic, have a somewhat indefinite and attenuated structure, with faint globular excrescences visible at times. So far the only staining method which has given fair results is the ordinary hæmalum-eosin method. The inclusion is stained a faint purplish-pink colour which distinguishes it from the more intensely-stained nucleus.

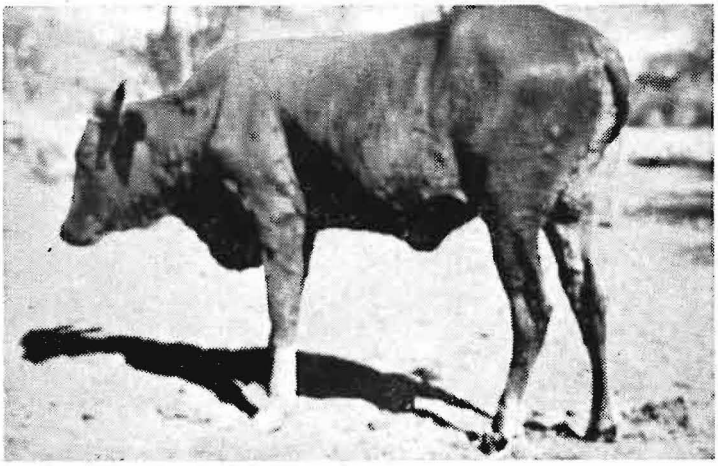

Fig. 3.
Skin nodules over the whole body.

(c) Infiltration with polymorphs (neutrophils and eosinophils) and fibrin further contributes to the local swelling.

(d) There is also local thrombosis of the smaller blood vessels, collateral oedema, and a variable degree of necrosis. It is not clear yet whether the necrosis is due to the circulatory interference, to the primary effects of a toxic agent, or to a combination of both.

(b) *Nostrils, Mouth, Pharynx and Larynx.* — Patchy lesions occur also on the mucous membrane of the nostrils, mouth, pharynx and larynx. In size and distribution they are similar to those on the skin, but their appearance is modified according to their situation. At the entrance to the nostrils one may see a few slightly raised,

greyish, round patches with an occasional pink, pimple-like protuberance deeper on the mucosa proper. In time the greyish necrotic epithelial pseudo-membranous cover to these patches macerates, hanging loose in soft shreds, or packs with drying nasal discharge until the whole mass is able to slough off. Breathing may be seriously impaired by the swelling of the mucosa and packing of discharge.

In the mouth, especially at the edges of the lips and on the dental pad, there may be similar thickened round patches with a greyish surface. They seem to macerate early and become round erosions and ulcers with a granulating bed.

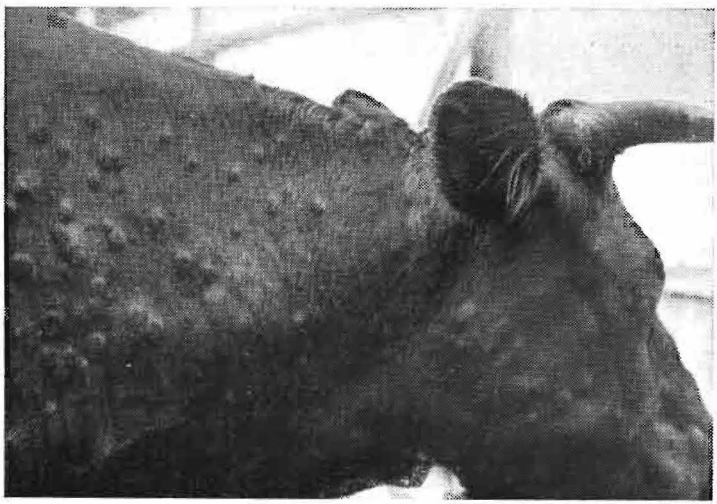

Fig. 4.

Typical skin nodules.

Necrotic or partly necrotic greyish-red patches occasionally appear on the mucosa of the pharynx, the glottis and in the larynx and trachea. The histological changes are much the same as in the skin.

(c) *Lymphatic Glands.* — All the lymphatic glands are enlarged, but most of all the superficial ones like the prescapular, precrural, and popliteal. On section the gland is moist but firm and of a slightly mat-greyish colour. Microscopically a very marked increase in histiocytic elements seems to account for the increase in size.

(d) *Other Organs.* — So far nothing of importance has been recorded in the other internal organs, except that in one artificially infected animal lesions were found in the peritoneum, larynx, trachea, but not on the skin.

Experimental Work

Experimental work in the disease has only just started and progress is of necessity slow, since it is hampered by the fact that large animals only (bovine) have to be used, isolation space is limited, and the incubation period is fairly long (up to two weeks).

What has been done to date, may be summarized as follows:—

1. The disease has been successfully reproduced at the laboratory by subcutaneous inoculation of lump material and also by natural transmission (unknown agent). It can therefore be accepted that the disease is infectious.
2. Small laboratory animals — sheep, rabbits, guineapigs and mice — could not so far be infected.
3. Bacteriological cultivation to date has proved negative. No protozoa have been demonstrated in the lesions or in the blood. These facts, together with the presence of inclusions, make it necessary to explore the possibility of a virus as the cause.
4. Transmission by insect vectors has not yet been attempted. Biting flies seem an obvious group to start experimenting with, although reports of the disease appearing eight miles from an outbreak without direct bovine contact would seem to suggest other indirect means of transmission.
5. The nature of immunity, if any, is not known.

Conclusion

There is no doubt that this disease could become a serious economic problem, if not a major epizootic. Every effort should thus be made by the judicious application of quarantine and other veterinary control measures of a general nature, to localise its spread and minimize losses, pending more definite knowledge about the disease, its cause, transmission, immunity and prevention.

THE CONNEXION BETWEEN DEGREE OF RAINFALL AND OF INFECTION OF CATTLE BY "*CYSTICERCUS BOVIS*" COBBOLD IN TANGANYIKA TERRITORY.

K. H. CHAPMAN,

Lecturer in Zoology, Rhodes University College, Grahamstown; formerly Field Zoologist, Veterinary Research Laboratory, Kabete, Kenya Colony.

The percentage above 2 per cent of cattle carcases sterilized for "*Cysticercus bovis*" Cobbold in various districts of Tanganyika Territory are quoted by Viljoen (1937), from figures supplied by Mr. H. J. Lowe, Mpwapwa, Tanganyika. The figures given range from 2·3 per cent to 21·6 per cent (monthly records in 1936). Study of these figures shows that the four highest monthly percentages were recorded from Iringa 21·6 per cent, Mpwapwa 18·4 per cent, Tukuyu 16·1 per cent, and Dar-es-Salaam 13·2 per cent for the months of May, April, January and March, 1936, respectively. No figures were given for Tukuyu for April and May, 1936. Iringa and Tukuyu are in the Southern Highlands of Tanganyika. Low average figures, on the other hand, are recorded for Dodoma, which has an average percentage of 5·65 per cent over the eight months January to August, with highest figures 9·1 per cent for August, lowest 3·4 per cent for January; and for Singida, with average over the six months January to May plus August of 6·2 per cent, highest 11·1 per cent (April), lowest 3·8 per cent (August).

Now these figures, when taken into consideration with the opinion of Dr. Mann, Acting Veterinary Officer at Liebig's Meat Canning Factory, Athi River, Kenya, that the highest infestations come from areas with heavy rainfall and lush vegetation, where eggs might be distributed by water, and that a much lower degree of infestation is found in drier areas such as Central Tanganyika, where cattle tend to range farther afield from human habitations, seem to agree with the explanation Viljoen gives of why, from the available statistics from Southern Rhodesia, it appears that *C. bovis* is not a common parasite there. He attributes this to the probability that a great deal of stock, even when native-owned or of native origin, is raised under semi-ranging conditions and thus does not come into contact with human beings (l.c., p. 376).

On the other hand, the view has also been held that during droughts, cattle tend to graze *nearer* to human habitations, where water is available, and are thus more often infected from contaminated pasture or by eating human faeces.

It appeared to me that here there were two factors which might be involved and should be considered, (a) rainfall and proximity of the cattle's grazing grounds to human habitations; as well as (b) the type of ground available for them to graze on. I obtained from Mr. D. G. White, Provincial Veterinary Officer for the Central Province of Tanganyika, the following figures:—

Meat Inspection Figures of Cattle Carcases Condemned at Slaughter Houses in Central Province (Tanganyika).

District and Year.	*No. Slaughtered.*	*No. condemned for* C. Bovis.	*Percentages condemned.*
Dodoma 1942 . . .	3853	117	3·3
1941 . . .	3198	168	5·2
1940 . . .	2274	106	4·7
Singida 1942 . . .	496	27	6·2
1941 . . .	611	17	2·7
1940 . . .	379	12	3·1
Kondoa 1942 . . .	235	7	3·0
1941 . . .	not available		4·3
1940 . . .	174	8	4·5

These figures give an indication of the percentage of the whole cattle population infected with *C. bovis,* and it is evident that in 1942 "the worst drought year in recent times," according to Mr. White, in the districts affected most — Dodoma and Kondoa — infection was *below average,* but infection in the Singida district increased although that district had only a slightly higher rainfall in 1942, than normal.

Mr White observed in a letter to me: "I do not think that the theory regarding cattle concentrating near human habitation during droughts quite applies in the Central Province, as during such times the tendency is for cattle to be herded *farther afield* in search of food and water, grazing near habitations having been used up at the end of the wet season, and water supplies being conserved for human consumption. (My italics.)

"In general, infestation certainly seems higher in damp regions, and the Southern Highlands Province appears to be the worst in Tanganyika. Cattle traders will rarely buy an animal from there, purely because the flesh from such an animal will very probably be condemned after slaughter. Incidentally, our damp areas are usually very high and cool — have these factors an effect on *C. bovis* infestation?"

Thus Mr. White's opinion regarding the factors operating in this question in the Central Province of Tanganyika differs from Dr.

Viljoen's opinion (1.c., p. 555) that *C. bovis* incidence is "higher in drought periods when bovines tend to remain *nearer human habitations*" (my italics; cf. Mr. White's opinion above). I discussed this point recently with Mr. I. Pullon, Veterinary Officer, Monduli, Masailand, Tanganyika, who agreed with the opinion of Mr. White.

It will be seen that Mr. White's figures are not decisive concerning the connexion between rainfall and degree of cattle infection with *C. bovis,* but that he does not support the view, from evidence in his province, that drought increases the degree of infection. The evidence cannot yet be said to be conclusive, so it is to be hoped that further investigations may be made on these points; but the frequent heavy infection of cattle from the densely-populated areas of Uganda, which I have myself observed, supports Mr. White's interpretation, since it is exactly in these areas that cattle are often herded into small spaces near human habitations.

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SOME FACTORS AFFECTING THE INCIDENCE OF EAST COAST FEVER IN NORTHERN PROVINCE, NYASALAND.

S. G. WILSON,
Veterinary Department, Nyasaland.

In recent years, an opportunity has occurred for collecting data on East Coast fever mortality in an area where the disease has long been enzootic. Cattle are of an indigenous Zebu type and are dipped in 0·16 per cent arsenical dip every seven days all the year round.

Cattle owners in the area are obliged to submit spleen smears from all cattle dying from any cause whatever. Diagnosis of *Theileria* infection is based on the finding of Koch's Bodies in these smears. It is generally considered that only two *Theileria* species occur in this area, i.e. *T. parva* and *T. mutans,* and as *T. mutans* does not *normally* produce Koch's Bodies in any abundance, it is assumed that *T. parva* has been the direct cause of death in most of the recorded cases. This assumption must govern all our work until definite cross-immunity tests have proved the contrary.

Under present conditions the incidence of East Coast fever is strictly seasonal, most deaths occurring during the three hot, rainy months of January, February, and March.

For instance, in the endemic area during 1944, over 16,000 spleen smears were examined from cattle dying from all causes. Only 342 smears or 2 per cent of the above total showed Koch's Bodies, and of these, 259 or 75 per cent of the total positives occurred during the period January to March, while 122 positives or 36 per cent were found in February alone. During the long dry season from April to November smears showing Koch's Bodies were rare and cases of East Coast fever widely scattered, with mortality usually limited to one beast.

The rigid periodicity of the epizootic wave and the small proportion of the total cattle population involved are striking features of this seasonal incidence. As noted above, only 2 per cent of the 16,000 smears examined were positive for East Coast fever, and in no area did the number of cattle involved rise above 5 per cent of the population. A working hypothesis to explain these features is required.

It might be assumed that the rigid periodicity of incidence was due to a sudden addition of fresh susceptible immigrants some time prior to the epidemic wave. Births form the main, if not the entire, source of such susceptibles. As East Coast fever is endemic to almost the entire area, cattle movements have a negligible effect. Careful

records are maintained of all calves born and these show that the large majority of calves are born in the period June to October. The actual period of maximum births — the mode of the birth curve — varies from year to year and this variation may be connected with annual variation in the weather. During 1944, 17,362 calves were born in one of the areas under review. Of these, 7,638 or 44 per cent were born during June, July, and August.

If cattle became more susceptible to *T. parva* when approximately six or eighteen months old one would then expect the highest incidence to occur as at present during the rainy months. But one would also expect subsequent minor epizootic waves to correspond with the remaining 56 per cent of births which fall out of the optimum months. Besides, present records do not prove one age group to be more susceptible than another. They only suggest that more deaths occur in the 1 to 3-years-old group than in the "calf" and "adult" groups. It is fairly obvious therefore that birth "waves" only offer at best a partial explanation of the seasonal incidence of East Coast fever.

Does the periodicity then depend on some equally rigid phase in the life-cycle of the parasite, more especially during its development in the tick?

Five tick species, *Rhipicephalus appendiculatus, Rhipicephalus capensis, Rhipicephalus simus, Rhipicephalus evertsi* and *Hyalomma impressum* near *planum* are generally credited with the power of transmitting *Theileria parva* (Neitz and Du Toit, 1938). Of these, *Rhipicephalus appendiculatus* is abundant throughout the Northern Province of Nyasaland and seems well established within its optimum climatic limits. It breeds easily in the laboratory at room temperatures and humidities and has a wide variety of animal hosts. A second tick vector, *R. capensis,* also occurs, but does not appear to be so well adapted to the prevailing conditions as *R. appendiculatus.* Moreover, up to the present, only the adult stages have been found feeding on cattle, and then only during the limited period from September to November.

Less is known concerning the third vector, *R. simus,* as its hosts are chiefly wild animals. It was rarely found on cattle and on these occasions, only adult stages were found. (cf. *R. capensis.*)

Neither of the remaining two vectors (*R. evertsi* and *Hyalomma impressum near planum*) occurs in this area.

All available information supports the hypothesis that the transmission cycle of *T. parva* in Nyasaland is normally completed only in *R. appendiculatus,* and that this tick is responsible for all epidemic waves. Knowledge of the life history of this tick is therefore a primary requisite to the study of East Coast fever in this area.

The initial results of such a study have already been given (Wilson, 1945). Briefly, each stage in the life cycle of *R. appen-*

diculatus prevails in turn during a distinct season. Larvae occur early in the dry season from April to July, nymphs occur through the dry season, but disappear in December, and adults are most prevalent during the rains. The occurrence of adults is not, however, entirely restricted to the rainy season. They occur, both males and females, throughout the dry season, but are never numerous and for all practical purposes it is true to say that the females never engorge except during the rains.

With the facilities available at present, it is quite impossible to obtain accurate counts from which to calculate the average number of larvae and nymphs actually infesting cattle at any one period. The task is more practicable for adult tick counts but, owing to the great variation in the numbers of ticks infesting different animals in the same herd on any one day, a very large number of counts would be required if a true mean were to be calculated. The figures given in Table I record impressions derived from a large number of counts from calves over a two-year period.

TABLE I.

Adult R. appendiculatus *per ear in three seasons of the year.*

I. Dry season months (April to November)	5 adult ticks approximately per ear per calf — in many areas nil during June to August, but number may vary up to 10 ticks. No engorged females.
II. Wet season months	
(a) December	Intermediate period — numbers of adult ticks rising to 10 per ear and over and a few engorged females appear.
(b) January–March	Adult ticks prevalent on ears and counts of 20 ticks and over common. Engorged females common.

If the number of doses of the infective agent, *T. parva*, does not count, i.e. if one infective tick can transmit an infection equally fatal to that caused when several infective ticks feed on a susceptible bovine, then the rate of infestation on animals in a highly endemic area would have doubtful significance.

But if the ratio of infective ticks to non-infective ticks is low, then a beast carrying a heavy tick infestation should run a greater chance of becoming infected. This applies equally to infestations of nymphs or adults.

No experiment has yet been designed to determine the ratio of infective to non-infective ticks in this area, even on a small scale.

However, the following facts point to the conclusion that the number of infective ticks is small. All the East Coast fever cases during January and February and possibly many in March represent end-points in the life cycle of *T. parva*. No larvae or nymphs are present to carry on the cycle to other cattle hosts. By the time larvae are common in April, East Coast fever cases are rare. Few larvae, therefore, will engorge on infected blood. A proportion of these will fail to develop into viable nymphs, so that still fewer nymphs will carry an infection derived from wet-season cases of East Coast fever. Of these, again, a proportion will fail to develop into adults, and another proportion will feed on non-susceptible animals — goats and sheep — and lose their infectivity. Many more nymphs and adults will be killed by dipping. Thus very few adult ticks will carry an infection contracted by the larvae in the previous wet season.

It is suggested that the low mortality from East Coast fever is the natural result of this low concentration of infected ticks.

We have still to explain why the East Coast fever incidence is contemporaneous with the adult phase of the transmitting tick and more particularly with the period the adult female ticks are engorging. The suggestion that *T. parva* becomes attenuated during the dry season when nymphs are abundant and so unable to set up an infection is contrary to the findings of Lewis and Fotheringham (1941). These authors conclude that as long as the tick survives, climatic conditions do not kill or weaken the parasite. Or, framing an hypothesis in relation to the host, it might be assumed either that animals are more resistant to East Coast fever during the cold, dry season or that continued rains coupled with bad management cause a fall in host resistance (Wilson, 1944).

In considering our present records it is well to remember that only fatal cases are recorded. Under natural conditions many sub-lethal infections may occur. In other words, are the numbers of animals which recover from the disease greater during the dry season than during the rains?

In this connexion, the following observations may be relevant. At our Experimental Farm, Lilongwe, where East Coast fever occurs during the rains, twenty calves of varying ages, born on the farm, were kept under observation and in no case could any sub-lethal infection be detected during the dry season, although we have records of such infections during the rains. In several cases, when a rise in temperature was noted in one of these calves, Trypan Blue was injected as recommended by Du Toit (1931), but small piroplasms remained absent from all blood smears. As an addition to this experiment, four susceptible adult beasts were imported and herded on the farm throughout the dry season of 1944, again without incident. Lastly, we have been able to follow the course of a black-quarter

epizootic in several dipping-tank areas during the period October to December, 1944. The average death rate from all diseases rose in some places during this epizootic from 0·8 per cent of the total population to 3·7 per cent per month; but in no case was there any increased incidence of East Coast fever. This applies even to those areas where the disease was allowed to run its course and where sub-acute or sub-lethal infections of *Cl. chauvoei* might be expected, and where sufficient time might elapse for the stimulation of the production of Koch's bodies if *T. parva* were present. The reaction to immunization with black-quarter vaccine should also be considered. The conclusion is that even sub-lethal infections of *T. parva* are rare during the dry season.

East Coast fever epidemics in Nyasaland are restricted to the rainy season, when adult *R. appendiculatus* ticks are common. One is, therefore, tempted to propose as an hypothesis that fatal East Coast fever infections are derived only from the adults of *R. appendiculatus*. Sufficient adults are always found during the dry season to account for the occasional cases of East Coast fever which do occur. *East Coast fever incidence coincides very closely with the appearance of engorging females of* R. appendiculatus.

A useful comparison would therefore be an estimate of the East Coast fever incidence amongst indigenous cattle in other areas where the seasonal periodicity of *R. appendiculatus* differs. In areas where East Coast fever never becomes established it may be found that the larvae and nymphs are restricted to a shorter seasonal appearance than in Northern Province, Nyasaland. Where East Coast fever shows no seasonal incidence, no seasonal periodicity of *R. appendiculatus* should occur.

A further necessary line of inquiry would be to establish the effect of long-continued climatic effects on the development of *T. parva* within the tick host. For instance it might be suggested that in Nyasaland this development is slow during the cold, dry season and the parasite does not reach the infective stage for cattle until the time when the adult tick phase occurs during the hot, wet season of the year.

Summary

1. During a three-year period the rate of incidence of East Coast fever has followed a well-defined pattern. The incidence is relatively high during the short rainy season and low or absent during the dry months of the year from April to November.

2. The proportion of the cattle population involved is actually low, ranging from 0 to 5 per cent, with an average approximating 2 per cent for the whole area.

3. This seasonal incidence shows no definite relation to a sudden influx of fresh susceptibilities by births.

4. *R. appendiculatus* appears to be the sole tick vector of *T. parva* in the area. The incidence of East Coast fever corresponds with the increased infestation of cattle by adult *R. appendiculatus,* as indicated especially by the prevalence of engorging female ticks of this species.

5. Evidence is given to show that only a low percentage of adult ticks are infective and that low incidence of disease is due to this rather than increased innate herd resistance or a high percentage of sub-lethal infections during the dry season.

6. No reason can be given as to why the disease is not transmitted by *R. appendiculatus* nymphs, but a line of further inquiry is suggested.

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CORRECTIONS.

Please attach these corrections to paper on page 53 of Volume XVI., Number 2, of The Journal of the South African Veterinary Medical Association.

Title: Should read: "The Action of Saponin and Other Excipients on the Virulence and the Immunizing Power of Anthrax Strains."

Table 1: Transpose the lines of figures in fourth column, headed "Results."

Table 2: The word "Lived" to be centred to cover the two columns headed "No." and "%".

Table 3: The word "Lived" to be centred to cover the two columns headed "No." and "%".
The figures "4 0" in fourth column to read "0 0".

Table 4: The word "Lived" to be centred to cover the two columns headed "No." and "%".

Table 5: The word "Lived" to be centred to cover the two columns headed "No." and "%".
Title to Table 5: "The effect of saponin excipient on a small immunizing dose of avirulent vaccine."

THE ACTION OF SAPONIN AND OTHER EXCIPIENTS ON THE VIRULENCE AND THE IMMUNIZING POWER OF ANTHRAX STRAINS.

TABLE 1.

The remote effect of saponin on the virulence of anthrax strains.

No. of guinea-pigs.	Received 0.5 cc. of following, subcutaneously, in fore limb.	Amount of spores injected, subcutaneously, into hind limb 24 hours later.	Results: No. dead by — 2nd day	3rd day	4th day	5th day	Lived.
70	¼% saponin	100 M.L.D.	1	33	32	4	0
240	Nil	100 M.L.D.	188	46	6	—	0

TABLE 2.

The remote effect of saponin on the immunity elicited by avirulent anthrax strains

No. of guinea-pigs.	Received 0.5 cc. of following, subcutaneously, in fore limb.	Immunized with (in hind limb)	Immunity tested with	Lived: No.	Lived: %
50	¼% saponin	less than one immunizing dose (in hind limb)	100 M.L.D.	13	26
50	Nil	Ditto	Ditto	33	66
10	Nil	Nil	Ditto	0	0

TABLE 3.

The inhibitory effect of saponin excipient on the virulence of anthrax spores

No. of guinea-pigs.	Inoculated with	Results								Lived	
		Dead by the —									
		2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	No.	%
20	100 M.L.D. spores in 1% saponin (0·2 cc.)	—	—	—	1	8	5	1	1	4	20
65	100 M.L.D. spores in 0·85% saline	46	13	3	3	—	—	—	—	0	0

TABLE 4.

The stimulatory effect of saponin excipient on a fraction of a lethal dose of anthrax spores

No. of guinea-pigs.	Inoculated with	Results								Lived	
		Dead by the —									
		2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	No.	%
50	$\frac{1}{5}$ M.L.D. in $\frac{1}{8}$% saponin	—	1	38	5	1	—	—	1	4	8
70	$\frac{1}{5}$ M.L.D. in 0·85% NaCl	—	4	9	4	3	—	—	2	48	69

TABLE 5.

The effect of saponin excipient on a small immunizing dose of avirulent vaccine.

No. of guinea-pigs.	Immunized with	Tested four weeks later with	Lived	
			No.	%
54	Small dose avirulent vaccine in $\frac{1}{4}$% saponin	100 M.L.D.	52	96
62	Small dose avirulent vaccine in 0·85% NaCl	100 M.L.D.	15	24
52	Not immunized	100 M.L.D.	0	0

CORRECTIONS

THE ACTION OF SAPONIN AND OTHER EXCIPIENTS ON THE VIRULENCE AND THE IMMUNIZING OF ANTHRAX STRAINS

MAX STERNE,
Onderstepoort.

Many excipients have been tried in order to increase the efficiency of anthrax vaccines. The best-known work is that initiated by Mazzucchi (1929) and Hruska (1931), who added saponin to anthrax vaccines and claimed that this reduced their virulence and at the same time increased their immunizing power. Mazzucchi's " Carbozoo " vaccine consisted of a Pasteur type anthrax vaccine strain suspended in saponin solution. Between 1929 and 1939 a large amount of work on this new vaccine was published all over the world. Many workers reported favourably, but others could not repeat Mazzucchi's results. Some years ago, Sterne (1939), reviewed this work, and in general confirmed Mazzucchi's results.

Staub (1932) and Ramon and Staub (1936), after a somewhat cursory investigation, concluded that saponin had little beneficial effect, and enthusiastically recommended an excipient of their own — a mixture of alum and agar. These workers (1935) also favoured a vehicle consisting of lanolin and olive oil — which has been used fairly extensively in Germany — but which requires a fantastically elaborate inoculation procedure. Tests made here have given mediocre results.

In the present paper, which is really a summary and review of work in press elsewhere, no attempt will be made at a formal exposition, and only the minimum amount of experimental work necessary to develop and illustrate the argument will be quoted.

Experiments

What appears to have been missed in previous work is that saponin has a general as well as a local effect. If saponin is injected into a guinea-pig — say, into a fore-limb or intraperitoneally — and 24 hours later about a 100 lethal doses of spores into a hind-limb, a distinct slowing down of the disease is seen. Similarly, if instead of virulent spores a small dose of avirulent, immunizing spores [Sterne (1939b), (1945)] is used, an inhibition of immunizing power is seen in the group prepared with saponin. Tables 1 and 2 illustrate this point, and show that saponin has a general effect of retarding the development of anthrax; that is, depressing virulence when virulent spores are used, and immunity when immunizing spores are used.

The effect is not confined to saponin, but is elicited by other substances such as turpentine or calcium chloride which cause a marked inflammatory reaction accompanied by considerable oedema. It is not elicited by lactic acid, concentrated sodium chloride, or concentrated sodium sulphate which cause extensive necrosis with relatively meagre oedema. It is therefore possible to ascribe the general effect shown by saponin to th inflammation provoked, rather than to saponin itself.

TABLE 1.

The remote effect of saponin on the virulence of anthrax strains.

No. of guinea-pigs.	Received 0·5 cc of following, subcutaneously, in fore limb.	Amount of spores injected, subcutaneously, into hind limb 24 hours later.	Results. No. dead by — 2nd day	3rd day	4th day	5th day	Lived.
70	¼% saponin	100 M.L.D.	188	46	6	—	0
240	Nil	100 M.L.D.	1	33	32	4	0

TABLE 2.

The remote effect of saponin on the immunity elicited by avirulent anthrax strains

No. of guinea-pigs.	Received 0·5 cc of following, subcutaneously, in fore limb.	Immunized with (in hind limb)	Immunity tested with	No.	Lived %
50	¼% saponin	less than one immunizing dose (in hind limb)	100 M.L.D.	13	26
50	Nil	Ditto	Ditto	33	66
10	Nil	Nil	Ditto	0	0

When the test dose of 100 lethal doses of spores is actually mixed with the saponin the inhibiting effect is still more noticeable. In table 3 is shown an experiment of this type which is characteristic of experiments frequently quoted to show the inhibiting effect of saponin. It must again be emphasized that saponin is not alone in eliciting this effect.

TABLE 3.

The inhibitory effect of saponin excipient on the virulence of anthrax spores

No. of guinea-pigs.	Inoculated with	Results: Dead by the — 2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	Lived: No.	Lived: %
20	100 M.L.D. spores in 1% saponin (0·2 cc.)	—	—	—	1	8	5	1	1	4	20
65	100 M.L.D. spores in 0·85% saline	46	13	3	3	—	—	—	—	4	0

Table 3 shows the effect on a large dose of spores. If the dose is now reduced to a fraction of a lethal dose the saponin appears to act quite differently. In table 4 is shown the result of inoculating one group of guinea-pigs with approximately $\frac{1}{5}$ of a lethal dose of spores in $\frac{1}{8}$ per cent saponin and another group with the same dose in physiological saline. In this experiment the saponin very noticeably increased the virulence. Similar results are obtained with a number of irritants — 50% glycerine, 20% NaCl, 8% $CaCl_2$, etc. (minute amounts of histamine also elicit this result). Thus any irritant used as an excipient appears to increase very markedly the virulence of a fraction of a lethal dose of spores.

TABLE 4.

The stimulatory effect of saponin excipient on a fraction of a lethal dose of anthrax spores

No. of guinea-pigs.	Inoculated with	Results: Dead by the — 2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	Lived: No.	Lived: %
50	$\frac{1}{5}$ M.L.D. in $\frac{1}{8}$% saponin	—	1	38	5	1	—	—	1	4	8
70	$\frac{1}{5}$ M.L.D. in 0·85% NaCl	—	4	9	4	3	—	—	2	48	69

An effect corresponding to that obtained in the experiment shown in table 4 is seen when saponin is used as an excipient for less than a full immunizing dose of avirulent vaccine. An example of such an experiment is shown in table 5. Obviously the saponin very considerably improved the immunizing power of the dose used. Again, other irritants used as excipients have a similar effect. Large immunizing doses of spores were relatively unaffected by the excipient, as such large doses immunized both groups solidly, so that differences could not be detected.

TABLE 5.

No. of guinea-pigs.	Immunized with	Tested four weeks later with	No.	Lived %
54	Small dose avirulent vaccine in ¼% saponin	100 M.L.D.	52	96
62	Small dose avirulent vaccine in 0·85% NaCl	100 M.L.D.	15	24
52	Not immunized	100 M.L.D.	0	0

DISCUSSION

These experiments enable us to form a reasonably clear picture of what happens when saponin, or another irritant, is used as an excipient for anthrax vaccines. In the first place, any irritant causing a certain amount of tissue destruction favours the development of anthrax. When small doses of anthrax are used, such as a fifth of a lethal dose of virulent spores, or a sub-immunizing dose of avirulent vaccine, the stimulating effect of the irritant in raising the virulent dose to more than a lethal dose, and the sub-immunizing dose to more than an immunizing dose, changes the picture very dramatically. The same stimulating effect on, say, a 100 lethal doses, or on a solidly immunizing dose of vaccine, will be undetectable — for an animal cannot be killed twice, nor can one detect a more than solid immunity. The inhibitory effect or saponin, and other substances provoking extensive oedema formation, does not set in fully until a few hours after the initial stimulation due to tissue destruction. With small doses this inhibition is overshadowed by the early stimulation. With large doses of spores, only the inhibition is evident.

Strong concentrations of saponin produce very extensive oedema and necrosis. This has a marked general and local inhibitory effect on anthrax. In Mazzucchi's earlier work, near virulent strains were suspended in very concentrated saponin. The extensive reaction which this caused inhibited virulence; while the enhanced immunity, as compared with other vaccines, resulted from the virulence of the strain

used. Other workers, who used less virulent strains, found that high concentrations of saponin inhibited immunity as well as virulence. Other workers who used lower concentrations of saponin sometimes obtained an improved immunity and sometimes not, depending on whether they used small or large doses of spores. Thus the results with saponin, or other irritant, depend on the amount of reaction caused, the virulence of the anthrax strain used, and on the number of spores per dose. If due regard is paid to the equilibria between these factors, any type of result can be predicted, and obtained.

So far as other excipients are concerned, it is worth noting that the 50 per cent glycerine used as a preservative in the Onderstepoort vaccine has a noticeable stimulating effect on virulence and on immunity. Lower concentrations are much less active. A very promising excipient, which is now being tested in the field, is a 20 per cent sodium chloride solution. Its stimulating effect is equal to that of saponin, it is a satisfactory preservative, and spores suspended in it retain their immunizing properties for long periods. It has an advantage over saponin in that it does not foam on shaking, and acts as a preservative. It lacks the secondary inhibitory effect of saponin. This might be a disadvantage with the Pasteur type of vaccine; but is probably of little importance with the avirulent uncapsulated vaccine strains used at Onderstepoort.

There is little doubt that irritants such as saponin and concentrated sodium chloride benefit anthrax vaccines. This is because the dose of spores put in vaccines lies, as a rule, in the range stimulated by irritants.

Ramon and Staub (1936) very strenuously recommend an excipient consisting of a mixture of one per cent alum and 0·2 per cent agar. Ramon contends that the action is similar to the action of alum on formol-toxoids — a prolonged stimulus due to slow absorption. However, anyone who troubles to inject a *small* dose of virulent or avirulent spores plus irritant into a guinea-pig will see in 24 hours a substantial lesion teeming with bacilli, whereas controls which received the same dose without irritant will show a barely detectable lesion. The increased immunizing effect is not due to slow absorption, but to the increased amount of antigen. It is elicited by irritants such as concentrated NaCl, concentrated Na_2SO_4, lactic acid, and also by minute amounts of histamine, none of which retard absorption appreciably.

The action of alum on anthrax is the same as that of any other irritant, and is due to its irritant action. As an excipient for field use it has the formidable disadvantage of killing a fair proportion of the spores in three to four months. In any case, the action of the excipients recommended by Ramon is slighter than that of almost any irritant tried here. Ramon's lack of success with saponin was probably due to the use of too high a concentration. No evidence has

been found here that the beneficial effect of saponin is due to any action on the bacillus. In fact, one of the chief advantages of saponin is its almost negligible action. Speaking generally, a good excipient is one that has an irritant action on the tissues, has as little action as possible on the bacilli, and has no physical properties that make its use obnoxious. Saponin, apart from its tendency to foam, is excellent, glycerine is not sufficiently irritant, concentrated NaCl may well prove the best of the lot.

Summary

1. Saponin, like other irritants which cause necrosis accompanied by considerable oedema, has a general effect of retarding the development of anthrax. This is shown by a decreased virulence in the case of virulent strains, and a decreased immunizing power in the case of vaccine strains.

2. Irritant excipients, whether they show a general inhibitory effect or not, markedly enhance the effects of small inocula. With virulent spores there is an increased virulence, with avirulent immunizing spores there is an increase of immunizing power. The dose of spores usually included in vaccines falls within the range stimulated by irritants such as saponin, concentrated NaCl, etc. Thus these irritants are beneficial in practice. Concentrated NaCl (20%) seems likely to be a useful excipient for field use.

3. Reasons for conflicting reports on, and anomalous results with, saponin vaccine are discussed. It is shown that the claim that saponin both depresses virulence and increases immunizing power has a firm basis, and that various effects can be obtained at will by varying the virulence of the strain, the concentration of the irritant, and the concentration of the spores.

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CLOSURE OF PERVIOUS URACHUS IN FOALS BY SUBCUTANEOUS LIGATURE

G. D. SUTTON,
Onderstepoort.

During the last six years, sixteen cases of pervious urachus, twelve in Percheron and four in thoroughbred foals, have been ligatured by a method which appears to be more successful and easier to carry out than those described in text-books of surgery. It has the advantage that a second visit to re-ligature the cord, owing to the ligature slipping or not being tight enough, is not found necessary in any of the cases attended.

In making the ligature, the foal is cast on its right side and held down by four men, one at the head, one holding the two fore limbs and one holding each hind leg; ropes for securing have not been found necessary. A bag is placed under the head to protect the eye. If desired, chloral hydrate per rectum can be used as an anæsthetic. The operator takes up his position next to the back of the foal and cannot easily be injured. The hair round the navel is clipped short with a scissors, the whole area cleaned with soap and water, dried, and painted with tincture of iodine. No. 2 catgut and a large curved suture needle is used. The catgut is doubled, threaded double through the needle and pulled through until the parts on either side of the needle are equal in length. When doubled back this gives four strands of catgut. With the foal lying on its right side, the suture needle is inserted through the skin above and slightly in front of the navel cord and worked round underneath the cord in the subcutaneous tissue. It is brought out through the skin behind and slightly above the cord. The needle is pulled right out, re-inserted at the point of emergence and brought out again at the original point of entrance above and anterior to the cord. In this way the four strands of the ligature are completely under the skin, round the cord, in the subcutaneous tissue. The ligature is pulled up as tightly as possible and tied off. (A left-handed operator could reverse the process, beginning posterior to the cord.) Oedema usually develops round the cord and under the belly, but is never serious and is easily reduced by warm water bathing or spraying if necessary. The only after treatment applied is dusting twice daily with boracic acid powder. The ligature becomes absorbed in time and it is unnecessary to remove it later.

All cases done by this method, except one which had already developed swollen joints and was not expected to live, recovered and closed up uneventfully.

SUMMARY

A successful method of subcutaneous ligature of pervious urachus is described.

CASES OF IMPACTION OF THE MOUTH IN CATTLE

G. D. SUTTON,
Onderstepoort.

Two cases of this condition, in Jersey bulls aged 2½ years and 8 years respectively, have been encountered. They were both pedigree animals, fairly representative specimens of their breed and not showing any noticeable deviations. They were on different farms in the Middelburg (Cape) district. In each case they were running on the veld with the cows and not receiving any supplementary rations. At the time, the veld was dry, consisting of Karroo bush and dry grass almost entirely of the Aristida species (steekgras).

The history supplied by the owners was that the animals were not eating and had not done so for a few days.

On general examination, the animals showed poor condition together with a marked hollowness of the flanks, especially on the left side and a large swelling involving the head. This latter was most prominent in the region just anterior to the pharynx between the rami of the mandible and the cheeks. The bony structures of the head and regional lymph glands did not show any swelling. Palpation of the swellings gave a doughy feel. The soft tissue pitted on pressure with the finger tips. No general signs of disease were apparent.

External examination left doubts as to the diagnosis, but as soon as the interior of the mouth was examined the cause of the condition was obvious. This was found to be impacted with a mass of food material. Treatment consisted of removing the impacted food material manually. During this operation it was found that the whole space between the cheeks and teeth on both sides as well as that behind the dorsum of the tongue up to the oesophagus was filled with this material. After the mouth had been cleared out, the animals were taken to water to see whether they could swallow and so that the mouth could be washed out. Being thirsty, they took water and at the same time washed out their mouths while drinking. There was no difficulty in swallowing. Next they were given lucerne hay. Deglutition took place normally. A further examination of the mouths showed no abnormalities of any sort. Both animals made an uneventful recovery without any further treatment.

The material removed from the mouths was composed entirely of dry grass mainly of the aristida species in the one case and this, together with a few dry poplar-tree leaves in the other. The material

appeared as if it had not been down to the rumen. The poplar leaves definitely gave this impression. It is thought that for some reason, possibly irritation from the dry aristida seed, some reflex action took place when the animals tried to swallow and the material was kept in the mouth. Ingestion of more food added to the bulk until a large accumulation resulted which became compressed by chewing movements, moistened with saliva and eventually impacted the mouth cavity. The condition appears to be one of ordinary impaction. There was no bulky object in the material which could have prevented degultition.

Summary

Cases of impaction of the mouth in cattle have been described.

A FEW PRACTICAL HINTS FOR VETERINARIANS

A. F. TARR,
Ixopo.

Drenching of Cattle

One occasionally encounters cases amongst cattle where drenching *per os* is extremely difficult and at times dangerous.

Among the difficult cases one may mention large, powerful bulls which sometimes prove to be stubborn and resent any handling of the head. In them one may cite conditions such as three-day sickness, where it may be necessary to treat for a severe diarrhœa which is sometimes associated with this disease.

In such cases the use of a ¼in to ½in. trocar and canula is suggested. The instrument is inserted in the usual way with a sharp plunge in the left flank and the trocar withdrawn. The necessary dose is then administered via the canula either by a large syringe, funnel or gravitation, etc. In cases of tympany of the rumen, antiferments can be administered in the same way after expulsion of the gases.

This method has been employed successfully in bulls, and in the treatment of tympany, diarrhœa associated with three-day sickness and other cases where drenching *per os* is contra-indicated, a lot of man-handling is avoided and it involves very little trouble.

Dosing of Fowls

The dosing of fowls *per os* by means of a syringe with a length of rubber tubing attached to the nozzle is somewhat cumbersome and takes up a great deal of time, with the result that many poultry

farmers resort to flock treatment rather than individual treatment which, for obvious reasons, is more desirable.

The method suggested is inoculation of the desired dose directly into the crop of the bird. A syringe with a needle about ¾in. in length is used and the doses can be marked off on the syringe. It is advisable for the operator to stand in one place with all the necessary apparatus next to him on a table, etc. The birds are caught, brought up with the breasts towards the operator who simply injects the required dose into the crop, which is generally partially distended with food.

This method has been used by some poultry farmers with marked success and to date not a single accident has been recorded. It is thus very safe, effective, simple, and speedy.

Taking of Blood Smears

The usual method of taking blood smears from cattle is to make a small cut into the ear in order to draw blood. This sometimes leads to fairly large cuts before blood is produced. The use of a pin gives very satisfactory results. All that is necessary is to locate one of the ear veins and prick it with the pin. If desired, the portion from which the blood is to be obtained may be cleaned by clipping, washing, etc. In order to stop bleeding, merely apply a little pressure with thumb or finger on the spot where the pin was inserted.

This method can also be used in other classes of animals where the ear veins are easily located.

INDEX VETERINARIUS

In a recent article [(1944) *Bull. Med. Libr. Ass.* 32:230], statements appeared which may mislead readers concerning the publication of *Index Veterinarius*.

It would be inferred from this article that the issue of *Index Veterinarius* is *often* delayed by at least six months, and that publication ceased at the end of 1942.

The author may not have understood the announcement on the front cover of *Index Veterinarius* concerning the dates of issue. This announcement shows the indexing period as January to June or July to December, according to the half-year covered, and in each case shows the date of issue as the December or June following the close of the indexing period — an interval of six months in each case. This interval is the time taken to prepare the manuscript for the press and for the printing.

Publication has been continuous since 1933 and still continues.

OBITUARY.

CARLESS, FRANCIS JOHN, Ingestre, Mooi River, Natal. Graduated London, May 16th, 1890. Died April 26th, 1945.

McNAE, ALEXANDER, 5 Dudley Road, Parkwood, Johannesburg. Graduated Edinburgh, May 30th, 1899. Died March 31st, 1945.

THE LATE F. J. CARLESS.

By the death at the age of 75 years of Mr. F. J. Carless, the veterinary profession in South Africa has lost one of its most prominent and respected members. Coming to South Africa for health reasons, he started practice in Natal. He was, however, a keen agriculturalist and started farming in 1911 at Mooi River and soon rose to be one of the best-known farmers in the country. He was a prominent breeder and official judge of Shorthorn cattle. From 1926 to 1928 he was President of the Natal Agricultural Union, on whose executive he served for nine years. He represented Agriculture in the South African Shipping Board and was a member of the Livestock and Meat Industries Control Board.

Notwithstanding his many other activities, Mr. Carless maintained his interest in and enthusiasm for the profession throughout. He was President of the South African Veterinary Medical Association from 1931 to 1936 and was largely responsible for getting the Veterinary Act, No. 16 of 1933, passed by Parliament. In 1939 he was elected Honorary Life Vice-President of the South African Veterinary Medical Association, being one of the only two members who have ever been elected to this position.

It is hoped to publish a further memoir on the late Mr. Carless in our next issue.

THE LATE ALEXANDER McNAE.

Mr. McNae was born at Maxwelltown, Dumfriesshire, Scotland. He served with the Imperial Light Horse in the Anglo-Boer War and took part in the East African campaign in the last war. For some years after the Anglo-Boer War he was in charge of the Government Stud Farm at Standerton. Later, he was Senior Veterinary Officer for South West Africa and retired from that office. After his retirement he was associated with various Rand racing clubs and assisted at the Municipal Abattoir in Johannesburg during part of the present war period. He is survived by his widow and a young son.

MOVEMENTS OF OFFICERS.

Mr. C. W. A. Belonje from Lydenburg to Middelburg, Cape. 7/5/45.

Mr. N. C. F. Steenkamp from Grahamstown to Nongoma. 1/6/45.

Mr. N. T. van der Linde from Potgietersrust to Grahamstown. 29/5/45.

Mr. J. S. van Heerden from Eshowe to Umtata. 3/5/45.

NOTES.

Mr. J. A. Thorburn, government veterinary office, East London, has resigned to take up an appointment with Messrs. William Cooper and Nephews, Johannesburg.

Mr. W. B. de Villiers has rejoined the government service and has been appointed as government veterinary officer, Potgietersrust, from 23rd May, 1945.

Dr. D. W. Bruner of the Kentucky Agricultural Experiment Station, who has been on military service in Italy with the American forces, visited Onderstepoort in June. He is a veterinarian and has been associated with work on equine abortion and on salmonella infections in general.

All members of the profession in South Africa will join in congratulating Dr. P. R. Viljoen, who has been Secretary for Agriculture since 1933, on his appointment as High Commissioner for the Union of South Africa in Canada. Until his appointment as Under-Secretary for Agriculture in 1931, Dr. Viljoen was in the Veterinary Division and at the time of his promotion, was Deputy-Director. We wish him every success in his new sphere of activity.

TICK INFESTATION AS AN AETIOLOGICAL FACTOR IN DISEASES OF UNKNOWN ORIGIN AMONG CATTLE.

GILLES DE KOCK.

Bovine theileriasis in South Africa with special reference to T.mutans infection was dealt with by de Kock et al. (1937). In T.parva infection it is believed that both Koch's bodies and the " small piroplasms ' disappear from the body in those animals which recover and that a " sterile immunity ' follows.

Since 1934 several experiments have been undertaken in which cattle from areas with minimal tick infestation (as a result of systematic dipping), were exposed in places where tick life was prolific, and where in some cases the presence of Koch's bodies had been established in smears from cattle (e.g. Tzaneen; Transvaal; Umzinto, Natal, and the Umfolozi and Hluhluwe Game Reserves, Zululand). Apart from causing piroplasmosis, anaplasmosis, heartwater and theileriasis, ticks are probably responsible for morbidity and even mortality through " factors ' at present unknown. From further studies on the pathology and pathogenesis of East Coast Fever (de Kock and Neitz: to be published), it is believed that isolated Koch's bodies, identified from time to time in the smears, are nothing more than the usual developmental forms of T.mutans, which apparently does not disappear from the body in the majority of cases. These Koch's bodies probably appear intermittently, and in very small numbers in one or a few lymph nodes. Reports of the presence of Koch's bodies in clinically healthy animals slaughtered by butchers have often been received. In the reports of the Senior Veterinary Officer, Natal, (Mr. Diesel) for April, May and June, 1943, the following Koch's body case (T.mutans) were recorded as a result of the intensive smear examination:—

Ladysmith 4; Pietermaritzburg 9; Vryheid 7; Dundee 12; Eshowe 59; Greytown 4; Durban 6; Port Shepstone 21; Nongoma 18; Estcourt 2; and Ixopo 3. Of these 145 cases, 46 were in calves. As a result of the control exercised by the field staff, particularly in respect of collecting smears from all dead animals, it was possible to exclude T.parva infection. Not in one instance did East Coast Fever manifest itself in these cases subsequently.

It is believed that there are a number of " exciting factors ' that may lower the resistance of the animal, and lead to an increase of the Koch's bodies in a number of lymph nodes, i.e. a " speed up " of the development stages. Koch's bodies, the developmental stages of T. mutans, have frequently been observed in the following conditions:—

1. Diseases of young animals such as coccidiosis, chronic scours, paratyphoid, verminosis, chronic vegetable and mineral poisoning.
2. Scalding as a result of dipping, unhygienic conditions, insufficient milk supply for calves and malnutrition generally.
3. Recrudescence of T. mutans infection as a result of environment. Doyle (1924) refers to the appearance of Koch's bodies in cattle after a sea voyage from Cyprus to the damp hot summer climate of Egypt.
4. The transfer of cattle from areas with minimal tick infestation to areas where tick-life is more prolific. The Government Veterinary Officer, Kokstad, investigated the occurrence of a number of Koch's body cases on Commons Valley, Umzimkulu.

On the 31st January, 1939, 155 cattle were moved from Bont Rand (in the Umzimkulu district), where the smear position was excellent and tick infestation minimal. Tick life in Commons Valley (in the same district) on the other hand was rife. About a fortnight after their arrival at Commons Valley six cases of Koch's body infection were identified by smear examination. All these cases showed enlargement of the lymph nodes with symptoms of prostration and emaciation. There was extensive injury to the ears and surrounding tissues, with necrosis. The following changes were recorded at post-mortem: Wasting, serous atrophy of the adipose tissue, anaemia, and degenerative changes in the myocardium, liver, and kidneys and in two cases *multiple erosions* on the mucous membrane of the abomasum. Microscopical examination revealed no lymphatic tissue reactions in the liver and kidneys.

In one group of cattle exposed at Tzaneen in the Transvaal in 1935, a certain proportion of those animals coming from Vryburg showed reactions and tissue changes, not unlike those of East Coast Fever, e.g. lymphocytic hyperplasia in the liver and kidneys, rarefaction of lymphatic tissue and loss of nodules in the lymph nodes as well as a deposit of hyaline material in the stroma. The latter lesion was also identified in the follicles of the spleen. On the other hand the cattle from Kaalplaas (Onderstepoort) exposed at the same time showed Koch's bodies and febrile reactions, but *no mortality* or anything that had a resemblance to East Coast Fever. The following criteria were taken into consideration to differentiate the acute T. mutans infection in the 1935 Vryburg Cattle from East Coast Fever:—

(a) small number of gamonts;
(b) comparative infrequency of small piroplasms in individual red cells;
(c) only a small percentage of red cells infected;
(d) epizootiology.

No evidence of East Coast Fever tissue changes was seen in the rest of the group of cattle exposed in the following experiments:—

1934 Vryburg and Kaalplaas (Onderstepoort) cattle exposed at Tzaneen, Transvaal.

1934 Allerton (Maritzburg) cattle exposed at Umzinto, Natal.

1935 Kaalplaas (Onderstepoort) cattle exposed at Tzaneen, Transvaal.

1936 Vryburg cattle exposed at Tzaneen, Transvaal.

1944 Kaalplaas (Onderstepoort) cattle exposed at Umfolosi Game Reserve, Zululand.

1944 Kaalplaas (Onderstepoort) cattle exposed at Hluhluwe Game Reserve, Zululand.

1944 Kaalplaas (Onderstepoort) cattle exposed at Hluhluwe Game Reserve, Zululand.

Of the 97 animals exposed, 66 showed symptoms (41 with Koch's bodies), and 30 died as a sequel of tick infestation. These 30 deaths do not include cases of heartwater, piroplasmosis or anaplasmosis, or the cases where animals were destroyed for the collection of specimens. Of these 30 animals which died, 7 showed lymphocytic hyperplasia in liver and kidneys.

The duration of the temperature reactions was from 14 to 52 days and deaths occurred from the 19th day after exposure. The highest temperature varied from 106° to 108° F. The duration and the intensity of the temperature reactions varied in the individual groups, but more so in the different years, comparing for instance the Vryburg cattle exposed at Tzaneen, respectively in 1934 and 1935. There was also a difference in mortality in some groups. At the Umfolosi Game Reserve, none of the Kaalplaas cattle died, whereas nearly 100 per cent. mortality occurred at the Hluhluwe Game Reserve in Kaalplaas cattle exposed at the same time. During these experiments the local cattle remained healthy. Apparently the breed of the animal does not play a part. Kaalplaas Zulu grades and Afrikaners were equally badly affected, and one Zulu cow from Zululand kept at Kaalplaas from the 17th March, 1936, to 4th January, 1944, even died as a result of tick infestation.

De Kock et al (1937) showed that ticks collected at Tzaneen produced febrile reactions when placed on cattle at Onderstepoort, accompanied by the appearance of Koch's bodies in the smears from lymph nodes in 5 out of 7 cases. One animal previously exposed at Tzaneen remained unaffected. Sub-inoculations of the blood of cattle during the febrile reactions into either sheep or cattle gave negative results.

Reference should be made to immunity tests carried out at Onderstepoort with East Coast Fever infected ticks on cattle exposed at Tzaneen and which had shown Koch's bodies (Neitz and de Kock, paper to be published). Cattle were infested with infected ticks 24 days, 1 month, 8 months, 12 months, 17 months, 20 months, and 3 years respectively after they had shown Koch's bodies and all succumbed to East Coast Fever.

Discussion of the Literature.

Cooper (1926) states that in addition to the diseases in India enumerated in his report, there is evidence on record to indicate that certain ill-defined fevers may be introduced by *toxins* or *poisons* injected by the ticks when they engorge. Theiler (1907) in his T. mutans experiments at Nelspruit came to the conclusion that there was some *other agency* responsible for the reactions in the cattle in the exposure experiments, and of which we have no knowledge at present.

Macleod and Gordon (1933) referred to a febrile reaction immunologically distinct from louping-ill that occurred in sheep grazed on some tick-infested farms in Scotland. When transmitted by inoculation, it was characterised by an incubation period of about 4 days followed by a febrile phase which lasted about 10 days. Mortality was low and animals were comparatively immune to further infection. There is evidence that tick-borne fever of sheep, as this disease is called, may *predispose affected animals to death from a secondary cause,* because direct mortality as a result of infection is rare (vide Onderstepoort transmission experiments). In a further paper by these authors (1936) they were of opinion that negative results by inoculation of emulsions of infected ticks were probably due to the action of saline on the infective agent, because when sheep serum is used tick-borne fever can be induced. Activation of the virus by allowing ticks to commence a blood meal would appear to be desirable. In certain valleys all the ticks on an infected farm harboured the virus.

Trager (1939[a]) showed that guinea pigs after one infestation with *Dermacentor variabilis* acquire an effective immunity against these parasites. The immunity develops to its fullest extent within about 2 weeks and lasts at least 3 months. The immunity can be passively transferred by inoculation of serum. In another paper, Trager (1939[b]) is of opinion that immunity can be produced artificially by the inoculation of extracts of larval ticks.

Comments.

From what has been said above and comparing it with statements in the literature, it would appear that certain ticks are probably capable of bringing about *morbidity* in cattle, especially when such cattle are moved from areas with moderate tick infestation to those where tick life is more prolific. Febrile reactions result, and *mortality* may occur when other contributory causes operate.

In view of the fact that in some cases the ears of the cattle were not affected, local injury and secondary infection can be excluded. Probably only a limited number of ticks are infected sometimes, and it requires mass infestation to bring about results. It is essential that this factor in the tick, "toxin" or "virus," be further investigated, and every attempt made to exclude it in the first instance in experiments on

theileriasis, heartwater, and other similar diseases. In the transfer of cattle to badly tick infested areas the problem of passive and active immunity to this factor should be explored (e.g. by immune serum, emulsified ticks, etc.) Infestation with ticks activated by previous feeds on hosts should receive consideration, as well as the use of emulsified ticks in serum instead of in saline. Further pathological studies of uncomplicated cases, especially of the central nervous system should be undertaken at various stages of the disease. In East Coast Fever areas, continual vigilance in " Koch's body " cases should be exercised to exclude East Coast Fever. Wherever possible suitable specimens in formalin should be submitted from the following organs:— brain, spinal cord, liver, kidney, spleen and at least two lymph nodes (e.g. precrural and mediastinal). Smears from the blood, spleen and lymph nodes should also be submitted for examination. The history of these cases should be carefully noted, especially whether the affected animals have been newly introduced, the extent and kind of tick infestation, condition of cattle, other contributory causes, whether symptoms, especially of a nervous nature were manifested, etc. The most obvious method of overcoming this evil, and controlling all tick-borne diseases is by systematic dipping, especially in those areas where tick life is prolific. Special attention should also be paid to proper hygiene, nutrition, etc.

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MODERN THERAPEUTICS.

A REVIEW OF THE USE OF SULPHONAMIDES AND OF PENICILLIN AND OTHER ANTIBIOTICS FROM BACTERIA AND MOULDS AS THERAPEUTIC AGENTS.

• DOUW G. STEYN,
Onderstepoort.

INTRODUCTION.

As indicated by the title of this paper, only the sulphonamides and antibiotics from bacteria and moulds will be discussed, and no reference will be made to the many synthetic organic compounds of arsenic, antimony, bismuth, gold, silver and mercury, and other therapeutic agents employed in the treatment of infectious and other diseases.

SULPHONAMIDES.

As an article on " Sulphonamides — their comparative efficacy in bacterial and other infections, relative toxicity, dangers, and prophylaxis " appeared in the *Jnl. S.A.M.A.* Vol. 13(4), 1942, 120-128 and Vol. 14(1), 1943, 31-37, only information acquired more recently about the sulphonamides will be referred to here.

A. *Sulphonamide preparations.*

The following sulphonamide preparations are those which are most generally employed in the treatment of diseases in man and animal: sulphanilamide [prontosil, neoprontosil (red prontosil) prontylin], sulphapyridine (Dagenan, M. and B. 693), sulphathiazole, (Thiazamide, M. and B. 760), succinylsulphathiazole, sulphaguanidine, sulphadiazine, sulphonamide E.O.S. (I.C.I.), Uleron (Diseptal A), sulphacetamide, sulphamethazine (methylated sulphadiazine), sulphamerazine, soluseptasine (M. and B. 137), proseptasine, albucid, Irgamid (derivative of sulphanilanide), and sodium sulphanilyl sulphanilate (SSS).

Sulphadiazine is at present the best all-round sulphonamide for bacterial infections.

Among some of the sulphonamide preparations captured from the Germans were Marfanil (Mesudin), which is 4-amino-methylbenzene sulphonamide, and Prontalbin, which is apparently one of Bayer's trade names for sulphanilamide. Marfanil-Prontalbin is probably a mixture of the two above preparations. The Germans claim that Marfanil is, in contrast to other sulphonamides, effective in the presence

of pus, and this was confirmed by tests in Britain. Marfanil was found to be a much weaker bacteriostatic on the test streptococcus than sulphathiazole, but it appears to be more active than other sulphonamides against anaerobic infections, especially *Clostridium septique.*

In eye diseases the following sulphonamides are recommended: sulphathiazole or sodium sulphathiazole (5% ointment), sulphacetamide (30% aqueous solution instilled into eyes, but ointments are preferable), and sulphadiazine and Uleron in 1 to 20% solutions, but ointments and especially 5 to 10% suspensions in cod liver oil are much more effective.

In cases of eye disease which will not yield to the local application of the above sulphonamides, the same drug should also be administered orally as is done in gonorrheal conjunctivitis in which condition it was found that sulphapyridine and sulphthiazole were definitely superior to sulphanilamide, (*J.A.M.A.* 121, 1943, 154).

B. *Some characteristics of the sulphonamides.*

It is stated that sulphanilamide- urea combinations are more effective against streptococcal and staphylococcal infections than sulphanilamide alone and are also less poisonous, (*Nature* 151, 1943, 586). The hydrochloride of sulphanilamide is approximately four times as toxic as the base. The toxicity of the sulphonamides is markedly reduced by injections of whole liver extract. This is believed to be due to the high vitamin C content of liver extract. The application of sulphonamides suspended in oil to wounds is stated to be liable to cause undesirable connective tissue reactions, (*Bull. War Med.* 3, 1943, 685). Recently it was established that the prolonged administration of sulphonamides is inclined to cause vitamin deficiency as they inhibit or check the formation of vital vitamins in the digestive tract by the action of gastro-intestinal bacteria. Sulphaguanidine prevents the formation of vitamin K and biotin, (*J.A.M.A.* 104, 1944, 88). Kornberg and his associates (*Public Health Reports.* U.S.A., 59 1944, 832), state that " sulphapyrazine, sulphadiazine or sulphathiazole fed to rats at a 1 per cent. level in purified diets resulted in a regular production of severe hypothrombinaemia and haemorrhage in two to three weeks. Sulphaguanidine, sulphanilamide and succinyl sulphathiazole were less effective." The hypothrombinaemia and haemorrhage were due to vitamin K deficiency caused by the above sulphonamides. Vitamin K, administered orally, prevented these phenomena. Monkeys receiving sulphathiazole and sulphapyridine (0·5 gm/kg) orally in milk, were found to be much more susceptible to the latter than to the former drug. Damage to the kidneys was the most prominent lesion.

In a large number of publications the danger of sensitization (fever, rash, conjunctivitis) to sulphonamides, whenever treatment with these drugs is continued beyond 6 days and has to be repeated later on, is

stressed. Patients may remain sensitive for long periods and may need treatment with sulphonamides urgently during the period of sensitivity. Skin tests for such a sensitivity are too unreliable, and Leftwich claims to have evolved a reliable intradermal test, which is described in *The Lancet*, 246, 1944, 668. The theory underlying this test is that the sulphonamide combines with the plasma proteins of the patient and that this combination acts as a hapten and produces the specific sensitivity. On the other hand some individuals are quite resistant to sulphonamides. In this respect Boroff (*Bull. U.S. Army Med. Dept.*, No. 78, 1944, 111) states: "The *in vitro* anti-sulfonamide action of the serums of certain individuals appears to bear relationship to the clinical resistance of these individuals to drug therapy."

Extracts and infusion of meat and parenchymatous organs, plasma, blood, serum, various exudates (pus) and transudates, albumen, gelatin, casein, fibrin, edestin, and sterile nutrient broth all, unfortunately, interfere with the bactericidal powers of the sulphonamides. Peptone inhibits sulphonamide activity even to a greater extent than the above-mentioned agents and the products of protein digestion apparently antagonise sulphonamide activity more markedly than the parent protein, (*Bact, Rev.* 7, 1943, 175). The antagonistic action of the above substances is probably due to the fact that the sulphonamides are adsorbed on to them. On the other hand, injections of papaverine rendered mice more susceptible to sulphapyridine, prontosil, sulphanilamide, uleron, albucid, and sulphathiazole, but there was no appreciable increase in the toxicity of sulphanilamide with morphine, codeine, narcotine, acedicon (thebaine derivative), chloral, paraldehyde, sulphonal, adalin, veronal, luminal, evipan, caffeine, atropine, or pyramidon. Although there is no clinical evidence, it is warned that caution should be exercised in the use of papaverine, dolantin (pethidin) or novocaine plus adrenalin at the same time as the sulphonamides. Procaine (novocaine) inhibits the bactericidal action of sulphonamides as it contains the aminobenzoic acid group.

Walker (*Lancet* 247, 1944, 192), referring to sulphonamides and infertility, states that "The germinal epithelium is peculiarly sensitive to toxins circulating in the body, and that there is sufficient evidence to suggest that the continued administration of this type of drug may adversely affect spermatogenesis."

Irgamid (N'- dimethylacroyl derivative of sulphanilamide) is comparable with sulphapyridine in its activity against streptococci and pneumococcal infections in animals and the sodium salt, when administered intravenously, is better tolerated than sulphapyridine by animals. No urinary concretions have been observed. It is rapidly absorbed from the alimentary canal. It is stated that of all the sulphonamides Uleron most frequently causes symptoms of polyneuritis and that these symptoms respond to vitamin B_1 treatment. However, the toxicity of

• the sulphonamides does not appear to be due to a state of vitamin B_1 deficiency.

In advanced age patients appear to be more susceptible to sulphonamides, especially as far as the appearance of rashes is concerned.

C. *Protection against poisoning with therapeutic doses of the sulphonamides.*

Sulphadiazine and its acetyl derivative are much more soluble in alkaline than in acid urine, consequently with alkaline urine there is a much smaller possibility of crystalluria which is such a frequent and sometimes fatal, complication in sulphonamide therapy. It is therefore recommended that the urine be rendered alkaline. In man this can be done by the daily administration of 12·0 gm. of sodium bicarbonate. It is also of very great value for patients to drink at least one pint of fresh orange juice daily during sulphonamide therapy.

In hot climates, and especially with excessive perspiration, great care should be exercised in the administration of sulphonamides, as under these conditions the urinary output is reduced to a minimum with the consequent danger of crystalluria. Under desert conditions it is recommended that not more than 1·0 gm. of sulphadiazine every 6 hours should be given to patients, and that the administration should be discontinued if the daily urinary output is less than one litre.

ANTIBIOTICS FROM MOULDS AND SOIL BACTERIA.

Alexander Fleming (St. Mary's Hospital, London) discovered the antibacterial substance penicillin in 1929, and since the discovery of its chemotherapeutic properties at Oxford in 1938, a tremendous amount of work has been done on large numbers of antibiotics isolated from various bacteria and many varieties and species of moulds. Of all the antibiotics isolated from moulds and soil bacteria, penicillin proved to be the most suitable for therapeutic purposes, and at present it is being mass-produced from the mould *Penicillium notatum*. Attempts are also being made to synthesize it.

It is of interest to note that in 1877 Pasteur and Joubert, working with the anthrax bacillus, were the first to observe the phenomenon that one organism was capable of producing a chemical substance (antibiotic) which possessed the property of stopping the growth of another. Unfortunately they did not realize its significance and possibilities.

It was not until 1938 that Florey and his collaborators discovered the tremendous potentialities of penicillin as a therapeutic agent. The name of this most ideal, although by no means perfect, of all therapeutic agents cannot be mentioned without thinking of Fleming, Florey, Chaim, Abraham, Gardner, Heatley, Jennings, Sanders and Fletcher, who performed such a lot of the spade work.

The following is a list of some of the more interesting and more important metabolic and antibiotic substances studied.

Name of antibiotic.	*Origin.*	*Remarks.*
1.	*Bacillus pyocyaneus*	Three antibiotics isolated, but all very toxic.
2. Gramicidin	Dubos spore-bearing soil bacillus *(Bacillus brevis)*	Bactericidal against Gram-positive organisms both *in vivo* and *in vitro*.
3. Tyrothricin	A crude extract from Dubos spore-bearing soil bacillus	It is a mixture of gramicidin and tyrocidine.
4. Helvolic acid	*Aspergillus fumigatus mut. halvola Guill.*	
5. Fumagacin	*Aspergillus fumigatus*	Markedly bacteriostatic only to Gram-positive organisms.
6. Clavicin (may be identical with patulin).	*Aspergillus clavatus*	Bacteriostatic and bactericidal against Gram-positive and Gram-negative organisms.
7. Claviformin	Aspergillus giganteus	Antibiotic.
8. Gigantic acid	Aspergillus giganteus	Yield is lower and purification no easier than penicillin.
9. Patulin and Tercinin	*Penicillium patulum, Penicillium expansum* and *Penicillium claviforme*	Patulin is equally bacteriostatic to both Gram-positive and Gram-negative organisms, but much less active than penicillin against Gram-positive organisms.
10. Notatin (Penicillin A)	*Penicillium notatum*	Formerly named "Penicillin." It is a powerful bactericide.
11. Penicillin	*Penicillium notatum*	Best therapeutic agent of all antibiotics isolated.
12. Penatin	*Penicillium notatum*	In some bacterial infections it is more effective than penicillin.
13. Penicidin	*Penicillium sp.*	Bacteriostatic. Activity suppressed by serum, blood, etc.
14. "Penicillin B"	*Penicillium notatum*	Differs greatly from the presently extensively used penicillin. Fairly toxic.
15. Glucose-oxidising enzyme.	*Penicillium notatum*	Bacteriostatic.
16. Palitantin	*Penicillium palitans*	
17. Sclerotiose	*Penicillium sclerotiorum*	

Name of antibiotic.	*Origin.*	*Remarks.*
18. Penicillic acid	*Penicillium puberulum and Penicillium cyclopium.*	Antibiotic.
19. Puberulic acid and Puberulonic acid	Various species of *Penicillium.*	
20. Streptothricin	*Actinomyces levendulae* (a soil fungus)	Bacteriostatic against both Gram-positive and Gram-negative organisms.
21. Glyotoxin	*Gliocladium fimbriatum* (a fungus).	Antibiotic. It has a marked spirochaeticidal action in vitro.
22. Proactinomycin	Various species of *Proactinomyces* (fungi).	Antibiotic.
23. Actinomycin	*Actinomyces antibioticus*	Antibiotic, very poisonous.

A. ADVANTAGES AND DISADVANTAGES OF SOME OF THE MOST PROMISING ANTIBIOTICS FROM MOULDS AND BACTERIA.

(a) *Actinomycin* — Actinomycin is markedly bacteriostatic against pathogenic aerobic and anaerobic infections and *in vitro* it is active against Gram-positive, and to some extent also against Gram-negative organisms. Unfortunately it is very poisonous and affects kidney and liver function. Intraperitoneally, intravenously, subcutaneously or orally, it is lethal to mice, rats and dogs in doses of 1·0 mg. per kilogram of body-weight. Doses of 0·05 mg/Kg. administered intraperitoneally to mice and rats daily over a 6-day period are fatal. There are gross pathological lesions in the organs and a marked shrinking of the spleen, (*Jour. Pharm, and Exp. Ther.* 74, 1941, 25). As a matter of fact, actinomycin is so poisonous that it has been hailed as a new rodent poison, (*J.A.V.M.A.* 103, 1943, 385).

(b) *Claviformin.* — Its activity is unimpaired in acid solution, but destroyed in alkaline solution. Staphylococci are most susceptible to it, followed by the typhoid bacillus and other Gram-negative organisms, but unfortunately it is toxic to animal tissues, and serum inhibits its antibiotic activity to a considerable extent. Consequently, it appears to be unsuitable for therapeutic purposes. Bergel *et al.* (*Jour. Chem. Soc., Sept.,* 1944, 415) state that clavatin isolated from *Aspergillus clavatus* is identical with claviformin from *Penicillium claviforme.*

(c) *Helvolic acid.* — Its bacteriostatic activity resembles that of penicillin, but the results of therapeutic experiments with *Streptococcus pyogenes and* staphylococci were disappointing. It was also established that habituation of staphylococci and streptococci to helvolic acid in-

creases their resistance to this antibiotic approximately 250-fold. Repeated injections of helvolic acid damage the liver.

(d) *Penatin.* — According to Kocholaty (*J.A.V.M.A.*, 102, 1943, 385), penatin has a wider range of application and possesses higher bactericidal powers than penicillin. Penatin killed bacteria in dilutions as high as 1:400,000,000. Anthrax, diphtheria, typhoid, paratyphoid, brucellosis, pneumonia and pus-forming organisms were killed with a dilution of 1:12,500,000. It is stated that its activity is not lowered by 90% serum, and that "large intravenous doses" had no ill-effects on rabbits and guinea-pigs. However, much more experimental evidence is required before it can be definitely stated that penatin is superior to penicillin as a therapeutic agent.

(e) *Patulin.* — Raistrick *et al* (*Lancet* 245, 1943, 625), report encouraging results in the treatment of the common cold with patulin, but other investigators have not achieved such promising results. According to Bergel *et al.* (*Jour. Chem. Soc., Sept.*, 1944, P. 415), clavatin isolated by them from *Aspergillus clavatus* is very probably identical with patulin from *Penicillium patulin.*

(f) *Proactinomycin.* — It is much more toxic than penicillin and its antibacterial activity is inhibited by serum.

(g) *Streptothricin.* — It is stated to possess selective bacteriostatic effects on Gram-negative and Gram-positive bacteria, including *Bacterium shigae.* It is recommended in the treatment of *brucellosis,* as it has a bacteriostatic effect on*Brucella abortus* in chicken embryos and in guinea-pigs. There are indications that in time streptothricin may prove to be of value in the treatment of bacillary dysentery, typhoid, and colon infections, (*J.A.M.A.*, 126, 1944, 103). Penicillin is of little or no value as a therapeutic agent against these Gram-negative infections.

(h) *Gramicidin, tyrothricin and tyrocidine.* — In the presence of animal tissues (blood, serum) gramicidin retains much of its activity, and it is much more bacteriostatic against Gram-positive than against Gram-negative organisms. Purified gramicidin and a highly concentrated preparation of penicillin were found to be of the same order of activity against strains of Gram-positive cocci in tissue culture medium.

Infusions of gramicidin *via* the teat canal, yielded very good results in the chronic form of bovine mastitis. Infusions of from 20 to 80 mg. of gramicidin in the form of the gramicidin-oil mixture caused such a mild reaction that it was possible to repeat the treatments on the second and third days, (*Studies Rockfeller Inst. Med. Res.* Reprints 120, 1942, 489). Also tyrothricin (150 mg. per quarter) produced recovery in 93% of selected cases of bovine mastitis, (*J. Dairy Sci.* 25, 1942, 713).

"Crude and purified gramicidin after initial stimulation inhibits the oxygen consumption of bovine spermatozoa completely in Ringer

phosphate of acid P^H and renders the cells immobile," whereas with sufficiently small amounts only stimulation is observed, (*Proc. Soc. Exp. Biol. and Med.* 47, 1941, 193). Gramicidin is only slightly leucocytolytic but has a powerful haemolytic action on rabbit's and sheep's erythrocytes *in vitro*, even in the presence of serum, plasma, and tissue extract. The bacteriostatic and haemolytic effects of gramicidin are destroyed by heat. Gramicidin, tyrothricin and tyrocidine are all non-toxic when administered orally, but parenterally they are poisonous and gramicidin and tyrothricin considerably more so than tyrocidine. Daily parenteral administration of 2·0 mg. of gramicidin or tyrothricin per kg. of body weight killed dogs in 2 to 8 days after symptoms of loss of appetite and weight, salivation and an almost 50% drop in red blood cell count.

Concentrations of gramicidin suspensions up to 0·5 % are not irritant when instilled into the conjunctival sac of rabbits, but dry material causes severe conjunctival irritation and long-persisting opaqueness of the cornea. When injected subcutaneously or intradermally its preparations remain unabsorbed for long periods and produces less marked induration than tyrothricin.

Tyrothricin is inactive in infections when given orally, but is bactericidal when in direct contact with staphylococci, streptococci and certain Gram-positive organisms. Tyrothricin and tyrocidin cause haemolysis of erythrocytes and are leucocytolytic, and they lose their bactericidal effect in the presence of blood and serum. Consequently, the main use of tyrothricin is in localised infections of soft tissues, such as mastitis. Commercially, it is supplied in a 2% solution of the extracts of *Bacillus brevis* in 95% alcohol and this is diluted in sterile distilled water to from 5 to 20 mg/100 cc. for use.

(i) *Penicillin.* — Penicillin is of great value as a therapeutic agent in the following diseases:— streptococcic mastitis; experimental ratbite fever (*Spirillum minus* and *Streptobacillus moniliformis*); syphilis (although more information of its curative powers is needed); psittacosis (very promising results); small-pox (promising results); gonorrhoea; promising results in Weil's disease (*Leptospirosis icterohaemorrhagica*); experimental relapsing fever in white mice and white rats (good results); *Staphylococcus aureus* and other staphylococcal infections; infections with *Clostridum tetani, Cl. welchii, Cl. septique,* and *Cl. oedematiens;* infections with *Streptococcus pyogenes, Strep. pneumoniae, Strep.viridans, Bacillus anthracis, Corynebacterium diphtheriae, Neisseria meningitis* (meningitis or spotted fever), and *Actinomycis bovis;* promising results in empyema (*streptococcus* and *pneumococcus*); blepharitis and conjunctivitis, and it is also of value in other types of eye affections; bilateral cavernous sinus; thrombophlebitis (1 case reported); murine typhus rickettsiae (grown in yolk sac).

Heilman and Herrell (*Proc. Staff Meetings Mayo Clinic,* 19, 1944,

340), achieved very encouraging results, both *in vitro* and in experiments upon mice, in the treatment of infections with the causal organism of swine erysipelas.

Penicillin is also a fairly effective therapeutic agent in staphylococcic mastitis, but is of no value in the treatment of tuberculosis, trypanosomiasis, toxoplasmosis, plague, cholera, dysentery, typhoid fever (typhoid bacillus however slightly susceptible to penicillin), bird malaria; infections with *Bacterium coli, Pseudomonas pyocynea, Proteus, Brucella melitensis,* (more information required), and *Bacillus of Friedländer;* influenza virus PRS; *lupus erythematosus;* acute and chronic leukaemia; ulcerative colitis; coccidiomycosis; moniliasis; viurs infections; malaria; Hodgkin's disease; infectious mononucleosis; pemphigus; poliomyelitis; and paratyphoid.

T'ung (*Proc. Soc. Exp. Biol. & Med.* 56, 1944, 8) states that:— "Penicillin exerted a considerable antibacterial action on 8 out of 15 strains of *Brucella in vitro.* This action was enhanced by the combination of penicillin, with a small amount of sodium sulphathiazole."

The discovery at the Wistar Institute of Anatomy and Biology that penicillin kills rat bone cancer cells without damaging normal cells growing beside them, may yet prove of great value in the combating of certain types of cancer, (*Vet. Med.* 39, 1944, 264).

(1) *Toxicity of penicillin.* — Of all therapeutic agents the therapeutic index of penicillin is the most favourable, and toxic reactions are rare. Only occasionally are chills, fever, urticaria, head-aches and vomiting seen and with intravenous injections local thrombophlebitis may develop. Pyle and Rattner (*J.A.M.A.* 125, 1944, 903) describe a case of acute contact dermatitis caused by purified penicillin.

The purified calcium salt of penicillin is not much more toxic for man and animal than the purified sodium salt, (*Proc. Soc. Exp. Biol. and Med.* 55, 1944, 76). Ten mg. intravenously and 20 mg. subcutaneously of the purified calcium salt caused severe but not fatal reactions in 20 gm. mice. Impure penicillin and its impure salts are more poisonous than the purified preparations. The calcium salt is easier to handle than the deliquescent sodium salt.

When given subcutaneously penicillin is well tolerated by mice in daily doses of 1·6 gm. per kg. body weight over a 5-day period, but under the same conditions 3·2 gm. per kg. body weight are lethal for some mice, (*J. Pharm. and Exp. Ther.* 77, 1943, 70). Guinea-pigs are more susceptible than rabbits and mice to penicillin. Twenty mg. of the sodium salt of penicillin, administered intravenously, has no effect on a mouse, and human leucocytes survive for an hour in a 1·0% solution of penicillin. Lymphocytes also suffer no ill-efects.

The toxicity of the salts of penicillin is primarily due to the cations used in their preparation. The relative increasing toxicity (based on

milliequivalents of the cations used in the preparation of the salts) of a number of salts tested was as follows:— sodium, ammonium, strontium, calcium, magnesium and potassium, (*Proc. Soc. Exp. Biol. and Med.* 55, 1944, 246).

In subjects with meningitis, absorption of penicillin was found to be more rapid after intrathecal injection than otherwise, (*Biol. Abstr.* 18, 1944, 712).

B. Methods of application and doses of penicillin.

Penicillin is inactive when administered orally or rectally, hence it is used intravenously, intramuscularly and subcutaneously, and locally on wounds, burns, etc.

Wounds and burns.

A cream prepared with lanette wax and soft paraffin with a concentration of 100 Oxford units per gram was found to be the most effective and economical means of applying penicillin to surface wounds and burns, (*Lancet* 245, 1943, 725). After a week's application of the cream, however, the wounds are inclined to become soggy. If dry treatment is desired a sulphonamide-penicillin powder is preferable.

Robinson and Wallace (*Science* 98, 1943, 329), describe dressings inoculated with Penicillin mould which apparently yield excellent results in the treatment of infected wounds. This method is cheap and of great value owing to the present scarcity of penicillin.

Penicillin does not appear to have any detrimental local effects or to affect adversely granulations on the wounds, rate of healing, or ease with which the grafts "took."

In *B.M.J.* May 13, 1944, 654, a crude penicillin filtrate for local treatment is described. (See also *B.M.J.* Dec. 11, 1943, 755).

Parenteral administration.

Penicillin is rapidly excreted in the urine, hence frequent administration is desirable. Beyer *et al.* (*Science* 100, 1944, 107), found that para-aminohippuric acid causes a marked retention of penicillin in the blood and consequently may yet contribute very materially to the saving of penicillin.

The intramuscular route appears to be desirable as repeated intravenous injections are inclined to cause local thrombosis of the vein. For intramuscular administration in man 15,000 Oxford units of penicillin at 4 hourly intervals are recommended (*Bull. U.S. Army Med. Dept.* No. 70, 1943, 9). In the continuous intravenous drip method, normal saline or 5% glucose containing 10,000 to 20,000 Oxford units of penicillin per liter is given over a period of 12 hours, with a total dosage of 64,000 to 200,000 Oxford units (*Lancet* 245, 1943, 106; *Proc. Staff Meetings Mayo Clinic* 18, 1943, 433).

As with many other drugs, the importance of adequate initial therapy is emphasized as there is the danger of production of strains resistant to penicillin if small initial doses were used. Such penicillin-fast strains have been produced with spirochaetes (syphilis in rabbits), pneumococcus (types I and III) and other bacterial strains. Sulphonamide-fast bacteria can be re-sensitized by the method of Tsuchiya (*J.A.M.A.* 121, 1943, 680), but it is not known whether penicillin-fast organisms can be re-sensitized in a similar way.

Eye diseases.

Penicillin is of great value in the treatment of ocular infections especially blepharitis and conjunctivitis. It can be used in the form of drops (500 Oxford units per c.c.) or ointment (100 Oxford units per gm.). Unfortunately, the solution (drops) appears to retain its effectiveness only for 4 hours and the ointment for 6 hours, (*B.M.J.* Aug. 5, 1944, 175, and *B.M.J.* No. 4342, 1943, 420).

Advantages of penicillin.

1. It is the least toxic and most effective of all antibiotics thus far tested. The white blood cells and tissue cultures (body cells) are not affected by concentrations of penicillin hundreds of times greater than that which stop bacterial growth.

2. It is very effective in sulphonamide-resistant strains of bacteria.

3. Penicillin and sulphapyridine have synergistic beneficial effects on mice infected with *Streptococcus haemolyticus* and *Staphylococcus aureus.*

4. Penicillin appears to be more effective than sulphonamides in streptococcal, staphylococcal and pneumococcal infections in mice and the protection afforded by penicillin was more lasting than that afforded by sulphonamides, (*J. Pharm. and Exp. Ther.* 77, 1943, 70).

5. The activity of penicillin is only slightly affected by the number of organisms present, and pus, blood, or decomposition products of dead tissues do not inhibit its activity. All this is in striking contrast to the sulphonamides.

6. Sulphonamides cause photosensitization, whilst this condition is not known to occur in penicillin therapy.

7. The prolonged administration of sulphonamides is likely to have a detrimental effect on spermatogenesis, whereas there is no evidence of such an effect by penicillin.

8. Sulphonamide hypersensitivity is becoming an increasingly serious complication in the human being, while such a phenomenon has not been encountered in the use of penicillin.

9. The prolonged administration of sulphonamides may cause vitamin deficiency, whereas with penicillin no such effect has been established.

Disadvantages of penicillin.

1. It is unstable towards acids, alkalis, heavy metals and many other chemical reagents.

2. It can at present not be administered orally (inactivated by gastric acidity) or rectally.

3. The use of penicillin is very seriously restricted by the extremely small supplies which are available. However, recent information indicates that in the near future we can expect such ample supplies that it will probably also be available for use in animal diseases.

Summary.

The most commonly used sulphonamide preparations are mentioned and some of their characteristics are referred to. Prophylactic measures against poisoning with therapeutic doses of sulphonamides are discussed.

Some of the more well-known antibiotics from bacteria and moulds are mentioned. Their characteristics, comparative therapeutic properties, and dangers are discussed. The therapeutic properties of penicillin and the sulphonamides are compared and attention drawn to the advantages of the former preparation.

Because of —

(1) the general abuse of sulphonamides in the treatment of almost every imaginable disease in man;

(2) the large number of cases of poisoning, many of which have been fatal, caused by therapeutic doses;

(3) the many cases of hypersensitivity to the sulphonamides, and

(4) the ever-increasing number of sulphonamide-resistant strains of bacteria (many of which have undoubtedly been produced by the extensive and prolonged use of sulphonamides in many different diseases, including the common cold), penicillin is proving a real boon to man and animal.

A NOTE ON THE EFFICACY OF COMMERCIAL ANTI-ANTHRAX BACTERINS.

MAX STERNE,
Onderstepoort.

At this laboratory we have been unable to elicit any substantial immunity against anthrax by using killed cultures. For interest's sake, four commercial bacterins, sold by reputable American firms, were tested against the Onderstepoort avirulent anthrax spore vaccine. [Sterne (1945)]. All the vaccines, including the Onderstepoort vaccine, were from bottles ready for sale. Each guinea-pig received the dose recommended for sheep. The guinea-pigs got two injections of the bacterins, at appropriately spaced intervals, but only one injection of the Onderstepoort vaccine was given.

The results of the subsequent immunity tests are shown in the table.

As the dose of Onderstepoort vaccine is that calculated to give a sound immunity in practice, it is obvious that even two doses of the bacterins fall far short of this standard. It has been shown previously that tests on guinea-pigs give an accurate reflection of the results to be expected in large animals.

Acknowledgment.

I wish to express my sincere appreciation of the assistance given me by Dr. H. W. Schoening and Dr. C. D. Stein, of the United States Bureau of Animal Industry.

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The immunizing power in guinea-pigs of four commercial anthrax bacterins and Onderstepoort avirulent spore vaccine.

Vaccine.	No. of guinea-pigs.	Immunizing procedure for each guinea-pig.		Immunity Test.	Results.						Lived.
		1st Injection.	2nd Injection two weeks later.	3 weeks after 2nd vaccine.	No. dead by — 2nd day	3rd day	4th day	5th day	6th day	7th day	
A. Bacterin	20	1 sheep dose	1 sheep dose	100 M.L.D. Pasteur II	7	8	3	—	—	—	2
B. Bacterin	20	1 sheep dose	1 sheep dose	100 M.L.D. Pasteur II	13	5	1	—	—	—	1
C. Bacterin	20	1 sheep dose	1 sheep dose	100 M.L.D. Pasteur II	10	8	—	—	1	—	1
D. Bacterin	20	1 sheep dose	1 sheep dose	100 M.L.D. Pasteur II	11	7	1	—	1	—	0
E. Onderste-poort	20	1 sheep dose	Nil	100 M.L.D. Pasteur II	—	—	—	—	—	—	20
F. Controls	20	Nil	Nil	100 M.L.D. Pasteur II	20	—	—	—	—	—	0

THE EXCRETION OF TORTOISE SHELLS BY CATTLE.

J. M. FOURIE,
Armoedsvlakte.

At post mortem in the field, tortoise shells are often found in the ruminal contents of cattle, which have died with symptoms of lamsiekte. To obtain further evidence of the significance of the presence of these shells as an indication that such cattle died of lamsiekte through the ingestion of carcase material of tortoises, the rate of passage through the gastro-intestinal tract of cattle was determined. For this purpose cattle were dosed *per os* with a known number of shells and excretion then determined through daily examination of the dung of stabled animals and examination of ruminal contents when some of these animals were slaughtered after certain periods. The observations are summarized in the following table:—

D.O.B. No.	*Date drenched*	*Material drenched with*	*Excretion of material*	*Date slaughtered and material recovered from fore-stomachs*
6862	9. 9.42	pieces of flat and round bones; tortoise shells	No observations	18.9.42; one piece of round bone was found in the rumen
8026	9. 9.42	do.	No observations	25.9.42; no material recovered
8780	23.11.42	30 shells	25.11.42: 1 shell 26.11.42: 3 shells 27.11.42: 3 shells 28.11.42: 0 shells	29.11.42; died of tympanitis. Only a few shells were found in the rumen
8733	8. 1.43	50 shells	11. 1.43: 1 shell 12. 1.43: 2 shells 13. 1.43: 5 shells 14. 1.43: 5 shells	15.1.43; 14 shells in rumen
5673	14.12.43	50 shells	No observations were made	4.1.43; no shells were recovered
8932	21.10.44	60 shells	26 complete shells and 7 pieces were excreted	28.10.44; 5 complete shells and 25 small pieces recovered
8942	21.11.44	60 shells	21.11.44 to 30.11.44 shells excreted daily in the following order:— 30, 16, 2, 5, 0, 0, 0, 1, 0, 1 (Total 55 shells)	1.12.44; only one piece of shell was found in the rumen

D.O.B. No.	Date drenched	Material drenched with	Excretion of material	Date slaughtered and material recovered from fore-stomachs
5929	11. 6.45	50 shells	12.6.45 to 21.6.45 shells excreted daily in the following order:— 25, 3, 1, 5, 0, 2, 2, 0, 2, 2 (Total 42)	22.6.45; 10 shells were recovered from the fore-stomachs
5805	11. 6.45	50 shells	12.6.45 to 1.7.45 shells excreted daily in the following order:— 15, 3, 1, 1, 2, 1, 5, 1, 2, 2, 2, 2, 2, 1, 2, 1, 0, 0, 0, 0 (Total 43)	Discharged on 2.7.45 after no shells had been excreted on four consecutive days

The above data reveal that nearly all the shells were excreted in about ten to fourteen days after drenching, and the belief amongst farmers that cattle will carry these horny shells in their stomachs for years could not be substantiated. Using rubber rings as indicators to determine the rate of passage of inert materials through the digestive tract of cattle, Moore and Winter found that, although excretion varied with different animals, the first rings may be passed in the faeces after 10 hours, the high point of excretion is between 23 and 60 hours and that all the rings are excreted within approximately 215 hours. According to authorities cited by Dukes the rate of passage of food residues through the alimentary tract of cattle is on the average 72 - 84 hours. It was rather unexpected to find, that in some cases, a large number of shells were excreted on the first day after drenching and on closer investigation it was found that even up to the third day many shells were excreted in cuds which were dropped. Moore and Winter do not record that rubber rings were excreted in cuds.

It is therefore evident that the presence of tortoise shells in the rumen of cattle at post mortem is good evidence in support of a diagnosis of lamsiekte and an indication that the animal may have been intoxicated by tortoise carcase material. Since the incubation period of lamsiekte may be as long as even seventeen days, it is possible that all similar carcase material may be excreted before death and it can, therefore, to a certain extent, be explained why in many cases of lamsiekte no carcase material is detectable in the fore-stomachs.

I wish to thank Mr. E. A. Deacon, Technical Assistant at Armoedsvlakte, who made most of the observations on the dosed cattle.

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THE LUNG WORM, *FILAROIDES OSLERI* (COBBOLD) IN SOUTH AFRICAN BRED DOGS.

(PRELIMINARY NOTE)

R. J. ORTLEPP,
Onderstepoort.

The subjects of this note are three* bull mastiffs bred in the same kennels from one sire and two dams; they were acquired during puppyhood by three different owners, two of whom live in Johannesburg and one in Pretoria. The first dog was received at Onderstepoort during May 1944, when it was about a year old; the other two dogs, brother and sister of the same litter, born 2.9.43, arrived at this institute in August and November, 1944, respectively. All three dogs showed the same symptoms as described by Steyn in the following article of this issue. The first determination of the infestation was made in the first subject on the embryonated eggs and this was later confirmed at post mortem; in the remaining two cases the determination was made on the eggs only, the subjects being kept at this institute for further observation and study. The eggs were obtained either by swabbing the back of the throat or else by examining the mucus vomited after a fit of coughing.

This parasite was discovered by Osler in 1877 in Canada in five young foxhounds; the worms produced a chronic tracheo-bronchitis. He named the parasite *Strongylus canis bronchialis.* These worms were examined a few years later in London by Cobbold who named them *Filaria osleri.* In 1921, Hall created a new genus *Oslerus* for the reception of this parasite. Until quite recently it was known as *Oslerus osleri,* but now it has been recognized that it belongs to the same genus as *Filaroides martis* (Werner, 1782) v. Beneden, 1858, from the Pine-marten - *Martes martes martes;* its correct name is thus *Filaroides osleri* (Cobbold).

Since the discovery of this parasite, nearly 70 years ago, about 20 cases of its occurrence in domestic dogs have been recorded in the literature. The subjects are from widely separated areas, e.g. from

* Since the above note was submitted for publication two additional cases of lungworm infection in dogs have been diagnosed by the writer; the owners of two other dogs have reported that their dogs are also infected, but this has not been confirmed at Onderstepoort. All these dogs are related bull mastiffs, bred in the same kennels as as those mentioned in the note above.

Canada, United States of America, Europe, Armenia, India, New Zealand and now South Africa, and in all cases only a few animals were involved. In addition to domestic dogs, a single case of its occurrence in a wild carnivore is recorded, namely by Price (1928), in a coyote.

The worms are found in soft nodules attached to the inner surface of the trachea generally at its bifurcation; (see fig. 1) the nodules may, however, follow the course of the large bronchi up to the apex of the lung; the nodules vary in size from that of a sorghum seed to that of a pea. In fresh material they have a reddish colour, are soft,

Fig. 1.
Filaroides Osleri. Trachea and bronchi showing nodules and extruding worms.

and the presence of the worms may be seen by transparency through the surface of the swelling. In a number of cases the posterior extremities of the females are extruded out of the nodule. In fresh material the worms, of which about a dozen or more may be present in each nodule, may be readily dissected out; they then have a creamy-white colour and are about 10 mm. long in mature females and about 6 mm. long in mature males. When killed in hot 70% alcohol the worms, especially the females, assume the shape of an open corkscrew.

The life-history of this parasite is unknown, but judging from analogy with nearly related worms e.g. *Mullerius* an intermediate host is probably necessary. The eggs are very characteristic. They are fully embryonated when laid and are provided with a very thin and pliable membrane instead of a shell; in consequence the shape of the eggs varies according to the movements of the contained embryo; typically shaped oval eggs are about 0·09 mm. long, 0·06 mm. broad and 0·01 mm. thick. The tail of the larva is characteristically kinked as in the larvae of other members of this group.

THE LUNG WORM, *FILAROIDES OSLERI* (COBBOLD) IN DOGS: A CLINICAL REPORT.

H. P. STEYN,
Johannesburg.

The object of this article is to place on record the discovery of the lung worm, *Filaroides osleri,* in dogs in South Africa, and to outline the symptoms observed in the two cases seen by the author. Since the discovery of the first two cases two more have been reported, one from Pretoria and another from Durban. The latter case has not been confirmed and no information is as yet available about it.

Case I. — A bull mastiff about one year old. The dog had been suffering from the disease for some time and was in poor condition, but was well grown and had not been stunted. It was shown to the author in consultation by a colleague. The most notable symptoms were: A fair degree of emaciation, marked dyspnoea with fits of coughing followed by vomiting efforts. If the dog had had a feed, the stomach contents would be emptied during subsequent vomiting and this appeared to be the main cause of the loss of condition and eventual emaciation.

The dyspnoea seemed to be caused by some form of laryngeal or high tracheal stenosis. This impression was so marked that, at first, the author and two colleagues all agreed that there must be a stenosis of this type. X-ray photographs of the tracheal and laryngeal regions were accordingly made and a laryngotomy performed, but with negative results. During the course of the laryngotomy a small quantity of mucus was coughed into the larynx and this was collected on a swab. Subsequent examination of the material revealed the presence of numerous worm eggs.

It should be noted that prior to the operation this case had not been noticed to vomit any mucus, but thereafter there was a copious muco-catarrhal discharge from the laryngotomy wound. Before the operation

the discharge had apparently been swallowed when it reached the pharynx.

The dog, which was kept at Onderstepoort, continued to lose condition and was eventually destroyed for post mortem examination.

Post Mortem Examination. — Numerous nodules causing an elevation of the mucosa, and thus partly obstructing the air passages, were found at the bifurcation of the trachea and in the bronchi. A fairly large quantity of muco-catarrhal discharge was present in the air passages (trachea, bronchi and bronchioli.)

The carcass was emaciated but all other organs appeared normal except that a fairly heavy infestation of tape worm, hook worm and ascarides was found in the alimentary tract, in spite of the animal having been treated for these parasites during the period of observation.

Case II. — A bull mastiff of about the same age as the first case. In this dog the symptoms had just recently commenced and were less pronounced than in Case I. There was no emaciation and practically no dyspnoea, but occasional fits of coughing followed by vomition or attempted vomition. The coughing fits could be brought on by slight exercise.

The diagnosis was confirmed by swabbing the larynx by means of a swab attached to a long-handled forceps, and by a microscopical examination of some of the mucus adhering to the swab.

This case was sent to Onderstepoort for further study, and the author having gone into private practice lost touch with it.

Remarks

The symptoms of the disease are very characteristic, the only difficulty which is likely to be experienced is the impression that they may be caused by some foreign body such as a needle in the pharyngeal or laryngeal region. The differentiation of the condition from an acute pharyngitis or laryngitis is easy because of its chronic course and the absence of any reddening of the throat.

Some difficulty may be experienced in getting a suitable throat swab, but it has been suggested by Dr. Ortlepp that faecal examination for the eggs may be undertaken by means of the flotation method or by using the centrifuge.

There is no known treatment. Phenothiazine, which has been reported to be of value for lung worm in sheep, was tried by the intratracheal route, but without success. This is undoubtedly because the worms are buried beneath the mucosa in the dog.

CASE REPORT.

MILK FEVER IN A EWE.

P. P. HUGO,
Government Veterinary Officer, Worcester.

I was telephoned on the 3rd of July, by Mr. D. V. du Toit, Overhex, to investigate a disease among his Dorset Horn Merino Cross ewes. He described the onset of the symptoms as being sudden, with paralysis in the hindquarters. He told me that one had already died, and that one of his best ewes with twin lambs was down with the disease. He said that the disease only occurred among his ewes with lambs, that they had all lambed in May, and were left to graze in the best paddocks.

On my arrival the owner said that he expected us to find the animal dead, as he had last seen her during the morning, when she seemed to be dying.

The animal, a six tooth ewe, was lying in a comatose state, front legs drawn in under the body, hind legs stretched out backwards, and the head and neck forward, resting on the lower jaw. She was badly bloated, pulse almost imperceptible, temperature subnormal, slow stertorous breathing, eyes wide open, dull and staring, and the mouth open.

A diagnosis of milk fever was made, and calcium administered intravenously from a stock solution containing calcium gluconate ξ 111, Acid boric ξ 111, and aqua ξ 12.

Having been given twenty cc., the ewe flickered her ears and belched and the eyes looked brighter. A further 40 c.c. was injected, the needle withdrawn, and the ewe put in a comfortable position to rest. After ten minutes a further 60 c.c. was given. When I withdrew the needle the ewe took interest in the surroundings and nibbled at the grass. I then lifted her to her feet, when she immediately urinated and defaecated, walked with a staggering gait for a few yards, urinated again, and then walked off to the rest of the flock with the gait markedly improved.

Since milk fever is very rarely met with among sheep, I thought it worth while recording this case.

CORRESPONDENCE.

The Editor, Jnl. S.A.V.M.A.

Sir, — Please allow me a little space to comment on the article by Mr. J. R. Frean published in your March 1945, issue regarding the use of morphine in the treatment of strychnine poisoning in a dog.

Any line of treatment should take into account that, as far as the clinician is concerned, the characteristic action of strychnine is to break down the normal synaptic resistance in the central nervous system thereby allowing radiation of stimuli. Any sensory stimulus will, therefore, not only cause the appropriate motor reflex, but violent spasms of nearly every muscle in the body.

Death is usually due to spasm of the diaphragm causing respiratory failure.

The emesis caused by morphine and its derivative, apomorphine, is accompanied by violent spasmodic contraction of the stomach and diaphragm. These drugs are therefore absolutely contra-indicated as they initiate spasms which, reinforced by the action of strychnine, nearly always cause the death of the animal. Most animals vomit after the ingestion of strychnine and emesis in a patient showing spasms, should be avoided at all costs. Only when the animal is seen picking up the poison is the immediate administration of a piece of washing soda to cause vomition justified.

Elimination of a toxic or fatal quantity of strychnine under an anæsthetic takes place usually within twelve hours so that the necessity for causing emesis does not exist.

Treatment of the spasms must be undertaken by means of an anæsthetic to suppress these uncontrolled impulses. Such anæsthetic must act promptly, cause narcosis without preliminary excitement and require minimum interference with the patient for its administration for fear of setting up fatal spasms.

All barbiturates are most effective in abolishing such impulses in such a manner, but pentobarbital sodium in 10 per cent. alcoholic solution, known as nembutal, is the anæsthetic of choice as it may be administered in one rapid dose intraperitoneally. Only a dose, sufficient to produce surgical anæsthesia in the same dog in health, is required.

Ten minutes after intraperitoneal administration, when anæsthesia sets in (or a few minutes longer in fat dogs in which absorption is slower), a favourable prognosis may be given, provided the patient is kept under observation in a quiet warm spot. It may be necessary to repeat the injection, giving the same or smaller doses depending on the severity of the returning spasms if any, when consciousness is recovered. In fifty-six consecutive cases of strychnine poisoning in dogs, successfully treated with nembutal in the past six years, I have twice found it necessary to give a third dose, prolonging anæsthesia beyond twelve hours, before recovery took place.

Yours faithfully,

W. J. RIJKSEN, B.V.Sc.

Windhoek, 18.6.45.

The Editor,

Journal S.A.V.M.A.

Sir, — In recent years there has been a greater tendency for the young graduate to enter private practice. Their enterprise and initiative has been discouraged by some of our senior State officials.

So great was the need in some districts that men have built up practices within a very short time. It is still amazing to me that good stock areas such as Bloemfontein, Kimberley, Ermelo and Potchefstroom and numerous others are still without practitioners. The men in the service naturally have not the time to attend to all the sporadic cases with the result that those in practice have found a good living with very hard work and certainly no fortune as imagined by some of our critics.

It is to be hoped that those in the forces and those about to graduate in the future will carefully consider all three of the main channels of service, municipal, state, and service through private enterprise.

In conclusion, through the initiative of the younger practitioners, alternatives to the State service have been created and these have paved the way for better conditions which we hope will come about through the recently appointed commission.

Yours faithfully,

J. G. Boswell.

Johannesburg, 9.7.45.

SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION.

Council Meeting held at Velra House, Pretoria, on 23rd August, 1945.

Present : C. J. van Heerden (Chairman), P. S. Snyman, J. H. Mason, R. Alexander, J. G. Boswell, A. D. Thomas, A. C. Kirkpatrick, E. M. Robinson, A. M. Diesel, D. G. Steyn and S. W. J. van Rensburg (Hon. Sec.-Treas.)

Apologies for Absence : Mr. S. T. Amos (President) and Dr. P. J. du Toit.

(1) *Minutes* of meetings held on 9th October, 1944, and on 20th March, 1945, were read and confirmed.

(2) *Arising from these minutes :*

(a) *Hormone Treatment :* The Secretary reported that after investigation the Veterinary Board had found that the Veterinarian concerned had acted in an unprofessional manner and that he had been cautioned.

(b) *Finance :* Council was informed that the necessary legal formalities connected with financial aid to the widow of a colleague had been completed and that the necessary assistance was now being rendered.

(c) *Post War Reconstruction :* The responsible Committee reported that the relative memoranda had been presented to the Veterinary Services Inquiry Committee and to the Public Service Inquiry Commission and that the members of the Committee had also given verbal evidence before these two bodies. The opinion of Council was sought on a suggestion from the Public Service Inquiry Commission that professional officers in the State Service should be permitted to retire at 65 years of age instead of at 60 in order to obtain a higher pension on retirement. After discussion it was decided that this be placed on the agenda for the General Meeting and that the Committee investigate the matter fully in the meantime.

(d) *Veterinary Services, Durban :* The correspondence that passed between the Association and the different bodies concerned was submitted, and after discussion it was resolved that no further action be taken.

(3) *Hormone Treatment of Racehorses :* Letters from the Secretary of the Jockey Club of South Africa and the Secretary of the Witwatersrand branch of the Association were considered. A committee consisting of Drs. R. Alexander (convener), J. Quinlan, D. G. Steyn, J. G. Boswell and J. Quin was appointed to investigate and report on recent developments.

(4) *Livestock and Meat Industries Control Board :* A letter dated 27th June, 1945, from the Municipal Veterinary Surgeons Committee suggesting that steps be taken to obtain veterinary representation on the Control Board was considered. Since representations were made to the Department, but without success, in 1941, it was decided that no further action be taken.

(5) *Sale of Drugs :* Minute 10/27 of 17th May, 1945, from the Director of Veterinary Services was read, and in view of subsequent developments it was decided that this be recorded.

A letter dated 13th August, 1945, from a member was also submitted. This drew attention to the great danger of penicillin fast bacteria being

developed in consequence of the indiscriminate sale of this drug to the public. During discussion it was stated that this matter was also causing great concern to members of the medical profession and it was decided to ascertain from the S.A. Medical Association what their attitude was.

(6) *Telephone Directories :* In view of the ruling given by the Veterinary Board that the names of veterinarians must not be published in the classified section of directories it was decided that steps be taken to have them inserted under "Veterinary Surgeons" in the body of the directory. It was decided to await the outcome of representations which had already been made by the Witwatersrand branch in this connection.

(7) *General Meeting :* This was provisionally arranged for October 16th and 17th and the following two committees were elected to make the necessary arrangements, namely: *Programme :* R. Clark (Convenor), P. J. du Toit and E. M. Robinson; *Entertainment :* M. de Lange (Convenor), W. D. Malherbe and J. Zwarenstein.

(8) *New Members :* Acceptance of the following to be recommended to the General Meeting : Campbell Dickson, B. C. Jansen, P. G. Joubert, F. W. Langbridge, W. M. McHardy, L. W. v. d. Heever and T. C. Wessels.

(9) *Honorary Life Vive-President :* It was unanimously resolved to recommend to the General Meeting the election of Mr. S. T. Amos as an Honorary Life Vice-President of the Association.

(10) *National Veterinary Medical Association :* Dr. J. H. Mason was appointed as Corresponding Member to the "Veterinary Record" for the area covered by the S.A.V.M.A.

It was decided that a complaint by a member in one of the Protectorates be referred to the Overseas Committee of the N.V.M.A.

(11) *General :*

(a) *Veterinary Education :* A suggestion by Dr. Thomas that the Association should consider the extended veterinary educational facilities now being offered to different classes of laymen was referred to the next Meeting of Council.

(b) *Sale of Vaccines :* Minute 27/1 dated 20th August, 1945, from the Director of Veterinary Services prescribing the conditions under which a rebate of 25% on certain vaccines is allowed to private practitioners was read and unanimously approved of.

(c) *Titles :* It was decided that members be circularized and asked to state whether they wish to be addressed by a military or by the courtesy title, and that the list be then submitted o he Deparment of Agricuture.

(d) *Journal :* A letter from a member making certain suggestions was read, and after discussions it was decided to refer this to the General Meeting.

The meeting adjourned at 11.20 p.m.

S. W. J. van Rensburg,
HON. SEC.-TREAS. S.A.V.M.A.

SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION

BALANCE SHEET at at 31st MARCH, 1945.

LIABILITIES.

Benevolent Fund as at 31st March, 1944		£768	5	0		
Add: Subscriptions collected		116	10	0		
Commission on Insurance Premiums		35	8	10		
Donations, etc.		6	1	0		
Interests Accrued		33	4	2		
		959	9	0		
Less: Assistance Payments		96	0	0		
					£863	9 0
Prize Fund as at 31st March, 1944		200	0	11		
Add: Adjustment		2	6	8		
Interest Accrued		7	13	4		
		210	0	11		
Less: Awards		10	0	0		
					200	0 11
Natal Branch as at 31st March, 1944		12	12	0		
Add: Subscriptions collected £ for £ contribution		0	5	0		
					13	2 0
Miscellaneous Creditors					1	8 4
Book Fund Suspense Account					88	9 1
Subscriptions Reserve Account					14	14 0
General Fund as at 31st March, 1944		2,163	19	6		
Less: Excess of Expnediture over Income 1944 - 45		57	6	10		
					2,106	12 8
					£3,287	16 0

ASSETS.

Investments at purchase price plus interest:						
Union Govt. 3½% Stock, 1952–57	£405	0	0			
Union Govt. 3½% Stock, 1954	202	14	2			
Union Loan Certificates	1,788	13	4			
United Building Soc. Preferent Share	101	6	8			
				£2,497	14	2
Interest (U.L.C.) Suspense A/c.				90	1	8
Loans to Mrs. Footner plus accrued interest				97	10	10
Student Advances (Three)				317	14	0
Miscellaneous Debtors				24	7	8
Subscriptions due	212	12	....			
Less: Amounts paid in advance	106	2	6			
				106	10	0
Cash in hand	21	2	10			
at bank	109	5	10			
Standard Building Society	23	9	0			
				153	17	8
				£3,287	16	0

SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION

INCOME and EXPENDITURE ACCOUNT, 1944–45.

EXPENDITURE.

1943–44						1944–45		
£2	4	3	To	Wreaths, etc		£4	6	7
3	17	6	,,	Branch Subsidies		2	10	0
				Witwatersrand Branch	2 5 0			
				Natal Branch	0 5 0			
					£2 10 0			
5	13	1	To	Bank Charges		4	14	10
6	14	3	,,	Cost of Meetings		26	0	3
16	14	0	,,	Adjustments		10	14	8
				Prize Fund	2 6 8			
				Subscriptions written off	8 8 0			
					£10 14 8			
28	12	0	To	Stationery		19	6	6
34	9	5	,,	Miscellaneous Expenses (Including honoraria £65.2.0.)		81	7	4
48	0	0	,,	Clerical Assistance and typing		56	12	0
173	17	10	,,	Net cost of Printing and Distributing Journal		216	12	7
				Gross Costs	296 16 9			
				Less Advertisements Subscriptions etc.	80 4 2			
					£216 12 7			
82	14	1	,,	Excess of Income over Expenditure		0	0	0
£402	16	5				£422	4	9

INCOME.

1943–44					1944–45		
£340	18	6	By	subscriptions accrued	£293	11	0
61	7	5	,,	Interest accrued	71	6	11
0	10	6	,,	Miscellaneous Receipts	0	0	0
0	0	0	,,	Excess of Expenditure over income	57	6	10
£402	16	5			£422	4	9

THE LOCATION OF SPERMATOZOA IN THE HEN BY MEANS OF CAPILLARY ATTRACTION.

G. C. VAN DRIMMELEN,
Bloemfontein.

Walton & Wetham (1933), in a review of the data on the life duration of spermatozoa *in vivo*, were particularly interested in the apparent anomaly of survival without evident concentration of the sperm cells in female birds. Concentration of the sperm suspension is universally characteristic of known instances of long survival in male as well as female organs. Ivanoff (1924) postulated that the sperm of the fowl entered ripe and unripe follicles in the ovary, because he found that irrigation of the oviduct and peritoneal cavity with spermatolytic fluids did not prevent the subsequent production of fertile eggs. Payne (1914) and Warren & Kilpatrick (1929) found spermatozoa in the oviduct, but all specimens seen between the 2nd and 56th day after the last mating were morphologically abnormal and tailless. These authors considered such cells capable of fertilizing ova, and doubt was cast on Ivanoff's hypothesis by the fact that the spermatozoa of a new mating replaced those from previous copulations within about 48 hours [Crew (1926), Warren & Kilpatrick (1929)]. The results of Ivanoff (1924) were confirmed by Walton & Wetham (1933), who could not demonstrate the spermatozoa in the oviduct of fertile hens after the most intensive search. Nevertheless they clearly favoured the view that fowl sperm remain in the oviduct during the period of fertility (two to three weeks), being protected in the folds of the mucous membrane, and neither the penetration of unripe follicles nor the fertilization by tailless sperm was accepted as proven.

Intraperitoneal insemination of fowls [Van Drimmelen (1945)] provided a new approach to the question, and the object of the present communication is to describe the demonstration of normal active long-tailed spermatozoa in the oviduct of fertile fowl hens up to the 14th day after insemination. Details of a new technique evolved for the purpose are given. Further studies along these lines are in progress.

Sufficient data are already available to show that under optimum conditions live, active spermatozoa can be found in the ostium abdominale of the oviduct of fertile hens.

Technique.

(a) *Collection of Spermatozoa.*

Many investigators have employed microscopical methods to determine the presence of male cells in the genital organs of fertile hens.

Barfurth (1896) used hanging drop preparations from scrapings of the oviduct mucosa and failed to see sperm on the 20th to the 24th days after separation from the male. Payne (1914) was best able to pick up the cells by means of a platinum loop drawn over the folds and crevices of the lining. Ivanoff (1924) could not find them using this technique. Walton & Wetham (1933) examined smears from the mucous membrane without success. Warren & Kilpatrick (1929) saw them in wet preparation up to 18 days after separation. Nimura (1939) tried methods employed for the mammalian oviduct, i.e. (i) washing with Ringer's solution by means of a pipette, or (ii) scrapings of the mucosa, but concluded that the best method in his hands was the following:— A small area of the inner wall of the duct (slit open longitudinally) was moistened with Ringer's solution, stirring the fluid with a platinum loop to create a thorough mixture with the mucus and albumen present. This mixture was examined under the microscope through a thin glass coverslip. Starke (1945, personal communication) stated that in the sheep's oviduct, spermatozoa could best be demonstrated by injecting distilled water into the upper end of an isolated portion of the tube suspended above a glass slide and open at the lower end. The drops of water falling on the slide held the cells in suspension.

In the present investigation scrapings of the mucus from the inner surface of the fowl's oviduct, were made at first with the edge of a glass slide or with a platinum loop. These scrapings — either pure or moistened with Ringer's, physiological saline, or thin egg albumen — were examined under a coverslip, and as thin, dried and stained films. The organs of only about three dozen hens have been searched over a period of several years. Recently, the diluents have been applied to the mucous surface with a glass bacterial (Pasteur) pipette, before collecting the material, the same pipette being immediately used in the place of the platinum loop, to collect a drop of suspension. The suction of a teat was found to be too unsteady and unsuitable for the collection of very small quantities. For this reason the pipettes were drawn thinner and thinner until it was possible to dispense with the teat altogether, making use of the capillary action of the tip to collect the minute quantities of fluid for microscopical examination. Discharge of the fluid from the pipette was done by blowing with the mouth. The new technique led to decreasing quantities of diluent being necessary, as it was found possible to obtain sufficient natural fluid around the ripening follicles in all parts of the oviduct except the vagina.

(b) *Dissection.*

A thorough inspection of the wet preparations takes considerable time and involves drying and chilling of the tissues, which considerably reduces the chances of finding the sperm still motile. Consequently a new procedure was adopted which involved the opening of the carcass

of a freshly killed hen, by means of a small slit in the body wall, under the left thigh near the acetabulum. Through this opening all the parts of the oviduct could easily be reached, a specimen of mucus could be taken from any portion that was desired, and the organs could then be replaced in the abdominal cavity. The carcass was then covered with a cloth containing a pad of cotton wool in order to preserve the body heat longer. Latterly instead of killing fowls they were opened up under anæsthesia using 0·7 – 0·8 cc. Nembutal (6·6 per cent. solution of Pentobarbital sodium), in order to maintain the circulation as well as the body heat throughout the period of examination. By administering repeated small doses of the drug (i.e. 0·3 cc. intravenously) the examination could be extended over a whole day.

The hens to be examined were either naturally mated and separated from the cock for various periods, or were artificially inseminated with large doses of semen per vaginam or by means of intraperitoneal injection.

Experimental Findings.

Two series of examinations were completed on the lines described, and the results will be presented in detail in a communication that is in the course of preparation. Some facts are, however, already available:—

(1) After natural copulation, the oviduct of hens in production were found to contain active spermatozoa in all its parts for 24 hours after separation. From 24 to 48 hours it became increasingly difficult to find the motile cells in the parts with thick secretory mucous membrane; but they were often still to be found in the vagina and infundibulum. All later examinations were unsuccessful.

(2) After artificial insemination per vaginam with large doses of semen (0·25 to 1·0 cc.) the spermatozoa were equally difficult to find in the centre portions of the oviduct when examined more than 24 hours after insemination. However, in one case, large numbers still remained active and were easily found in the uterus, albumen region and infundibulum on the third day (± 72 hours), whilst in another a vigorously active spermatozoon was encountered on the 14th day in the infundibulum.

(3) Immediately following intraperitoneal injection of large amounts of semen (0·25 to 1·0 cc.), spermatozoa were found in the serous fluid of the upper abdominal cavity and in the fluid round the ovary, as well as in the upper regions of the oviduct (depending on the locus of discharge of the semen). After a period of 24 hours, no sperm were found in the peritoneal fluid, not even round the ovary, but all parts of the genital tract contained them, and this was definitely not dependent on the penetration of the oviducal wall by the instruments of insemination. On the 11th day after the injection active sperm cells were found in the infundibulum of one hen which had received a dose of 1·0 cc. of mixed semen, whilst on the 8th day and the

12th day some active and morphologically normal spermatozoa were found in two hens which had been dosed with 0·3 cc. of pure semen from a single ejaculate.

(4) The following difficulties were met with during the examination of wet preparations:—

(a) Cilia: The motility of the very numerous cilia, which occur in the duct, prevented identification of sperm cells in the pieces of mucosa examined in scrapings. On numerous occasions detached ciliated cells or portions of cells or free cilia resembled abnormal spermatozoa. Some bundles of closely interwoven cilia could only be distinguished from spermatozoan heads by staining the dried film with different dyes, to show that neither the acrosome nor the centrosome at the point of attachment of the middlepiece could be defined. These structures are retained in sperm heads when the middlepiece and tail detach in vitro.

(b) Brownian movement: In the examination of small quantities of fluid containing cilia, cells and particles of mucus in suspension, there is so much movement in every field that no thin, long body like the avian spermatozoon can remain stationary in a wet preparation. This has also often been observed in semen samples stored for ageing in vitro.

(c) Motility of the tail and middlepiece without head was often encountered in the examination of semen, but at no time was a head definitely seen to progress by its own momentum. This is in agreement with the experience of Phillips (1935), who stated that the motility of spermatozoa was apparently a function of the middlepiece. Whilst many workers have referred to spermatozoa as being "viable" or "alive" when they merely observed the cells to move, it is now generally accepted [Milovanov (1940)] that vigorous progressive movement (when examined at body temperature) of a large percentage of cells is essential for fertilization.

Discussion.

From the evidence presented it would appear that the spermatozoa evidently awaiting ova for fertilization are only to be found in the infundibulum and not in any other locality after periods of more than 72 hours following insemination. The mucous membrane of the infundibulum is, however, very shallow compared with that of other parts of the oviduct, and moreover this mucosa assists in secretion. McNally (1942) found the layer of mucin which strengthens the collagenous vitelline membrane of the ova to be deposited in this region. Consequently the view that it is the only structure wherein viable sperm are retained in the hen requires the support of further evidence.

Although many of the spermatozoa seen in the 11-day case appeared to be in close contact with the mucosa, it must be admitted that these cells could have adopted this position after death. The observation of Walton (1926), cited and confirmed by Quinlan *e.a.* (1932), that mammalian sperm appear to attempt entry of cells present in their surroundings, may explain this finding.

In any case, the fact that spermatozoa were demonstrated in an active and morphologically normal state at the upper end of the oviduct on the 8th, 11th, 12th and 14th day after insemination of virgin hens, suggests that ovulation in the fowl can be followed by successful impregnation as long as 14 days after separation from the cock.

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GLOBIDIOSIS IN CATTLE.

C. F. B. HOFMEYR,
Pretoria.

The causal organism of the disease about to be described has been identified tentatively as *Globidium besnoiti* by research workers at Onderstepoort.

Globidiosis of cattle is a chronic protozoal disease manifesting itself mainly by a pronounced sclerosis of the skin associated with *seborrhoea sicca.*

Synonyms: The author has been using the term "thick-skin disease" (Afrikaans — "dikvelsiekte") in popular reference to globidiosis. In view of the skin thickening some describe it as "elephant-skin disease" ("olifantvelsiekte").

Historical: The opinion has been voiced by many farmers that this disease came down from the North and that cases occurred in the Rustenburg district four to five years prior to the author's investigation. Such testimony can not be accepted without reservation, because there is a universal tendency to confuse globidiosis with sarcoptic mange. However, it does not appear unlikely that there may be some truth in these statements.

The first authentic case was seen by the author on a farm about 25 miles north of Rustenburg during March, 1941. As it had been rather casually pointed out to him a few moments before his departure, a thorough general examination was not made. As a routine measure skin scrapings were made and later examined with negative results. A short time afterwards, thorough clinical and post-mortem investigations were carried out on two farms to the west and northwest of the first farm. From pathological examinations made by the Onderstepoort Veterinary Research Institute on specimens sent in from these farms *Globidium* infection was demonstrated.

Distribution: The disease is definitely known to occur throughout the whole of the Bushveld area from the Western Transvaal to Potgietersrust district and probably further north. The cases seen by the author elsewhere all originated from these parts.

Epizootology: Globidiosis is enzootic in the areas mentioned above and has not been observed to assume epizootic proportions. As has been stated, it is at present known to occur only in the Bushveld, i.e. a summer rainfall area, where summer shade temperatures not infrequently exceed 100°F., downpours tend to be torrential, interspersed

with periods of fair weather, often of drought, and where the total annual precipitation is up to 25 inches, the altitude being less than 4,000 feet.

There is a marked seasonal variation in the occurrence and intensity of the disease. In spring the cases tend to be mild and comparatively few in number. With the onset of summer, cases occur more commonly and individuals are more severely affected. A climax is reached during the hottest months from November to February, after which there is a decline in the numbers afflicted and in the severity of the symptoms. The position in the autumn resembles that in spring, and during winter fresh cases of globidiosis are not frequently encountered.

It is felt that the cause of this marked variation in seasonal incidence must be sought in factors with a direct influence on the organism while it is not in association with the bovine host, rather than in those with a primary effect on the animal.

The reason is this. The breeds represented on the ranches in the Rustenburg district, where the disease has been most closely investigated, include imported breeds, Afrikanders and native cattle. The response of imported breeds to climatic conditions differs markedly from that of the indigenous cattle. To quote one instance: With the terrific solar irradiation during summer it is the rule for imported breeds to show a pronounced hyperthermia as well as other signs of maladaptation to environment; the Afrikander breed and native cattle, however, show only a slight relative increase in temperature and are much less distressed by severe conditions. If, then, the seasonal cycle of globidiosis is to be explained on the basis of varying resistance of the bovine host at different times of the year, it would be logical to assume that the disease would take a severer toll of those breeds that are mostly affected by seasonal climatic fluctuations. Such is not the case, as Globidium infection occurs indiscriminately in indigenous and imported breeds, and colour plays no part.

Dipping and handdressing, whether regularly or irregularly done, or not at all, do not appear to have a deterrent or stimulating effect on globidiosis, as it assumes the usual characteristics irrespective of the deticking practices indulged in. All the dips used contained arsenic as the main ingredient. Occasionally paraffin emulsion was included in the dip, while some farmers added aloes to the dip, presumably to make the cattle less attractive to ticks. The handdressing materials included a great number of different substances, some being weird concoctions of uncertain origin.

Under transmission mention is made of the influence on the disease of certain methods of ranching.

Pathogenicity: Globidiosis has been diagnosed by the author in cattle from the age of six months and onwards and even in aged

animals. It cannot be stated yet whether young calves show a special resistance to the disease or whether they are less exposed to infection. It has been observed in all breeds in the Bushveld, and there does not appear to be any one, whatever the colour, with special resistance. No affected dairy cattle have been encountered, but it is likely that their management would operate against introduction of infection. There does not appear to be any other reason why they should be immune from the disease.

The author has seen a relatively large number of bulls suffering from globidiosis. It is claimed by some farmers that bulls are particularly susceptible to the disease. As the bulls are invariably the most valuable animals in these herds any illness afflicting them is almost certain to attract the farmers' attention as well as to be mentioned to the veterinarian. It is, therefore, necessary to have much more information concerning the number of affected and healthy bulls and other animals in these herds before it can be stated that bulls are specially susceptible.

A globidium has also been demonstrated in skin sections of horses by workers at Onderstepoort. It remains to be proved whether the organism found in horses is identical with the globidium of cattle. Skin lesions were observed by the writer in a horse on a farm where globidiosis of cattle existed. They resembled in a general way the lesions in cattle, but the owner having applied a number of different oily and tarry preparations, the determination of the exact state of the skin or the taking of biopsy specimens was rendered impossible.

Symptomatology.

The symptoms can be divided into three more or less well-defined stages, viz.:—

(1) The febrile stage.
(2) The depilatory stage.
(3) The seborrhœa sicca stage.

(1) *The Febrile Stage.*

The first signs of the onset of globidiosis is fever, up to 107°F, but usually lower, depending on the intensity of the clinical reaction and the environmental temperature. The animal tends to miss its daily visits to the drinking troughs, penetrates into dense bush, or keeps to the deepest shade as photophobia soon becomes intense. The hairy coat, especially along the buttocks, limbs, flanks, lower abdomen and lower neck loses its lustre and stares. In severe cases the whole body is thus affected. Anasarca develops markedly, especially along the lower line, but may be generalized and is usually symmetrical, though occasionally more pronounced on one particular limb. Closer examination discloses tenderness and heat in the swellings. The gait is stiff and the animal is reluctant to move as if attempting to avoid

skin tension. Further, there is a typical febrile pulse, tachycardia, hyperpnœa and decreased if not entirely suppressed ruminal movements. The motions are usually normal or slightly loose. Diarrhœa sometimes occurs and abortions are not infrequent. The lymph glands, especially the prescapular and precrural, are enlarged.

Particular attention should be paid to the eyes and nostrils. Lachrymation occurs, as well as hyperæmia of the sclera. Within a few days of the onset of the fever, pinpoint specks become apparent on close inspection of the sclera. They start as minute areas which gradually enlarge until towards the end of this stage they are white elevations, smaller than a pin's head. Commonly these specks can be observed in the cornea, more often close to the periphery and surrounded by a narrow zone of corneal opacity. This, incidentally, illustrates very well the function of the lymphatic system in the dissemination of sporozoites throughout the body. There is a clear mucoid discharge from the nostrils, often with white floccules.

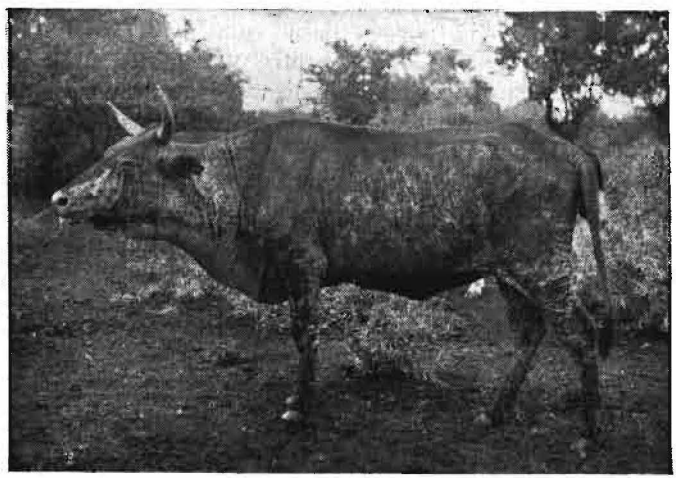

FIG 1. — *Globidiosis. Advanced case showing thickened, wrinkled, hairless skin. Difficult respiration. Dribbling from mouth.*

Examination of the Schneiderian membrane reveals a bright red colour, later it becomes cyanotic, with pinpoint specks similar in appearance and development to those in the sclera. The white elevations, as seen after some days, may be so densely crowded together in the visible part of the mucous membrane that they appear confluent. The site occupied by these globidium cysts, for such they are, must be stressed as it is felt that it has an important bearing on the spread of infection. Epistaxis sometimes occurs. The severest cases show a rapidly progressive rhinitis with a thick hæmorrhagic, mucopurulent discharge,

great swelling of the nasal mucosa and a collection of brownish crusts inside the nasal passages and around the nostrils. These cause a severe nasal stridor, and, together with the products of tissue trauma as well as possibly from toxins liberated by the globidium, may lead to a rapidly fatal termination in a few cases. A short cough can sometimes be heard, due to pharyngo-larangeal irritation and auscultation of the lungs usually reveals coarse rales which are the result of the collection of clear mucus and are not due to bronchitis.

The febrile stage lasts about five to ten days. The immediate effects of the globidial invasion then terminate and the swellings have developed to their maximum.

As the acute symptoms subside the second stage commences.

(2) *The Depilatory Stage.*

From this stage on the pathological changes and the clinical picture are dominated by the lesions of the skin. These present a pronounced sclerodermia, the skin thickness being greatly increased and the elasticity lost. This feature must be emphasized. As a sequel to the anasarca, the developing fibrous tissue and the close crowding of globidial cysts in the skin and subcutis, the epidermal nutrition is interfered with. The hair falls out over the swollen parts, the skin on the flexor surfaces cracks and a sero-sanguinous fluid oozes out. Necrosis of the skin occurs on those parts coming in contact with the ground when the animal is recumbent. Towards the end of this stage, hard, lifeless sitfasts are apparent on the sides of the stifles, the brisket and elbows. Photophobia is less marked, grazing is gradually resumed in many cases and the general examination reveals most of the symptoms as mentioned under the febrile stage, but in a less acute form. The anasarca subsides, leaving a skin with broad wrinkles along the lower line. This is typical and must be noted. With the disappearance of œdema it can readily be ascertained that the increased thickness of the skin is due to fibrous tissue. The loss of the hair continues. When death occurs at this stage it is due to exhaustion and debility produced by damage during the febrile stage. The depilatory stage lasts for from two weeks to about a month and gradually goes over into the last stage.

(3) *The Seborrhoea Sicca Stage.*

Here, most of the hair on the formerly anasarcous skin has been lost. The size and distribution of the areas of depilation vary according to the dimensions and sites of the previous swelling. A thick scurfy layer coming off in fine flakes covers the denuded parts, the sitfasts separate from the underlying tissues and together with the fissures on the flexor surfaces, strongly attract the attention of the blowfly *Chrysomyia bezziana.* With the contraction of the fibrous tissue which has formed, the skin hardens and becomes more closely

adherent to the deeper tissues. Deep cicatrices show more plainly, the whole being reminiscent of the hides of pachyderms. The globidium cysts remain in evidence at the sites described and the superficial lymph glands remain permanently enlarged. The severe cases may show crusts round the nasal orifices for months, but the dyspnœa decreases. From a distance the animal appears to be infected with mange. It goes about its way appearing listless and debilitated and it easily succumbs to such vicissitudes as bad weather and insufficient food. Those slightly affected and showing loss of comparatively little hair recover to such an extent that to the uninitiated nothing abnormal would be noticed. Other cases take months or even years to put on any appreciable condition and few, if ever, again become prime. The

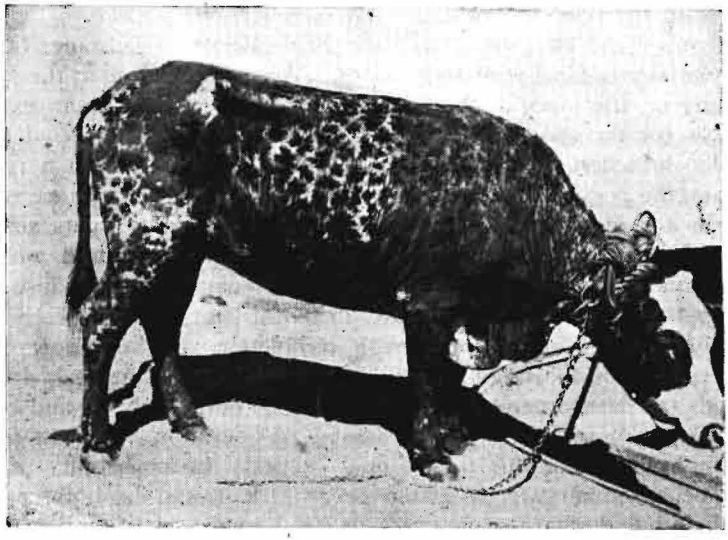

FIG. 2. — *Globidiosis. Wrinkling and thickening of skin. Peculiar pattern of hairlessness like markings on a giraffe.*

destruction of most of the hairy coat is permanent, as are the changes in the cutis and subcutis.

In convalescent animals a peculiar feature is sometimes observed. The surviving hair forms patterns on the body resembling the markings of a giraffe. This may have something to do with the distribution of the larger blood vessels.

TRANSMISSION.

The method by which globidiosis is transmitted from one animal to another is unknown, but from observations in the field, a theory is put forward. It is significant that the disease shows a higher incidence on developed ranches than on those where older farming

methods or lack of methods are the rule. To be more explicit, by developed ranches is meant farms where provision for water has been made in the form of dams, i.e. stagnant pools with usually a small body of water, or more especially drinking troughs served by pipes from boreholes.

Very suggestive observations were made on a ranch with a modern lay-out. A few animals were affected with globidiosis. Of these, two bulls were watered separately and the other animals had a trough to themselves. Subsequently, young cattle were allowed access to this trough. The first one of these to show symptoms commenced to do so a week after having drunk from this trough for the first time, and within a month eight of them became infected.

Now, if we consider ways by which the globidium might find its way into the outside world in large numbers, it is clear that there is only one route of escape, viz., the Schneiderian membrane, lined as it is with cysts filled with sporozoites. When those close to the surface rupture on the mucosa, the nasal secretions would act as an excellent vehicle for transportation to the exterior. When an infected animal drinks, infection of the water is bound to take place. In a running stream, the possibilities of enough sporozoites finding a host are remote, and in a dam the chances are inversely proportionate to its size. In a drinking trough the likelihood of infection is favoured, not only on account of the small capacity of the troughs, but because when an appreciable number of cattle drink at the same time, as they usually do, they drain the trough completely, as the inflow cannot compensate for the large amount of water taken out at peak drinking periods. The sporozoites are therefore not only likely to find a host, but what is more, may do so on the day of liberation. It must further be emphasized that this theory only suggests the probability of what may be the main way infection occurs. It would be quite possible for infected discharges on grass or feed to act in a similar way.

As a prophylactic measure it is advised that infected animals be isolated and care be taken to ensure that they will not be watered with healthy cattle.

The morbidity is very variable. It may be from 1 per cent. on certain farms up to 20 per cent. on others. The direct mortality is low, being less than 10 per cent. in the cases observed. The indirect mortality is influenced to some extent by the care taken of the animals. No specific treatment is known. At best it can only be symptomatic. Adequate nutritious and easily digested food is essential, as well as protection from the sun. On no account should animals have to walk long distances to water or food. As the disease is not enzootic in Pretoria district, the author has had limited opportunities of carrying out therapeutic treatment and wishes to suggest to those who may encounter the disease in the future, the use of arsenical and antimony compounds, as these drugs have an affinity for the skin, which is the habitat of the parasite.

As far as immunity is concerned, it can only be stated that no case has been encountered which had previously been infected.

Differential Diagnosis.

Except possibly during the early part of the febrile stage, confusion with other febrile diseases is unlikely. Examination of blood smears should be done in any case. *Three-days' stiffsickness* may cause confusion, but it need only be remembered that here the stiffness is due to myositis and in globidiosis to skin tenderness.

Lumpy-skin disease in certain cases shows the following symptoms seen in globidiosis: pyrexia, discharge from the nostrils, big localized swellings or puffy swelling of the skin along the lower line, with staring coat and stiff gait. Buccal hyperæmia or papillitis, erosions between the dental pad and upper lip, "lumps" in the skin on any part especially the scrotum, and pox-like elevations on the teats will immediately indicate "lumpy-skin disease". In globidiosis after some days, the development of cysts can be demonstrated and will allow of differentiation.

Specific or non-specific skin disease should never be confused with globidiosis, because at the stage when the latter may simulate the former, the cysts are easily seen.

Comments.

The author has witnessed the spread of globidiosis over a period of more than four years in the Rustenburg and Brits districts and feels alarmed at the extent to which it is occurring. There is no doubt that it constitutes a serious economic threat to the farming community in the bushveld areas. Although the direct mortality is low, a large percentage of infected cattle represent an almost total economic loss. Especially during the past six years or so the bushveld has been experiencing a transition from a, generally speaking, backward farming area to a progressive ranching country with the introduction of numerous pedigree animals. This part of the Transvaal is destined to play a leading role in South Africa as far as ranching is concerned, provided the veterinary profession does its part to minimize losses. Furthermore, it is suggested that it should be proclaimed a scheduled disease, so that the machinery to stamp it out could be brought into existence. Control becomes more difficult with the passage of time.

Summary.

Globidium infection of cattle is recorded in South Africa for the first time.

The pathogenesis and epizootology are discussed in the light of observations over a period of more than four years.

The symptoms of the disease are described in detail. A method of transmission is suggested and a plea is made for co-ordinated investigation and for State control.

A METHOD OF GRADING RAW MILK, WITH SPECIAL REFERENCE TO THE GRADING OF MILK FOR SOUTH AFRICA.

MAJ. E. J. PULLINGER,
S.A. Veterinary Corps.

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CHAPTER 1:

INTRODUCTION.

In a recent report (Pullinger, 1944), attention was drawn to the unsatisfactory state of the South African milk industry. All phases of the industry were subjected to criticism in this report, but particular stress was laid upon the fact that the industry is fundamentally unsound because of the unsatisfactory state of the actual production of milk. In a subsequent report, Nelson (1944) presented figures which served once again to stress the unsatisfactory quality of raw milk introduced into certain South African towns. These two reports represent the only concrete data on the subject that are available, but throughout the country the army supply organization, the military veterinary milk inspectorate and army medical officers have been impressed with the immense difficulty of obtaining good quality, safe milk in large quantities for camps and military hospitals. The question of safe milk has already been discussed by Pullinger (1945); as regards quality, the term is used to include chemical composition, bacterial content, "keeping quality," pus content, and palatability.

Considerable concern is being felt by responsible authorities with regard to the milk supply as is evidenced by the frequent references made of recent years to the question of compulsory pasteurisation. Whilst the need for compulsory and controlled pasteurisation is too obvious to warrant discussion (*vide* Wilson, 1942, and Pullinger,

1945), it is not universally realized that compulsory pasteurisation will be a disastrous failure unless very definite steps are taken to improve the average quality of incoming raw milk supplies. Whatever steps are taken to improve the quality of raw milk supplies, the question of the grading of milk becomes of paramount importance, and standard tests will have to be adopted and grades of milk will have to be determined upon the basis of these tests. Such attempts as have hitherto been made to develop standards in South Africa have been based entirely upon out-of-date experience, and apparently little or no attention has been paid to the modern trend of development overseas. The two exceptions to this generalization are the efforts made (a) by the Port Elizabeth Health Authorities to introduce the Breed Count and the methylene blue reductase test, and (b) by the Department of Agriculture in planning a methylene blue reductase survey. Unfortunately the outbreak of war prevented this latter scheme from materialising and even the preliminary work has not been done.

Paragraph A: Object of the present report.

During the course of carrying out routine duties in the control of milk supplies for military consumption, a vast amount of data has been collected from different parts of South Africa. In addition, figures have been collected by the Johannesburg Municipal Health Department. The object of the present report is to make these figures available and to outline ways and means whereby a practical scheme of grading might be developed. The actual data set out refer to Breed counts and methylene blue reductase tests performed as outlined by Wilson *et alia* (1935).

CHAPTER 2:

GENERAL PRINCIPLES OF GRADING.

The question of the grading of milk was very thoroughly investigated by the British Medical Research Council Commission headed by Professor G. S. Wilson (Wilson *et alia,* 1935), and it would be presumptuous to attempt to improve upon all the phases covered by that report. Those interested are referred to the report in order to obtain a balanced review of the value of the various methods of testing milk. Particular attention should be paid to the section dealing with the "Total Plate Count" of bacteria, because the idea is so widely held in South Africa that this test is the only satisfactory method of, and the perfect yardstick for, assessing the cleanliness of milk.

Paragraph A: Methods of collecting samples.

This is a subject that has received very full consideration in the above-mentioned report, but local South African conditions present factors with which the M.R.C. Commission may not have had to

contend. It is a common experience amongst milk graders at depôts to find striking differences between different cans of milk delivered by a producer on any particular day. Evidence of this can be obtained from a scrutiny of farmers' dairy receipts, which show that one or two cans of milk may be lost in a day through souring, but that it is a rare occurrence for the whole consignment to be spoiled. These differences between cans are due to a number of causes including:—

1. Milk of different ages being delivered at the same time;
2. Some milk cans being improperly washed;
3. The milk from cows with unsound udders being grouped in one particular can.

These are but three of the many possible explanations that can be offered. To get a true picture of the milking operation on the farm it is necessary therefore to sample every can of milk, or at least every can of sweet milk, because the sampling of one can covers only a fraction of the farmer's total effort, whereas the whole supply of sweet milk goes to improve or to deteriorate the pooled supplies that reach the consumer.

To obtain a composite supply from every can delivered by a producer is difficult. It would be quite impracticable to stir every can and sample with a dipper, and the other available methods are the use of a sampling tube or sampling direct from the scale pan. Of these, the later method is by far the simplest, and in practice such a sample is a reasonably good mixture and one suitable for chemical tests on which no grave issue such as an adulteration prosecution hangs. If the bacteriological test is to be an immediate count of bacteria by the plate or Breed methods the ultimate result will not be seriously influenced by the fact that the scale-pan already contained the dregs of another supplier's milk. If, however, the milk is very fresh and has to incubate some hours at atmospheric temperature before testing, or if the portion of milk remains in the fluid state during test, as occurs in the reductase test, then scale-pan contamination will vitally influence the final result.

For grading purposes the sampling-tube method should be used wherever possible and every can should be sampled. Where, however, a Breed or plate count is to be done almost immediately, then sampling from the scale-pan is permissible.

Paragraph B: The frequency of repeating tests.

Farmers milk their herds twice or thrice in twenty-four hours, and each milking must be looked upon as an independent operation. In South Africa, when milk is subjected to bacteriological test, it is common to find that one sample is tested monthly from each farm and sometimes the interval between tests is much longer. Moreover, the sample is taken from a ten-gallon can or even from a pint bottle.

The total inadequacy of such a method of testing is all too apparent. If a genuine 24-hour composite sample is taken, then a single monthly test gives a picture of one-thirtieth of the farmer's monthly dairying effort. If the sample comes from only one of the two or three daily milkings, the picture obtained is one-sixtieth or one-ninetieth of the whole, whilst if the sample represents only a can or a pint bottle the picture is proportionately inadequate. In addition, therefore, to a composite sample being necessary, it is also imperative that tests should be frequent. Daily testing would be the ideal, but five tests a week is a practical target at which to aim. Also samples should, wherever possible, be composite for the 24 hours' milking, because there is a tendency for the standard of farm hygiene to be very different at night as compared to that which obtains in the daytime.

Paragraph C: The age of milk when tested.

This is a point which has been fully discussed by Wilson *et alia* (1935), and the same problem under South African conditions was raised by Pullinger *et alia* (1944). In spite of the very clear warning issued by Wilson that milk should be twelve to eighteen hours old before it is subjected to test, the custom persists in South Africa of testing milk when very fresh, or if there must be a delay, samples are refrigerated. Fresh milk has a powerful bacteriostatic action which wanes during the first six to eight hours after withdrawal. Also chance contaminants of milk, such as scabs of sour milk that have dried, contain bacteria in a somewhat dormant state and these take a few hours to pass through their "lag phase" of growth. The result of the combination of these factors is that all milk, unless very filthily produced, has a low bacterial count in the early stages, which may bear no true relationship to the actual "keeping quality" of the milk, and may be no true reflection of the hygiene of production. Milk samples having fairly similar low bacterial counts when very fresh may have totally different "keeping qualities" as judged 12 to 24 hours later. From the consumer's point of view the "keeping quality" is to-day of greater importance than ever before, because most consumers have to use for breakfast milk that was delivered on the previous day and which is at least 24 hours old, but possibly much older.* Where any serious effort is to be made to grade milk according to bacterial content, attention must be paid to the *Latent Defects* which do not show up during the first eight hours after milking. Prior to testing, therefore, milk should be stored at atmospheric temperature until it is 12 hours old. If this procedure is adopted it may prove impossible to achieve the comparatively low bacterial standards claimed overseas, but *Latent Defects* will at least be uncloaked and the grading will be a far better index of the actual "keeping quality".

* Since this was written, milk vendors have begun to aim at getting the bulk of their deliveries finished before breakfast.

Chapter 3:

THE PROBLEM OF INTERPRETING THE RESULTS OF TESTS.

In the past, it has been customary to lay down some definite numerical standard of bacteria per cubic centimetre, and any sample of milk having a count in excess of that figure is classed as sub-standard. In practice it is found that when samples are frequently tested, even the best producers show considerable fluctuations, some samples being far inferior to the accepted standards. This fact is recognized by controlling authorities and some latitude is given to producers by penalising them only if they frequently fall below standard. In other words, the so-called strict numerical standard is in fact used only as a general guide.

A record is given in Table 1 of a series of frequently repeated Breed counts of milk delivered by twelve producers who fall into three different categories. It will be seen that all the producers showed some degree of fluctuation, which, in the case of No. 539, was very slight, but in the case of all others amounted to a tenfold fluctuation and more. The occurrence of these fluctuations is emphasized partly to indicate the need for frequent testing if a true picture of keeping quality is to be obtained, and partly to demonstrate the difficulty of assessing the true meaning of a series of bacterial counts which have been collected as a result of repeated testing.

In the case of producer No. 539 (Table 1), no doubts can exist regarding his efficiency, for only twice in the series did the counts rise above 100,000 per cc. and even then they were only slightly above that figure. The producer is, in fact, reasonably consistent, though even he showed inconsistencies at certain times of the year (*vide* Tables 8, 9 and 14). Producers Nos. 540, 541 and 542, though producing under similar conditions, all showed deterioration during the latter part of the series and were obviously less efficient than No. 539. From the figures given, however, it is far from easy to judge whether they should fall into a different category or grade to No. 539, and for that matter it is difficult to decide how Nos. 540, 541 and 542 compare one with another. This difficulty becomes even more apparent with long-distance suppliers, as will be seen by comparing Nos. 14, 10 and 5 with each other and with No. 4, or Nos. 44, 84 and 191 with each other and with No. 76.

The City of Johannesburg has in the region of 600 dairy farmers registered as having permits to introduce milk. If these producers are all tested five times a week, by the end of the month a total of 12,000 bacterial counts will have been amassed which are quite unintelligible and only offer a broad indication that some producers are good, some indifferent and some bad. The fundamental problem

TABLE 1.

Normal Fluctuation of Bacterial Counts in a Continuous Series of Tests from Different Producers.

Class of Milk.	*Producer No.*	BREED COUNT FOR 20 SUCCESSIVE TESTS.* *Test No.*																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
BEST QUALITY	539	30	120	20	20	20	20	20	40	20	20	20	40	40	20	20	20	42	20	40	160
LOCAL MILK	540	40	120	20	20	20	20	80	20	280	160	20	200	400	240	320	480	1100	80	20	160
8 hours old	541	30	20	40	30	20	30	30	20	240	160	40	20	160	20	400	20	80	160	40	40
on test . . .	542	40	30	80	40	30	20	40	320	30	40	20	120	160	40	240	400	160	160	80	40
ROAD MILK	4	300	30	200	90	30	150	250	90	180	60	330	150	300	150	400	350	300	60	30	240
30-mile journey, 8 hours old on test .	14	270	240	90	1500	150	150	720	90	1500	210	190	270	300	2400	180	240	540	300	600	60
	10	30	30	870	60	270	620	480	500	1500	120	450	150	600	240	400	240	480	120	120	300
	5	120	30	900	360	90	240	210	240	90	30	240	240	1200	1500	300	450	240	540	150	90
RAIL MILK	44	150	90	150	2100	90	960	90	2400	360	390	450	1500	90	3000	T.N.	1800	450	320	T.N.	600
100-mile journey 28 hours old on test .	84	210	T.N.	360	2100	2400	420	T.N.	480	T.N.	T.N.	600	T.N.	180	60	600	600	300	900	990	T.N.
	191	3000	90	1200	450	3000	90	990	210	180	3300	2700	600	T.N.	2700	T.N.	540	T.N.	900	90	T.N.
	76	1500	180	630	T.N.	T.N.	T.N.	T.N.	1200	2700	2100	300	T.N.	2100	T.N.	900	T.N.	1500	T.N.	T.N.	T.N.

N.B. * All Counts × 1,000.
T.N. = Too numerous to count, i.e. over 4,200,000.

of grading is to find some method of resolving these counts into a usable form. Analysis by graphing of each supplier's results has been tried. It involves an immense amount of labour and the final picture is a fluctuating graph which is very little, if any, more instructive than the original series of counts. Nelson (1945) endeavoured to utilize bacterial counts by a process of mathematical averaging. For the purpose of making a rough survey this method is useful, because it does indicate the general trend of results. For the purpose of grading or standardizing, however, it is not acceptable, because the process of averaging is mathematically unsound. Most series of bacterial counts sooner or later reveal a figure "too numerous to count," whilst in many series this result appears frequently. To obtain a mathematical average, this result has to be given some arbitrary value which may be out of all proportion to the true state of affairs. In the work reported in this article, four million bacteria per cc. was taken as the highest countable figure, and any count higher than that was classed as too numerous to count. Quite obviously, therefore, a "too numerous" result might equally well mean a count of 5 million or 5 billion. For the purpose of averaging, however, some arbitrary figure has to be used. Two examples are given to demonstrate the fallacies of this procedure.

Example A: "Too numerous" given an arbitrary value of 10 million. A producer, in the course of ten tests, gives a count of 10,000 per cc. on nine occasions and a "too numerous" count once. This would give an average of just over one million per cc. In other words, a producer giving nine excellent results and one bad one is classed as equivalent to one who regularly gives a count of one million and is therefore consistently fairly unsatisfactory.

Example B: "Too numerous" given an arbitrary value of 5 million. A producer giving a "too numerous" result at every test and whose count possibly rises to billions is given an average figure of 5 million, which makes him practically equivalent to another producer who gives consistently high but always countable results.

It would seem that any form of direct mathematical analysis of results is foredoomed to failure, because fundamentally it is a fallacy to weight good results too heavily with the bad ones. The consumer is concerned with the quality of the milk he receives each day, and he would judge the quality of his supply by comparing the number of times the supply was good with the number of times it was bad. Put another way, his milk does not suddenly go sour in his porridge plate because he remembers that last Sunday the supply was badly tainted. This, too, appears to be the logical way in which laboratory results should be used for grading purposes, and in the subsequent report a procedure is described whereby milk can be graded by any of the recognized tests by a direct comparison of the proportion of good results to bad results.

Paragraph A: Suggested method of interpreting results for grading purposes.

The technique, significance, and weaknesses of the Breed count have been considered by Wilson *et alia* (1935). Broadly speaking, however, the count gives an approximate estimate of all single organisms and clumps or organisms which absorb methylene blue stain. Records are available in South Africa of between one hundred thousand and two hundred thousand Breed counts of farm supplies, and these records have been drawn upon freely in preparing this report.

In the course of collecting these records it has been found convenient to divide counts into the following five categories:—

Category A: 300,000 or less
„ B. Over 300,000 and up to 900,000.
„ C: Over 900,000 and up to 2,000,000.
„ D: Over 2,000,000 and up to 4,000,000.
„ E: Over 4,000,000.

As these figures stand, no particular significance is attributed to the groupings chosen, but experience has shown that the figures constitute a convenient series for sub-division. In the course of correlating numerous Breed counts with farm and herd inspection, and with sour milk returns the impression has been obtained that any producer who can consistently give results that fall into category A is a really good producer, and that those whose results consistently fall into categories A and B are also reasonably satisfactory. If these criteria are applied to the counts recorded in Table 1, it will be seen that only nearby producers did remain consistently in those categories. It was therefore tentatively decided to designate categories A and B as Good results and categories C, D and E as Bad results. A ratio of Good results to Bad results in a month can then be worked out by comparing the number of times results fall into categories A and B with the number of times they fall into the other three categories. This has been called the Good:Bad ratio.

Preliminary attempts were made to use the Good:Bad ratio for grading purposes by Pullinger (1944). In Table 14 of that article is given a list of analysed Breed counts. At that stage the category was an expression of all the tests done during the month. Thus, if 80 per cent. of all of a farmer's tests fell below 300,000 per cc., his monthly category was A. Any producer having a category of A or B for the month was classed as Good for that month, and in Table 14 the proportion of Good farmers to Bad farmers was expressed as a Good:Bad ratio. A summary of these results is given in Table 2 of this article, from which it is clear that only in the winter months did the number of producers who were predominantly good exceed those predominantly bad. These findings were at least of value in indicating that the choice of 1,000,000 per cc. as the division between

TABLE 2.

Monthly Summary of Dairy Hygiene Effort shown by a Group of Producers.

(Abstracted from Report Pullinger, 1944.)

	1942: Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	116	119	127	122	113
Good: Bad ratio	4:1	1:2	1:4	1:5	1:3

	1943: Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.
No. of Producers	132	129	137	137	137	142	139	137	132	113
Good: Bad ratio	1:5	1:6	1:4	1:4	1:1	4:1	3:1	3:1	1:4	1:12

TABLE 3.

Correlation between Breed Counts and Methylene Blue Reductase Times of 2007 Samples.

Number and % of Counts		Reduction Time in Hours *4	3½	3	2½	2	1½	1	½
Below	No.	1070	77	49	40	4	14	1	3
1,000,000	‡%	91·4	65	52	23	9·3	11·3	1·04	1·48
Above	No.	97	40	46	101	39	124	85	217
1,000,000	‡%	8·6	34	48	77	90·7	88·7	98·96	98·52
Total Counts . . .		1167	117	95	131	43	138	96	220

N.B. — * 4 Hours and longer.
‡ Percentage of all samples which reduced in the time indicated.

Good and Bad was an error on the side of severity, rather than leniency. It was necessary, however, to obtain some independent check upon the choice of 1,000,000 as a dividing line. For this purpose parallel Breed counts and methylene blue reductase tests have been compared and the details were reported by Pullinger *et alia* (1944) in a discussion of the "Latent Defects" in milk. The relevant data are contained in Tables 3, 4 and 5 of that article, but a summary is given in Table 3 of this article for application to the present problem. From Table 3 it will be seen that 91·4 per cent. of all samples which took four hours or more to reduce methylene blue had Breed counts

below 1,000,000 per cc. This point serves as an independent justification for a provisional division of categories A and B as good and C, D and E as bad, since on overseas experience four hours is the lowest acceptable division between satisfactory and unsatisfactory milk.

Elaborating upon the original system of giving each producer a category it was then decided to give every test result a category as already outlined, and then summarise the results of the whole month as a Good: Bad ratio.

Chapter 4.

PROPOSED METHOD OF ANALYSIS APPLIED TO AVAILABLE DATA.

Having provisionally accepted the Good: Bad ratio as a workable method of classifying counts, it becomes necessary to apply this method under practical conditions and to analyse a series of Breed counts as Good: Bad ratios in order to be in a position to decide what constitutes a mean or median ratio at any time of the year.

Paragraph A: Calculation of Good:Bad ratio.

Breed Count.	*Category.*
300,000 per cc. or less	A
Over 300,000 per cc. and up to 900,000 per cc.	B
Over 900,000 per cc. and up to 2,000,000 per cc.	C
Over 2,000,000 per cc. and up to 4,000,000 per cc.	D
Over 4,000,000 per cc.	E

Breed Counts for Producer X in May, 1944, analysed into Categories.

Daily Breed Counts**	3000	90	1200	450	3000	90	990	210	180	3300
Category	D	A	C	B	D	A	C	A	A	D
Daily Breed Count**	2700	600	00*	2700	00	540	00	900	90	00
Category	D	B	E	D	E	B	E	B	A	E

Analysis of Categories.

Category A: 5
„ B: 4 } A+B = 9 Good results.

„ C: 2
„ D: 5 } C+D+E=11 Bad results.
„ E: 4

** All counts (X 1,000).
* 00=Too numerous to count.

The ratio of good tests to bad tests or Good: Bad ratio 9: 11
or 1:1·2

Paragraph B: Class of milk comprising the bulk of all fluid milk supplies.

If an attempt is to be made to lay down a general minimum standard for milk, attention has to be given in the first place to the average quality of the milk as at present supplied, because improvement will never be achieved by setting a minimum standard which is too far above the existing average quality. The outcome of such procedure is to exclude the bulk of the milk supplies from the market, an action which cannot be taken since the consuming public will demand milk. If too high a standard is set which excludes too much milk the resulting outcry will end in the standard being waived and the whole purpose of grading will be thereby obscured. A reasonable proportion of the incoming milk supplies must in the first place be able to conform to any standard that is chosen, and it is therefore imperative that data be obtained regarding the average quality of incoming milk.

Large consuming centres usually have three main classes of milk supply:—

1. Producer-distributor (i.e. Producer-retailer) milk;
2. Farm supplies to raw milk shops;
3. Farm supplies to pasteurising depots.

Of these classes the producer-distributor milk usually is and always should be the best quality available. Such milk is produced by the retailer himself under conditions of high capitalisation and it is uneconomical to produce fluctuating quantities of milk or milk which is nutritionally inadequate, unpalatable, or of poor keeping quality. Incidentally such milk has to withstand a minimum of handling and can be delivered to the consumer quicker than any other class of milk.

The supplies for raw milk shops are usually produced fairly near to the market under conditions of fairly high capitalisation. Moreover since such milk may even have to travel 30 miles to market and then be distributed in the raw state it should have high keeping quality too; and higher possibly than that of producer-distributor milk of equivalent age.

The supplies to pooling and pasteurising depots have in the past tended to come from further afield because a lower price was paid to producers by pasteurising firms. This price distinction has lately disappeared and in the future pasteurising firms are likely to draw greater supplies of "nearby" milk. Such firms will, however, have to continue to absorb all supplies of "long-distance" milk which could not be marketed in the raw state. As will be shown later, "long-distance" milk is not initially faulty, in fact it is possible that production methods are on a higher level of hygiene on the far-distant farms, but due to the spoilage to which milk is subjected during transit to market, much of the "long-distance" milk arrives in a seriously deteriorated condition. This aspect is discussed later and was also considered at some length by Pullinger (1944).

In Johannesburg the following are approximate figures of the volumes of each class of milk handled in the City daily:—

Producer-distributor supplies	4,000 gallons
Raw milk shop supplies	28,500 gallons
Pasteurising depot supplies	24,500 gallons

and from these it is very evident that the average quality of milk reaching Johannesburg must be based jointly upon the supplies to raw milk shops and pasteurising depots, the producer-distributor supplies constituting a mere fraction of the whole.

Paragraph C: Analysis of Breed counts as Good:Bad ratios.

Unfortunately only very limited numbers of tests of raw milk shop supplies are available. Such as they are, these are listed in Table 7 and will be discussed later. There is available, however, a relatively large series of tests of farm samples arriving at two pasteurising depots. In August, 1942, there were 120 producers being tested as regularly as possible, but this number later increased and altogether 316 producers have been incorporated in the survey which has lasted for three years. During this period some producers have fallen out, and new ones have come in and as will be seen from Table 6 only a limited number have featured at all consistently. Nevertheless the survey involved the analysis of about 103,000 breed counts on milk which had travelled anything from 20 to 250 miles to the Johannesburg market and constitutes a fair cross-section of the total supply.

In Table 4 is recorded a summary of every producer's monthly Good: Bad ratio regardless of whether the producer was sampled regularly or irregularly. The object of this particular analysis is to ascertain the actual monthly scatter of Good: Bad ratios and for such a purpose every result is relevant.

In subsequent sections where the actual performance of individual producers is considered, results have only been used where a producer has been tested eight times or more in the month. It is strongly urged that two tests a week is a minimal requirement of a fair grading scheme, but five tests a week should be aimed at.

In tabulating the scatter of Good: Bad ratios in Table 4 it was found necessary to allow separate columns for producers against whom no bad or no good results had been recorded, because a series of counts, however few in number, which shows all good and no bad results must stand apart from a series showing at least one bad result. The converse applies equally.

An examination of Table 4, in which producers have been divided into nearby and long-distance categories indicates that throughout any year the scatter of Good: Bad ratios is most dense between the ratios of 5: 1 and 1: 5 so that it is from within this range that the "average" baseline would have to be chosen. To simplify the choice, summations

TABLE 4.

Monthly Summary of Good:Bad Ratios of All Producers Breed-tested during a Three-year Survey.

1942:

ROAD MILK, 30-MILE RADIUS:

Month and Year . .	Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	49	39	38	40	44
Total Samples	303	428	631	741	666
All Good	26·5	10·3	2·6	—	8·8
22:1 to 16:1	2·0	10·3	2·6	—	8·8
15:1 to 11:1	—	2·6	—	2·5	2·2
10:1 to 6:1	18·4	7·7	2·8	7·5	6·6
5:1 to 2:1	32·6	33·3	29·0	52·5	26·6
1:1	14·5	28·0	23·5	27·5	16·0
1:2 to 1:5	2·0	2·6	23·7	10·0	20·0
1:6 to 1:10	2·0	2·6	10·5	—	4·4
1:11 to 1:15	—	—	—	—	—
1:16 to 1:22	—	—	—	—	4·4
All Bad	2·0	2·6	5·3	—	2·2

RAIL MILK, 30-250-MILE RADIUS:

Month and Year . .	Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	71	79	81	78	78
Total Samples	738	1673	1308	1233	1125
All Good	36·6	6·3	1·2	—	11·5
22:1 to 16:1	—	1·3	—	1·2	—
15:1 to 11:1	—	—	—	—	—
10:1 to 6:1	16·9	7·6	3·7	—	—
5:1 to 2:1	40·8	54·4	37·0	10·8	6·4
1:1	2·8	25·3	28·4	25·3	11·5
1:2 to 1:5	1·4	3·8	27·2	47·0	27·0
1:6 to 1:10	—	—	—	8·4	17·0
1:11 to 1:15	—	—	—	—	11·5
1:16 to 1:22	—	—	—	1·2	5·1
All Bad	1·5	1·3	2·5	6·1	10·0

N.B. — These figures represent the *percentage of all producers* (irrespective of whether their milk was sampled consistently or not) whose monthly Good: Bad ratios fell in the ratio groups as shown, with independent percentages for Road and Rail Milk Producers.

(*Continued on next page.*)

TABLE 4.

(*Continued from previous page.*)

Monthly Summary of Good:Bad Ratios of All Producers Breed-tested during a Three-year Survey.

1943:

ROAD MILK, 30-MILE RADIUS:

Month & Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	44	44	48	47	42	47	48	52	48	44	51	50
Total Samples	705	746	781	835	683	786	806	764	708	688	833	806
All Good . . .	11.4	2.3	14.6	10.6	30.9	31.9	39.6	21.2	4.2	—	2.0	2.0
22:1 to 16:1 .	2.3	4.6	8.3	8.5	26.2	21.3	8.3	15.4	—	—	2.0	—
15:1 to 11:1 .	—	2.3	2.1	2.1	2.4	8.5	10.4	5.8	—	—	—	—
10:1 to 6:1 . .	13.6	9.1	14.6	12.8	7.1	19.1	16.7	17.3	4.2	2.3	2.0	2.0
5:1 to 2:1 . .	20.5	27.3	14.6	25.5	21.4	14.9	8.3	30.8	20.8	20.5	11.8	22.0
1:1	18.1	11.4	16.6	15.0	4.9	2.2	10.4	5.5	18.7	—	16.0	18.0
1:2 to 1:5 .	15.9	29.6	20.8	25.5	7.1	2.1	6.3	2.0	33.3	45.4	45.0	26.0
1:6 to 1:10 .	6.8	6.8	4.2	—	—	—	—	3.0	12.5	15.9	7.4	10.0
1:11 to 1:15 .	—	—	—	—	—	—	—	—	—	—	4.0	—
1:16 to 1:22 .	—	6.8	—	—	—	—	—	—	—	4.5	—	14.0
All Bad	11.4	—	4.2	—	—	—	—	—	6.3	11.4	9.8	6.0

RAIL MILK, 30-250-MILE RADIUS:

Month & Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	86	86	89	87	85	182	184	186	185	152	189	183
Total Samples .	1109	1545	2183	1440	1643	3805	3257	3101	2715	1898	2861	3112
All Good . . .	—	—	—	—	11.8	25.8	21.7	10.8	1.6	2.0	1.1	0.5
22:1 to 16:1 .	—	—	1.1	1.1	3.5	15.4	7.1	2.7	0.5	0.7	—	—
15:1 to 11:1 .	—	—	1.1	1.1	3.5	7.7	12.0	4.8	1.1	—	—	—
10:1 to 6:1 .	1.2	1.2	—	3.4	12.9	18.1	12.0	17.2	1.1	—	0.5	0.5
5:1 to 2:1 .	3.5	3.5	4.5	12.6	30.6	20.3	30.4	37.6	13.0	4.6	4.2	3.3
1:1	3.5	4.7	9.0	17.2	14.1	6.0	8.2	16.6	18.9	10.5	10.4	11.4
1:2 to 1:5 .	15.0	36.0	22.5	21.8	18.8	5.5	6.5	7.5	43.8	30.9	30.2	31.7
1:6 to 1:10 .	10.5	16.3	24.7	17.2	—	—	1.1	0.5	9.7	15.8	13.8	12.6
1:11 to 1:15 .	3.5	4.7	5.6	1.1	—	0.6	—	0.5	3.8	9.2	4.8	6.6
1:16 to 1:22 .	11.6	16.3	15.7	13.8	3.5	—	—	1.6	0.5	3.3	4.8	5.5
All Bad	51.2	17.3	15.8	10.7	1.3	0.6	1.0	—	6.0	23.0	30.0	27.9

N.B. — These figures represent the *percentage of all producers* (irrespective of whether their milk was sampled consistently or not) whose monthly Good: Bad ratios fell in the ratio groups as shown, with independent percentages for Road and Rail Milk Producers.

(*Continued on next page.*)

TABLE 4.

(*Continued from previous page.*)

Monthly Summary of Good:Bad Ratios of All Producers Breed-tested during a Three-year Survey.

1944:

ROAD MILK, 30-MILE RADIUS:

Month & Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	46	46	45	44	47	41	43	44	41	40	45	53
Total Samples	703	582	646	531	640	581	514	664	485	438	602	495
All Good . . .	—	—	4.4	—	2.1	2.4	9.3	9.1	7.3	—	—	—
22:1 to 16:1 .	—	—	2.2	2.3	6.4	4.9	4.7	2.3	—	—	—	—
15:1 to 11:1 .	—	—	—	9.1	10.6	4.9	2.3	—	—	—	—	—
10:1 to 6:1 .	—	—	4.4	22.7	23.4	12.2	11.6	13.7	4.9	—	—	—
5:1 to 2:1 .	4.3	21.7	37.7	31.8	44.7	46.3	46.5	54.5	34.1	—	—	6.0
1:1	—	17.5	7.0	16.0	6.4	19.5	11.6	13.6	31.8	7.5	—	18.4
1:2 to 1:5 .	26.2	30.4	33.3	13.6	6.4	9.8	9.3	6.8	19.5	45.0	37.8	51.5
1:6 to 1:10 .	17.4	13.0	4.4	—	—	—	—	—	—	15.6	20.0	3.0
1:11 to 1:15 .	10.8	2.2	2.2	—	—	—	—	—	—	2.5	6.7	6.0
1:16 to 1:22 .	6.5	2.2	2.2	—	—	—	—	—	—	—	13.3	9.1
All Bad	34.8	13.0	2.2	4.5	—	—	4.7	—	2.4	30.0	22.2	6.0

RAIL MILK, 30-250-MILE RADIUS:

Month & Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
No. of Producers	189	184	195	192	197	190	174	177	183	183	165	132
Total Samples .	2972	3199	3556	2708	3188	3133	2908	2852	1954	1927	2159	1960
All Good . . .	0.5	—	1.5	2.1	8.1	5.8	5.2	2.8	2.7	0.5	0.6	0.8
22:1 to 16:1 .	—	—	—	—	5.1	1.1	1.7	0.6	—	—	—	—
15:1 to 11:1 .	—	0.5	—	—	3.6	0.5	1.7	0.6	0.5	—	—	—
10:1 to 6:1 .	—	1.0	1.5	3.1	12.7	7.4	9.2	5.1	1.1	—	—	—
5:1 to 2:1 .	—	1.6	9.2	28.6	49.8	40.0	57.5	27.7	31.7	0.5	—	—
1:1	1.6	9.8	24.1	30.2	16.7	30.0	13.8	23.2	29.5	1.6	1.2	7.6
1:2 to 1:5 .	9.5	35.3	43.1	24.5	1.5	10.5	5.8	27.1	27.3	25.7	15.2	28.8
1:6 to 1:10 .	10.1	17.4	9.2	3.6	0.5	3.7	0.7	4.5	0.5	16.4	18.2	12.1
1:11 to 1:15 .	7.4	7.1	3.6	0.5	—	—	—	0.6	0.5	7.6	3.0	4.5
1:16 to 1:22 .	5.8	6.5	3.6	0.5	—	—	—	4.0	—	1.6	4.2	2.3
All Bad . . .	65.1	20.8	4.2	6.4	2.0	1.0	4.5	3.8	6.2	46.1	57.6	43.9

N.B. — These figures represent the *percentage of all producers* (irrespective of whether their milk was sampled consistently or not) whose monthly Good:Bad ratios fell in the ratio groups as shown, with independent percentages for Road and Rail Milk Producers.

(*Continued on next page.*)

TABLE 4.

(*Continued from previous page.*)

Monthly Summary of Good:Bad Ratios of All Producers Breed-tested during a Three-year Survey.

1945:

ROAD MILK, 30-MILE RADIUS:

Month and Year.	Jan.	Feb.	Mar.	Apr.	May	June	July
No. of Producers	38	37	37	37	36	30	28
Total Samples	485	329	387	416	375	370	321
All Good	—	—	5.4	10.8	19.5	46.7	49.9
22:1 to 16:1	—	2.7	—	2.7	—	3.3	3.6
15:1 to 11:1	—	5.4	—	5.4	5.6	13.3	14.3
10:1 to 6:1	5.2	—	2.7	—	16.6	16.7	14.4
5:1 to 2:1	26.3	18.9	37.8	44.3	36.1	20.0	17.8
1:1	10.5	18.9	24.2	18.9	13.8	—	—
1:2 to 1:5	34.2	16.2	18.9	10.8	5.6	—	—
1:6 to 1:10	13.2	8.1	2.7	—	—	—	—
1:11 to 1:15	—	—	—	—	—	—	—
1:16 to 1:22	2.6	—	2.7	—	—	—	—
All Bad	8.0	29.8	5.4	7.1	2.8	—	—

RAIL MILK, 30-250-MILE RADIUS:

Month and Year.	Jan.	Feb.	Mar.	Apr.	May	June	July
No. of Producers	176	168	140	168	157	149	118
Total Samples	2836	1682	2385	2444	1904	1348	1487
All Good	1.1	1.8	1.4	3.6	11.8	37.7	42.2
22:1 to 16:1	—	—	—	—	—	1.3	5.2
15:1 to 11:1	—	—	—	0.6	3.2	10.0	12.8
10:1 to 6:1	—	—	0.7	3.0	8.2	14.8	9.3
5:1 to 2:1	1.7	1.2	4.3	18.6	39.3	26.8	21.2
1:1	2.8	3.6	15.7	22.5	21.2	6.0	7.6
1:2 to 1:5	19.9	16.4	47.9	28.5	9.6	2.7	—
1:6 to 1:10	19.9	5.3	10.0	10.1	—	—	—
1:11 to 1:15	5.1	1.8	5.0	3.0	—	—	—
1:16 to 1:22	6.3	2.4	2.9	—	—	—	—
All Bad	43.1	67.5	12.1	10.1	7.1	0.7	1.7

N.B. — These figures represent the *percentage of all producers* (irrespective of whether their milk was sampled consistently or not) whose monthly Good: Bad ratios fell in the ratio groups as shown, with independent percentages for Road and Rail Milk Producers.

are given in Table 5 of the percentages of all monthly Good: Bad ratios falling into the groups:—

(a) Above 5: 1.
(b) Above 1: 1.
(c) Above 1: 2.

From this table it is clear that only in the depths of winter, and not always then, do more than 50 per cent. of nearby producers achieve Good: Bad ratios above 5: 1, whilst "long-distance" producers are less satisfactory. A ratio of 5: 1 must therefore be considered as too severe to serve as a general standard.

In the season 1942-43 more than 50 per cent. of "nearby" producers achieved Good: Bad ratios higher than 1: 1 except in October, January, and February. During the same season "long-distance" producers achieved this level during the winter but not in the summer. For the same period a high proportion of "nearby" producers achieved a ratio of 1: 2 throughout the year but "long-distance" producers still failed to reach even this level during the summer. It will be noted that during the two subsequent years the position was very much worse. This difference represents a war-time deterioration which is discussed subsequently, but must obviously be ignored in deciding upon an average base-line.

Reviewing the position, therefore, it is evident that there is some justification for suggesting a Good: Bad ratio of 2: 1 as the summer baseline and 5: 1 as that for winter. It is freely admitted that "long-distance" producers did not in the main achieve such levels, nor did many of them even succeed in achieving very much lower levels such as 1: 2. Obviously it would be unreasonable to reduce the baseline to the absurd level of 'all bad" in order to fit in more than 50 per cent. of "long-distance" producers in December 1942. It should be remembered that the meaning of these ratios is that in summer a producer must register two Breed counts below 1,000,000 per c.c. for every one count above that level, whilst in winter he must register five counts below to every one count above that level.

Paragraph D: Definition of summer and winter seasons.

An examination of the figures recorded in Tables 4 and 5 indicates that in 1942 milk showed a marked deterioration in quality during October heralding the onset of warm weather. In 1943 deterioration occurred during September and in 1944 once again in October. From these figures it would appear to be reasonable to calculate the summer season as beginning on September 1st. During 1943 the milk began to improve in quality during March and by April improvement was quite apparent. During the subsequent two years the same thing occurred and it is suggested therefore that the summer season should include the seven months of September to March. All subsequent analyses are based upon this assumption.

TABLE 5.

Good:Bad Ratios listed in Table 4 Analysed to find a Suitable Base-line for Standardization Purposes.

1942:

Month and Year.	Aug.	Sep.	Oct.	Nov.	Dec.
ROAD MILK, 30-MILE RADIUS:					
Good : Bad Ratio	* %				
% above 5:1	46.9	30.9	8.0	10.0	26.4
% above 1:1	* % 79.5	64.2	37.0	62.5	53.0
% above 1:2	* % 94.0	92.2	60.5	90.0	69.0
ROAD MILK, 30-250 MILE RADIUS:					
% above 5:1	* % 53.5	15.2	4.9	1.2	11.5
% above 1:1	* % 94.3	69.6	41.9	12.0	17.9
% above 1:2	* % 97.1	94.9	70.3	37.3	29.4

1943:

Month & Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
ROAD MILK, 30-MILE RADIUS:												
Good:Bad Ratio	* %											
% above 5:1	27.3	17.3	39.6	34.0	66.6	80.8	75.0	59.7	8.2	2.3	6.0	4.0
% above 1:1	* % 47.8	44.6	54.2	59.5	88.0	95.7	83.3	90.5	29.0	22.8	17.8	26.0
% above 1:2	* % 65.9	56.0	70.8	74.5	92.9	97.7	93.7	95.0	47.7	22.8	33.8	44.0
ROAD MILK, 30-250 MILE RADIUS:												
% above 5:1	* % 1.2	1.2	2.2	5.6	32.3	67.0	52.8	35.5	4.3	2.7	1.6	1.0
% above 1:1	* % 4.7	4.5	6.7	18.2	62.9	87.3	83.2	73.1	17.3	7.3	5.8	4.3
% above 1:2	* % 8.2	9.2	15.7	38.4	77.0	93.3	91.4	89.4	36.2	17.8	16.2	15.7

* Percentage of producers.

(*Continued on next page.*)

TABLE 5.

(*Continued from previous page.*)

Good:Bad Ratios listed in Table 4 Analysed to find a Suitable Base-line for Standardization Purposes.

1944 :

Month & Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
ROAD MILK, 30-MILE RADIUS:												
Good:Bad Ratio * %												
% above 5:1	—	—	11.0	34.1	42.5	24.4	27.9	25.1	12.2	—	—	—
* %												
% above 1:1	4.3	21.7	48.7	65.9	87.2	71.7	74.4	79.6	46.3	—	—	6.0
* %												
% above 1:2	4.3	39.2	55.7	81.9	93.6	91.2	86.0	93.2	78.1	7.5	—	24.4
ROAD MILK, 30-250 MILE RADIUS:												
* %												
% above 5:1	0.5	1.5	3.0	5.2	29.5	14.8	17.8	9.0	4.3	0.5	0.6	0.8
* %												
% above 1:1	0.5	3.1	12.2	33.8	79.3	54.8	75.3	36.7	36.0	1.0	0.6	0.8
* %												
% above 1:2	2.1	12.9	36.3	64.0	96.0	84.8	89.1	59.9	65.5	2.6	1.8	8.4

1945 :

Month and Year.	Jan.	Feb.	Mar.	Apr.	May	June	July
ROAD MILK, 30-MILE RADIUS:							
Good : Bad Ratio * %							
% above 5:1	5.2	8.1	8.1	18.9	41.7	80.0	82.2
* %							
% above 1:1	31.5	27.0	45.9	63.2	77.8	100.0	100.0
* %							
% above 1:2	42.0	45.9	70.1	82.1	91.6	—	—
ROAD MILK, 30-250 MILE RADIUS:							
* %							
% above 5:1	1.1	1.8	2.1	7.2	23.2	63.8	69.5
* %							
% above 1:1	2.8	3.0	6.4	25.8	62.5	90.6	90.7
* %							
% above 1:2	5.6	6.6	22.1	48.3	73.7	96.6	98.3

* Percentage of producers.

Chapter 5.

COMPARISON OF PRODUCERS MONTHLY GOOD: BAD RATIOS WITH THE SUGGESTED STANDARDS.

In the foregoiong chapter an attempt was made to choose workable Good: Bad ratios (viz. 2:1 and 5:1 for summer and winter seasons respectively), this choice being dictated by the scatter of Good: Bad ratios throughout the year. Having made this choice it is then necessary to ascertain what proportion of producers actually do line up to these standards throughout the year.

Paragraph A: Detailed survey of 183 Johannesburg Suppliers.

In Table 6 is recorded the extent to which 183 suppliers maintained or failed to maintain the suggested summer and winter standards. These producers were all delivering milk to pasteurising depots, the first forty-one being 'near-by" (i.e. within a 30-mile radius) and the remainder "long-distance" producers. Some of the producers have been subjected to more or less continuous testing for three full years whilst others have been under test for shorter periods, but none have been included in this survey who have not been under test for one full year.

During 1942-43 Producers Nos. 5; 10; 12; 13; 17 and 39, that is to say 6 out of 34 "'nearby" producers maintained the summer standard consitently, whilst 11 out of 38 maintained the winter standard consistently. Only 3 (i.e. Nos. 5; 12 and 13) maintained both summer and winter standard consistently during that year. Of the "long-distance" producers No. 50 maintained the standard throughout the year whilst one or other seasonal standard was maintained by a few other producers. During the subsequent years of 1943-44 and 1944-45 the whole position deteriorated rapidly and gravely, and in these latter years no one maintained either summer or winter standards consistently. When it is remembered how low these tentative standards are, it will then be realised how poor the keeping quality of much of this milk must be. The figures listed in Table 6 show the number of months in each season that every producer was substandard, the number of large figures appearing in the table stress only too clearly that failure to attain the monthly Good: Bad ratio standard was the rule rather than the exception.

From the foregoing analysis it is quite evident that although a tentative standard was chosen based upon the scatter of Good: Bad ratios actually obtained by these producers and by others like them, nevertheless when this standard was applied to farmers individual efforts it proved that they could not maintain the standard consistently throughout the season.

TABLE 6.

Table showing Number of Months in Summer and in Winter when Producers who have been Consistently Tested and who have Failed to Maintain the Good:Bad Ratio of 2:1 and 5:1 respectively.

Producer No.	No. of months G:B Ratio Substandard					
	1942-3		1943-4		1944-5	
	Sum.	Wint.	Sum.	Wint.	Sum.	Wint.
1	·	4	7	5	·	·
2	6	5	4	1	·	·
3	6	0	3	2	5	4
4	1	1	5	2	3	1
5	0	0	4	2	·	·
6	3	1	5	1	4	2
7	4	2	2	2	4	1
8	5	1	5	2	5	0
9	1	0	1	1	·	·
10	0	1	6	1	4	0
11	5	1	6	3	6	1
12	0	0	4	1	2	1
13	0	0	4	2	5	0
14	2	2	3	2	5	0
15	3	3	·	·	·	·
16	5	2	7	2	7	2
17	0	2	5	1	4	1
18	·	1	6	2	4	2
19	3	1	·	·	·	·
20	2	3	4	2	3	2
21	3	2	·	·	·	·
22	1	0	5	2	4	2
23	4	2	·	·	·	·
24	3	1	5	1	5	3
25	6	1	6	2	5	1
26	3	0	6	3	4	1
27	6	5	6	1	7	2
28	6	4	·	·	·	·
29	3	1	5	4	2	2
30	2	0	6	3	5	3
31	2	3	6	4	4	·
32	1	0	3	1	5	1
33	4	0	5	0	7	3
34	1	0	6	2	4	3
35	7	2	4	3	6	3
36	·	1	6	3	4	3
37	·	·	7	3	4	2
38	·	1	4	1	·	·
39	0	1	6	1	4	1
40	·	·	5	4	5	3
41	·	·	5	2	7	1
42	·	·	6	2	4	1
43	5	5	6	4	6	2
44	1	0	3	2	·	0
45	5	1	1	1	4	0
46	6	2	7	3	7	1
47	5	4	7	4	5	1
48	5	2	6	2	5	3
49	4	4	1	4	3	1
50	0	0	3	1	5	2
51	5	1	6	2	6	3
52	3	3	6	5	2	1
53	3	3	4	3	·	1
54	5	3	4	5	·	·
55	4	0	6	4	7	2
56	7	3	7	5	6	1
57	7	3	7	5	6	4
58	5	2	3	3	3	2
59	4	2	3	1	1	2
60	4	1	0	2	7	3
61	1	2	6	3	7	3
62	6	2	4	4	3	2
63	7	4	7	5	7	2
64	6	5	7	4	5	3
65	7	4	7	4	7	4
66	6	5	7	7	·	1
67	4	1	4	3	6	2
68	2	3	2	4	·	1
69	5	5	7	5	7	4
70	6	1	6	2	6	2
71	2	1	5	3	5	0
72	4	1	6	3	6	5
73	4	2	3	2	·	·
74	5	3	5	2	4	1
75	0	2	7	3	·	4
76	5	1	5	4	6	1
77	4	1	3	4	3	3
78	7	5	7	5	7	5
79	6	3	7	1	5	1
80	4	3	6	4	·	2
81	5	4	7	2	7	·
82	7	3	7	2	6	2
83	3	1	5	2	·	1
84	2	2	3	4	7	1
85	7	3	7	5	5	4
86	7	2	6	5	5	3
87	2	2	3	2	3	3
88	5	3	7	5	6	4
89	6	2	6	2	7	3
90	6	1	6	4	6	2
91	4	2	3	3	·	2
92	3	4	2	2	3	4
93	5	2	7	4	5	2
94	1	4	3	4	·	1
95	·	0	6	1	6	2
96	7	3	7	2	5	·
97	6	2	7	2	7	3
98	5	2	7	3	7	2
99	7	2	7	3	5	2
100	6	5	7	5	7	3
101	7	5	5	3	·	2
102	·	·	6	1	6	2
103	·	·	6	3	7	3
104	·	·	4	5	·	3
105	·	·	7	3	4	4
106	·	·	7	5	5	1
107	·	·	6	5	6	1
108	·	·	7	5	4	4
109	·	·	4	5	7	4
110	·	·	5	5	3	1
111	·	·	7	3	5	2
112	·	·	5	4	4	3
113	·	·	5	4	·	2
114	·	·	7	4	4	4
115	·	·	7	2	5	·
116	·	·	7	2	6	2
117	·	·	4	2	6	1
118	·	·	·	·	·	3
119	·	·	7	5	6	2
120	·	·	6	5	4	4
121	·	·	4	5	5	·
122	·	·	4	5	·	3
123	·	·	7	2	5	2
124	·	·	7	3	·	3
125	·	·	6	3	4	2
126	·	·	7	5	6	5
127	·	·	4	5	6	5
128	·	·	4	3	5	1
129	·	·	7	4	5	4
130	·	·	7	5	·	3
131	·	·	7	1	4	·
132	·	·	4	5	·	4
133	·	·	7	3	5	4
134	·	·	4	5	·	1
135	·	·	5	4	5	3
136	·	·	7	4	5	3
137	·	·	5	5	·	4
138	·	·	7	4	·	1
139	·	·	6	5	3	2
140	·	·	6	4	·	2
141	·	·	5	5	5	2
142	·	·	7	3	5	3
143	·	·	·	2	7	2
144	·	·	6	3	·	1
145	·	·	7	3	·	·
146	·	·	4	4	·	·
147	·	·	3	3	5	2
148	·	·	2	4	4	1
149	·	·	6	2	5	1
150	·	·	4	5	6	4
151	·	·	5	4	·	·
152	·	·	4	4	·	1
153	·	·	5	4	·	3
154	·	·	4	2	·	2
155	·	·	6	1	·	·
156	·	·	3	5	·	3
157	·	·	4	3	5	3
158	·	·	1	4	6	2
159	·	·	6	3	5	2
160	·	·	4	5	·	·
161	·	·	7	3	4	2
162	·	·	5	5	·	1
163	·	·	7	3	·	1
164	·	·	7	2	5	2
165	·	·	6	3	·	1
166	·	·	7	5	5	2
167	·	·	·	3	5	3
168	·	·	·	4	4	2
169	·	·	·	2	6	5
170	·	·	·	·	5	2
171	·	·	·	·	6	3
172	·	·	5	4	6	2
190	·	·	2	5	7	2
191	·	·	7	2	·	·
192	·	·	7	4	·	·
193	·	·	7	5	7	2
194	·	·	7	4	7	2
195	·	·	4	3	3	·
196	·	·	6	3	·	1
197	·	·	6	5	6	1
198	·	·	7	3	5	1
199	·	·	3	3	·	·
200	·	·	7	3	·	·

N.B. — Producers Nos. 1 – 41 are within 30-mile radius.
Producers Nos 42 – 172 are within 100-mile radius.
Producers Nos 190 – 200 are beyond 100-mile radius.

TABLE 7.

Summary of Breed Count Good:Bad Ratios for Different Classes of Milk Producers and for Different Districts of South Africa.

DISTRICT.	YEAR AND SEASON / CLASS OF MILK SHOWING SOURCE OR AGE.	1944–1945 SUMMER Producers tested	SUMMER * % maintaining tentative standard	SUMMER % Producers substandard for: One Month	Two Months	Over 2 Months	WINTER Producers tested	WINTER * % maintaining tentative standard	WINTER % Producers substandard for: One Month	Two Months	Over 2 Months
JOHANNESBURG	Producer–Retailer (8-hour)	.	.	.	.	.	.	.	.	.	.
,,	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
,,	Pasteurising Depot (30-mile)	34	**17.7**	14.7	11.8	55.8	38	**29.0**	34.0	18.4	18.6
,,	Pasteurising Depot (long dist.)	58	**3.5**	5.2	6.9	84.4	59	**6.8**	18.6	29.0	45.6
PRETORIA	Pasteurising Depot (8-hour)	24	**29.2**	20.8	25.0	25.0	22	**41.0**	31.8	18.2	9.0
,,	Pasteurising Depot (20-hour)	20	**15.0**	20.0	10.0	55.0	17	**41.2**	23.5	11.8	23.5
BLOEMFONTEIN	Pasteurising Depot (8-hour)	19	**0**	5.0	15.0	80.0	19	**0**	0	0	100
PIETERMARITZBURG	Pasteurising Depot (8-hour)	46	**8.7**	21.7	15.2	54.4	38	**10.5**	42.0	10.5	37.0
UMLAAS ROAD	Pasteurising Depot (8-hour)	72	**55.5**	18.0	12.5	14.0	75	**85.5**	9.3	2.7	3.0
DURBAN	Pasteurising Depot (8-hour)	24	**20.8**	20.8	16.7	41.7	33	**3.3**	24.2	15.0	57.5
PIETERSBURG	Raw milk shop supplies (8-hr.)	.	.	.	.	.	12	**0**	0	0	100
EAST LONDON	Raw milk shop supplies (8-hr.)	21	**42.8**	14.2	14.2	28.8	21	**57.0**	38.0	5.0	0
GRAHAMSTOWN	Raw milk shop supplies (8-hr.)	11	**9.1**	18.2	18.2	54.5	11	**0**	0	0	100
CAPE TOWN	Raw milk shop supplies (8-hr.)	28	**10.7**	35.7	28.6	25.0	28	**14.3**	43.0	28.7	14.0
WORCESTER	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
QUEENSTOWN	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
KIMBERLEY	Raw milk shop supplies (8-hr.)	6	**0**	0	33.3	66.7	6	**33.3**	16.6	16.6	35.5
POTCHEFSTROOM	Raw milk shop supplies (8-hr.)	8	**0**	25.0	37.5	37.5	8	**12.5**	50.0	37.5	0
PORT ALFRED	Raw milk shop supplies (8-hr.)	3	**0**	0	100	0	3	**0**	0	0	100

N.B. — * Tentative SUMMER Standard Good:Bad Ratio 2:1. Tentative WINTER Standard Good:Bad Ratio 5:1.

(*Continued on next page.*)

TABLE 7. — (Continued from previous page.)

Summary of Breed Count Good:Bad Ratios for Different Classes of Milk Producers and for Different Districts of South Africa.

DISTRICT.	YEAR AND SEASON / CLASS OF MILK SHOWING SOURCE OR AGE.	1943 – 1944								
		SUMMER					WINTER			
		Producers tested	* % maintaining tentative standard	% Producers substandard for			Producers tested	* % maintaining tentative standard	% Producers substandard for		
				One Month	Two Months	Over 2 Months			One Month	Two Months	Over 2 Months
JOHANNESBURG	Producer–Retailer (8-hour)	13	**84.4**	7.8	7.8	0	13	**92.2**	0	0	7.8
"	Raw milk shop supplies (8-hr.)	14	**14.3**	7.3	35.6	42.8	14	**50.0**	28.7	7.3	14.0
"	Pasteurising Depot (30-mile)	36	**0**	2.8	2.8	94.4	36	**2.8**	30.5	39.0	27.7
"	Pasteurising Depot (long dist.)	136	**0.7**	2.3	3.0	94.4	140	**0**	5.7	17.8	76.5
PRETORIA	Pasteurising Depot (8-hour)	24	**25.0**	25.0	4.0	26.0	21	**33.3**	23.7	28.5	14.5
"	Pasteurising Depot (20-hour)	23	**13.0**	17.4	8.7	60.9	22	**9.2**	31.8	41.0	18.0
BLOEMFONTEIN	Pasteurising Depot (8-hour)	19	**0**	5.0	10.0	85.0	19	**0**	0	0	100
PIETERMARITZBURG	Pasteurising Depot (8-hour)	58	**46.5**	19.0	5.2	29.3	52	**56.0**	38.5	3.8	1.7
UMLAAS ROAD	Pasteurising Depot (8-hour)	80	**52.5**	18.8	17.5	11.2	80	**64.0**	14.7	14.7	6.6
DURBAN	Pasteurising Depot (8-hour)	.	.	.	.	.	35	**40.0**	23.0	17.0	20.0
PIETERSBURG	Raw milk shop supplies (8-hr.)	17	**11.8**	17.6	35.0	35.6	16	**18.8**	50.0	25.0	6.2
EAST LONDON	Raw milk shop supplies (8-hr.)	13	**46.2**	15.4	23.0	15.4	11	**100**	0	0	0
GRAHAMSTOWN	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
CAPE TOWN	Raw milk shop supplies (8-hr.)	25	**40.0**	56.0	4.0	0	26	**34.6**	54.0	10.4	0
WORCESTER	Raw milk shop supplies (8-hr.)	5	**80.0**	20.0	0	0	5	**20.0**	60.0	20.0	0
QUEENSTOWN	Raw milk shop supplies (8-hr.)	3	**100**	0	0	0	3	**100**	0	0	0
KIMBERLEY	Raw milk shop supplies (8-hr.)	4	**0**	25.0	0	75.0	6	**0**	66.7	0	33.3
POTCHEFSTROOM	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
PORT ALFRED	Raw milk shop supplies (8-hr.)	3	**33.3**	33.3	33.4	0	3	**0**		0	100

N.B. — * Tentative SUMMER Standard Good:Bad Ratio 2:1. Tentative WINTER Standard Good:Bad Ratio 5:1.

(Continued on next page.)

TABLE 7. — (Continued from previous page.)

Summary of Breed Count Good:Bad Ratios for Different Classes of Milk Producers and for Different Districts of South Africa.

DISTRICT.	YEAR AND SEASON — CLASS OF MILK SHOWING SOURCE OR AGE.	1942 – 1943									
		SUMMER					WINTER				
		Producers tested	* % maintaining tentative standard	% Producers substandard for			Producers tested	* % maintaining tentative standard	% Producers substandard for		
				One Month	Two Months	Over 2 Months			One Month	Two Months	Over 2 Months
JOHANNESBURG	Producer–Retailer (8-hour)	.	.	.	.	.	.	.	.	.	.
,,	Raw milk shop supplies (8-hr.)	35	**20.0**	11.4	57.2	11.4	35	**8.6**	17.2	37.1	37.1
,,	Pasteurising Depot (30-mile)	31	**0**	0	6.4	93.6	30	**13.4**	33.4	26.6	26.6
,,	Pasteurising Depot (long dist.)	101	**0**	1.0	1.0	88.0	124	**2.3**	25.0	33.8	38.7
PRETORIA	Pasteurising Depot (8-hour)	23	**0**	8.7	8.7	82.6	24	**8.3**	25.0	29.2	37.5
,,	Pasteurising Depot (20-hour)	15	**0**	20.0	6.7	73.3	16	**6.4**	25.0	12.4	56.0
BLOEMFONTEIN	Pasteurising Depot (8-hour)	.	.	.	.	.	.	.	.	.	.
PIETERMARITZBURG	Pasteurising Depot (8-hour)	59	**56.0**	25.5	6.8	11.7	61	**69.0**	16.4	14.0	0.6
UMLAAS ROAD	Pasteurising Depot (8-hour)	.	.	.	.	.	.	.	.	.	.
DURBAN	Pasteurising Depot (8-hour)	41	**34.0**	19.5	27.0	19.5	43	**37.0**	21.0	16.3	25.7
PIETERSBURG	Raw milk shop supplies (8-hr.)	15	**66.0**	20.0	14.0	0	16	**100**	0	0	0
EAST LONDON	Raw milk shop supplies (8-hr.)	21	**71.5**	14.2	4.8	9.5	22	**77.3**	13.7	4.5	4.5
GRAHAMSTOWN	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
CAPE TOWN	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
WORCESTER	Raw milk shop supplies (8-hr.)	5	**100**	0	0	0	5	**60.0**	40.0	0	0
QUEENSTOWN	Raw milk shop supplies (8-hr.)	3	**66.7**	33.3	0	0	3	**66.7**	33.3	0	0
KIMBERLEY	Raw milk shop supplies (8-hr.)	4	**0**	100	0	0	4	**25.0**	0	0	75.0
POTCHEFSTROOM	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.
PORT ALFRED	Raw milk shop supplies (8-hr.)	.	.	.	.	.	.	.	.	.	.

N.B. — * Tentative SUMMER Standard Good:Bad Ratio 2:1. Tentative WINTER Standard Good:Bad Ratio 5:1.

Chapter 6.

APPLICATION OF SUGGESTED STANDARDS TO VARIOUS CLASSES OF MILK AND TO MILK FROM DIFFERENT AREAS.

All details of this phase of the investigation have been summarized in Table 7. The survey covers in some degree all classes of fluid milk and practically all the main milk consuming centres of the Union of South Africa. The figures represent the percentages of all classes of producers who have yearly:—

a. Succeeded in maintaining the suggested summer or winter standard;
b. Failed to maintain it for one month only;
c. Failed to maintain it for two months;
d. Failed to maintain it for more than two months.

It has been made clear in the preceeding chapters that these tentative standards were chosen primarily from an analysis of the efforts of about 316 fluid milk producers scattered throughout the southern half of the Transvaal and northern half of the Orange Free State, and delivering milk from 20 to 250 miles to pasteurising depots in Johannesburg. In the case of certain centres comparatively few producers have been tested, but in practically every case the number tested represents a reasonable proportion of the total number of farmers holding municipal permits to introduce milk into the area.

Paragraph A: Producer-distributor milk.

In the year 1943-44 it proved possible to make a very small survey of producer-distributor supplies, thirteen firms being tested regularly for a maximum period of twelve months, only eight tests being done per producer per month. The samples moreover were not herd samples. In spite of these shortcomings the findings are instructive and valuable. The details of this work are listed in Tables 7; 8; 9 and 10. Referring for the moment to Tables 7 and 8, it will be seen that with two exceptions these producers had no difficulty whatsoever in maintaining the standards suggested. The one exception, No. 563, was so very unsatisfactory that his dairying licence should have been cancelled. The other exception, No. 505, spoiled the otherwise good record by one unsatisfactory month. As was explained earlier in this report the producer-distributor milk represents only a small proportion of the total supply of a large town. In smaller towns and villages the proportion is very much higher but it must not be assumed that the quality under such circumstances is necessarily as good as that recorded here. In big towns producer-distributors who usually produce the milk within the municipal boundaries have been brought up to this high level by years of constant education and coercion by the local health authorities.

TABLE 8.

Monthly Good:Bad Ratio of Producer–Distributors calculated from Breed Count Records.

Producer No.	GOOD : BAD RATIO												No. of months substandard *	
	1943 July	Aug.	Sep.	Oct.	Nov.	Dec.	1944 Jan.	Feb.	Mar.	Apr.	May	June	Summer	Winter
505	7:0	8:0	4:0	7:1	9:0	6:1	1:2	5:1	2:0	.	.	.	1	0
507	.	.	.	.	9:0	6:0	9:0	8:0	8:0	6:0	8:0	9:0	0	0
539	7:0	8:0	4:0	7:0	9:0	8:0	9:0	9:0	8:0	6:0	8:0	9:0	0	0
540	7:0	8:0	3:1	8:0	8:1	8:0	8:1	8:1	8:0	6:0	5:0	9:0	0	0
541	7:0	8:0	3:1	8:0	9:0	8:0	9:0	9:0	8:0	6:0	8:0	9:0	0	0
542	7:0	8:0	4:0	1:7:1	8:1	7:0	9:0	7:0	8:0	7:0	8:0	9:0	0	0
548	.	.	.	2:0	8:0	6:0	9:0	9:0	8:0	5:0	8:0	10:0	0	0
549	.	.	.	.	9:0	6:1	2:1	7:1	7:1	6:0	8:0	10:0	0	0
550	.	.	.	.	9:0	6:0	8:1	9:0	8:0	6:0	7:1	5:0	0	0
551	.	.	.	.	7:0	7:0	9:0	8:0	8:0	6:0	8:0	10:0	0	0
563	.	.	.	.	.	.	0:3	0:8	0:7	0:5	1:4	.	3	3
564	.	.	.	.	.	.	4:0	8:1	7:1	6:0	8:0	9:0	0	0
565	.	.	.	.	.	.	4:0	9:0	8:0	6:0	8:0	10:0	0	0

N.B. — * Tentative SUMMER Standard Good:Bad Ratio 2:1. Tentative WINTER Standard Good:Bad Ratio 5:1.

Certain of the producer-distributors listed here, namely Nos. 507, 539, 548, 551 and 565 never had a bad result recorded against them. That is to say they never showed a Breed count of over 1,000,000 per cc. Producers of this calibre have already achieved a high standard of dairying and it seems probable that they could fairly easily be lifted to the standard of overseas high-grade (certified) producers. This point will again be raised in Chapter 8, paragraph G.

Paragraph B: Farm supplies to raw milk shops.

Data is available regarding the efforts of farmers in ten different areas, who have permits to introduce milk for sale in raw milk shops. An extraordinary range of variation is to be seen between the dairying efforts in different areas, but generally speaking high-veld farmers have put up a very indifferent performance, whilst those farming in or near the coastal belt have done very much better. Considering the matter in greater detail:—

(a) *Johannesburg*: A limited number of results are specifically listed under this heading in Table 7, but those 34 to 36 farmers classed as supplying pasteurising depots from within a 30-mile radius might equally well be classed as potential raw-milk-shop suppliers, and in fact their supplies have been diverted to supply the demands of raw milk purveyors. There is, however, considerable difference between the tests of samples from the regular as compared to the occasional raw-milk-shop supplier. The reason for this is that the raw milk purveyor is faced with the problem of marketing milk in a sweet state and suppliers are selected with this object in view. Whilst pasteurisation does not render sour milk sweet, the process does definitely retard the rate of souring so that pasteurising depots can absorb those supplies which without pasteurisation would be unmarketable. This is not by any means a desirable state of affairs, but it is one which has developed because milk consigned to pasteurising depots has in the past always been priced one penny lower than milk consigned to raw milk shops. This price discrepancy has recently been removed and in the future the raw milk purveyor will not have a price factor to assist him in choosing the best incoming farm supplies.

In 1943-44 only 14.3 per cent. of producers in this category maintained the tentative summer and 50 per cent. the tentative winter standard. In 1944-45 only 20 per cent. maintained the summer and 8.6 per cent. the winter standard.

(b) *Pietersburg:* Producers in this area put up a very poor performance in the first place, but there was considerable impovement during the third year thanks to intensive propaganda carried out by the local veterinary inspectorate. In the third year the summer standard was maintained by two-thirds of the producers and the winter standard by all of them.

(c) *Potchefstroom:* These producers proved to be unsatisfactory during the year when they were under test.

(d) *Kimberley:* These producers were generally substandard.

(e) *Port Alfred:* The suppliers were usually substandard, thus constituting the exception to the general rule regarding the better keeping quality of milk produced in the coastal belt.

(f) *East London:* Compared with up-country producers those tested at East London made determined and larelgy successful efforts to maintain standard. Under strict military control and guidance, of twelve producers nearly half maintained the summer standard and all the winter standard in 1943-44. Those listed in the following year represent a different group of farmers who put up an even better performance.

(g) *Cape Town:* Whilst producers in this area did better than those on the highveld, the results are nevertheless very unsatisfactory, 40 per cent. being the highest figure for farmers maintaining standard.

(h) *Worcester:* The small group of farmers tested in this area put up an encouraging performance in the summer but were much less satisfactory during winter. This unusual state of affairs may result from a breakdown of dairy hygiene during the excessively wet winter climate.

(i) *Queenstown:* The producers tested in this region gave good results during 1943-44, but deteriorated considerably during the subsequent season.

Paragraph C: Farm supplies to pasteurising depots.

By far the largest groups of figures presented in this report refer to supplies from this category of producer.

(a) *Johannesburg:* Suppliers to this centre are divided provisionally into "nearby" (i.e. within a 30-mile radius and usually delivering by road) and "long-distance" (i.e. 30 to 250 mile radius and normally delivering by rail). It must be stressed at this point that what constitutes "nearby" milk to a large city would be "long-distance" milk to a small town. As has been pointed out the farmers within the 30-mile radius are potential raw milk shop suppliers.

In the results recorded in this report all samples were a minimum of 8-hours old when tested, having been stored at atmospheric temperature. Much of the milk entering Johannesburg, however, from both near and far was considerably older than 8 hours when it reached the sampling point. The precise age of milk varied enormously, some of the age complexes being listed below.

1. Milk withdrawn at 7.00 p.m. was railed to market and did not arrive under test until 12.00 noon next day by which time it was 17 hours old. The morning milk was sometimes railed at the same time in

which case the sample was a mixture of milk 17 and 29 hours old. If, however, the morning milk was railed independently that batch was not tested.

2. Milk withdrawn at 6.00 p.m. in outlying areas was held on the farm overnight and the following morning's milk was added, the whole consignment being railed during the afternoon. The consignment reached the consignee at about 10,00 a.m. next day and was under test by noon. By that time half the milk was 42 hours old and the other half 12 hours fresher. The only way these time periods could be shortened would be by milking at midday and midnight. This would decrease the maximum age of the milk by 7 hours, but would involve milking in the heat of the day and in the depths of the night, both procedures being highly undesirable for successful dairying.

3. In certain cases milk may be even older, particularly when railed on branch lines where no trains run on Sunday. In such cases milk was drawn on Saturday afternoon and was stored on the farm until Monday afternoon, the consignment growing as result of the addition of the product from each subsequent milking. By the time the milk was railed the first batch was nearly 48 hours old. It was received at the depot on Tuesday morning at about 10.00 a.m. and was under test by noon by which time the oldest portion of the consignment was about 64 hours old. Lest it be thought that dairying cannot be operated under such conditions the Good: Bad ratios of two such producers are recorded:—

	1943:						
No. District.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
198 Wakker-stroom	17:0	15:1	5·5:1	1:1	1·2:1	1:1·4	1:3·6
198 Harrismith . .	—	—	14:1	1:1·8	1:1·3	1:5	1:1·4

	1944:							
No. District.	Jan	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.
198 Wakker-stroom . . .	1:14	1:7	1:18	2:1	7:1	4:1	1:1·2	2·3:1
198 Harrismith	0:10	0:14	1:2·8	1·1:1	1:1	1:4	4:1	1:1·9

Whilst these results were frequently below the tentative standards, they are considerably better than those shown by many nearby producers.

In Johannesburg from 1942-45 there was a steady deterioration in the keeping quality of milk supplied by both "nearby" and by "long-distance" producers. In 1942-43, during the summer 17.7 and 8.5 per cent. of "nearby" and "long-distance" producers respectively main-

tained standard, whilst in the winter the percentages were 29 and 6.8. In the subsequent years these figures were even more unsatisfactory, one of the worst features of the picture being the relatively high percentages shown in the columns recording the percentage substandard for more than two months of the season.

(b) *Pretoria:* Suppliers to this centre are divided into age categories representing those who could be tested on an 8-hour old morning milk basis, and the remainder whose samples comprised a mixture of morning milk with that from the previous evening milking, the latter being approximately 20 hours old when tested. During the first season some attempt was made to maintain standard, the figures for the summer being 29·2 and 15·0 per cent. of producers (8-hour and 20-hour milk respectively). In the winter the figures were 41 and 41·2 per cent. In the following year 1943-44 signs of deterioration appeared which showed up slightly during the summer months but became quite marked by the end of the winter. The winter percentages dropped from 41 in the previous year, to 33·3 for 8-hour and 9·2 for 20-hour milk suppliers. By the third year 1944-45 the deterioration had become catastrophic in character. Though the fact does not show up in the accompanying tables, some of the failure of the Pretoria producers to maintain standard during 1944-45 was due to a tremendous flare up of bovine mastitis affecting practically all herds under test. On numerous occasions Breed counts were raised to an innumerable level due to the presence of mastitis-type streptococci. Moreover, though the fact did not affect the Breed count, samples were very frequently loaded with pus cells.

(c) *Bloemfontein:* The 19 farmers supplying a pasteurising depot in this town consistently failed to maintain the suggested standards.

(d) *Pietermaritzburg:* A group of about 50 farmers supplying a pasteurising depot in this town put up a far more promising performance than the high veld farmers. After three years of testing and of supervision, 56 per cent. maintained the summer and 69 per cent. the winter standard. In comparing these figures with those of say Johannesburg, allowance must be made for the fact that in Pietermaritzburg only morning milk was tested when 8 hours old and the sample came from a single can and not from the farmers bulk. These points to some extent explain the better results. Incidentally at this centre it proved possible to maintain a very strict military farm inspection service in addition to laboratory control. The value of this inspection is shown by the steady yearly increase in the percentage of farmers who maintained standard. In 1942-43 54·4 per cent. of producers in the summer and 37 per cent. in the winter were substandard for more than two months in the season. In 1944-45 these figures had dropped to 11·7 and 0·6 per cent. for the summer and winter season respectively.

(e) *Umlaas Road:* Like the Pietermaritzburg farmers, those supplying the Umlaas Road pasteurising depot put up a very satisfactory

performance and one which was only surpassed by the producer-distributor group. In 1942-43 the summer and winter percentages of producers maintaining the suggested standard consistently were 55·5 and 85·5 respectively, whilst in 1943-44 the figures were 52·5 and 64. Once again there was an indication of a general lowering of standard of production.

(f) *Durban:* From the rather limited list of farmers supplying pasteurising depots situated in Durban it would appear that the results are better than those of high veld farmers but not so good as those of Umlaas Rd. or Pietermaritzburg. The actual figures for 1942-43 were summer 20·8 per cent. maintained standard and winter 3·3 did so. In 1943-44 the winter percentage was 40 and in 1944-45 the summer and winter percentages were 34 and 37.

Chapter 7.

APPLICATION OF GOOD: BAD RATIO ANALYSIS TO THE METHYLENE BLUE REDUCTASE TEST.

The application of the Good: Bad ratio to the methylene blue reductase test has been worked out as follows:—

The colour reduction time has been divided into categories comparable to the system used for the Breed count.

Colour persisting 4 hours or more	Group	A.
Colour persisting 3½ hours but reduced at 4 hours	,,	B.
Colour persisting 2½ hours but reduced at 3½ hours ...	,,	C.
Colour persisting ½ hour but reduced at 2½ hours	,,	D.
Colour reduced in ½ hour or less	,,	E.

The basal dividing line has been chosen as 3¾ hours (equivalent to the 1,000,000 Breed count) by which it is meant that if the colour is reduced in 3½ hours the result is classed as bad, and if it does not reduce in 3½ hours but persists longer than that then the sample is good. It is assumed that results are only read at half-hourly intervals.

Unfortunately not enough producers have been tested consistently by the reductase method to build up an adequate Good: Bad ratio distribution table comparable to the Breed count in Table 4. For trial purposes therefore the basal Good: Bad ratios of 2 : 1 in summer and 5: 1 in winter have been used. In Table 9 a list is given of producer-distributor methylene blue reductase results analysed as Good: Bad ratios and comparable to the Breed count ratios listed in Table 8. For convenience a direct comparison of results is made in Table 10. In this batch there was close agreement in the summer season between the Breed and reductase results but in the winter there

was a considerable degree of disagreement. It is contended that this difference supports the views:—

(a) That latent defects may exist in milk which are not detectable by the Breed count;

(b) That these defects tend to be uncloaked by hot weather and then become detectable by bacterial count tests;

(c) That the reductase test tends to uncloak these tests even in cold weather.

In Table 11 the performance of 42 raw-milk-shop suppliers is analysed with comparative figures for the two tests. It shows the number of months in each season that individual producers were sub-standard. In this series it appears that the suggested reductase test standards were harder to maintain than the Breed standards. Further support to this supposition is given by another series of comparative tests recorded in Table 12. These results represent the repeated testing of a large number of producers carried out for two months only over 2,700 comparative tests being done. In Table 13A is listed such long-term reductase test results as are available, set out in the same manner as the Breed records of Table 7, and it is quite apparent from these records that the reductase test shows up the same inability of producers to maintain any reasonable standard consistently. The actual questions of the relative values of the suggested Breed and reductase standards will be discussed in Chapter 8, Part I, Paragraph E.

(To be continued.)

TABLE 9.

Monthly Good:Bad Ratio of Producer–Distributor calculated from Methylene Blue Reductase Records.

Producer No.	GOOD : BAD RATIO												No. of months substandard *	
	1943 July	Aug.	Sep.	Oct.	Nov.	Dec.	1944 Jan.	Feb.	Mar.	Apr.	May	June	Summer	Winter
505	6:1	7:1	3:1	7:1	7:1	6:1	1.2:1	6:1	2:0	.	.	.	1	0
507	.	.	.	.	8:0	6:0	8:1	8:0	7:1	6:0	7:1	8:1	0	0
539	6:1	8:0	4:1	8:0	8:0	7:0	9:0	9:0	8:0	6:0	8:0	9:0	0	0
540	6:1	8:0	4:1	7:1	8:1	7:0	3.5:1	2:1	8:0	6:0	8:0	3.5:1	0	1
541	6:1	3:1	4:1	7:1	8:0	7:0	9:0	9:0	7:1	5:1	8:0	8:1	0	1
542	2.5:1	1.7:1	1.5:1	1.7:1	7:1	7:0	9:0	7:1	8:0	5:1	8:0	9:0	0	3
548	.	.	.	2:0	3:1	5:1	9:0	8:1	7:1	4:1	8:0	10:0	0	1
549	.	.	.	.	8:0	2.5:1	7:1	7:1	1.7:1	2:1	3:1	1.5:1	0	3
550	.	.	.	.	7:1	5:1	9:0	8:1	8:0	6:0	7:1	5:0	0	0
551	.	.	.	.	7:0	7:0	9:0	8:0	7:1	6:0	8:0	10:0	0	0
563	.	.	.	.	.	.	0:3	0:8	0:7	0:5	1:4	.	3	2
564	.	.	.	.	.	.	3:1	9:0	1.7:1	5:1	8:0	9:0	0	0
565	.	.	.	.	.	.	4:0	9:0	9:0	6:0	8:0	10:0	0	0

N.B. — * Tentative SUMMER Standard Good:Bad Ratio 2:1. Tentative WINTER Standard Good:Bad Ratio 5:1.

TABLE 10.

Comparison of Breed and Reductase Good:Bad Ratios taken from Tables 8 and 9.

Producer's No. and Test		GOOD:BAD RATIO												No. of Months Substandard *	
		1943 July	Aug.	Sep.	Oct.	Nov.	Dec.	1944 Jan.	Feb.	Mar.	Apr.	May	June	Summer	Winter
505	Br.	7:0	8:0	4:0	7:1	9:0	6:1	1:2	5:1	2:0	.	.	.	1	0
	Red.	6:1	7:1	3:1	7:1	7:1	6:1	1.2:1	6:1	2:0	.	.	.	1	0
507	Br.	.	.	.	.	9:0	6:0	9:0	8:0	8:0	6:0	8:0	9:0	0	0
	Red.	.	.	.	.	8:0	6:0	8:1	8:0	7:1	6:0	7:1	8:1	0	0
539	Br.	7:0	8:0	4:0	7:0	9:0	8:0	9:0	9:0	8:0	6:0	8:0	9:0	0	0
	Red.	6:1	8:0	3:1	8:0	8:0	7:0	9:0	9:0	8:0	6:0	8:0	9:0	0	0
540	Br.	7:0	8:0	3:1	8:0	8:1	8:0	8:1	8:1	8:0	6:0	5:0	9:0	0	0
	Br.	6:1	8:0	4:1	7:1	8:1	7:0	3.5:1	2:1	8:0	6:0	8:0	3.5:1	0	1
541	Red.	7:0	8:0	3:1	8:0	9:0	8:0	9:0	9:0	8:0	6:0	8:0	9:0	0	0
	Red.	6:1	3:1	4:1	7:1	8:0	7:0	9:0	9:0	7:1	5:1	8:0	8:1	0	1
542	Br.	7:0	8:0	4:0	1.7:1	8:1	7:0	9:0	7:0	8:0	7:0	8:0	9:0	0	0
	Red.	2.5:1	1.7:1	1.5:1	1.7:1	7:1	7:0	9:0	7:1	8:0	5:1	8:0	9:0	0	3
548	Br.	.	.	.	2:0	8:0	6:0	9:0	9:0	8:0	5:0	8:0	10:0	0	0
	Red.	.	.	.	2:0	3:1	5:1	9:0	8:1	7:1	4:1	8:0	10:0	0	1
549	Br.	.	.	.	.	9:0	6:1	2:1	7:1	7:1	6:0	8:0	10:0	0	0
	Red.	.	.	.	.	8:0	2.5:1	7:1	7:1	1.7:1	2:1	3:1	1.5:1	0	3
550	Br.	.	.	.	.	9:0	6:0	8:1	9:0	8:0	6:0	7:1	5:0	0	0
	Red.	.	.	.	.	7:1	5:1	9:0	8:1	8:0	6:0	7:1	5:0	0	0
551	Br.	.	.	.	.	7:0	7:0	9:0	8:0	8:0	6:0	8:0	10:0	0	0
	Red.	.	.	.	.	7:0	7:0	9:0	8:0	7:1	6:0	8:0	10:0	0	0
563	Br.	.	.	.	.	.	.	0:3	0:8	0:7	0:5	1:4	.	3	2
	Red.	.	.	.	.	.	.	0:3	0:8	0:7	0:5	1:4	.	3	2
564	Br.	.	.	.	.	.	.	4:0	8:1	7:1	6:0	8:0	9:0	0	0
	Red.	.	.	.	.	.	.	3:1	9:0	1.7:1	5:1	8:0	9:0	0	0
565	Br.	.	.	.	.	.	.	4:0	9:0	8:0	6:0	8:0	10:0	0	0
	Red.	.	.	.	.	.	.	4:0	9:0	9:0	6:0	8:0	10:0	0	0

N.B. — * Tentative SUMMER Standard Good:Bad Ratio 2:1. Tentative WINTER Standard Good:Bad Ratio 5:1.
Br = Breed Count. Red = Methylene Blue Reductase.

Table 11.

Comparison of Breed Count and Methylene Blue Reductase Good : Bad Ratios.

NO. OF MONTHS GOOD: BAD RATIO SUBSTANDARD. ★

Producer No.	1943 – 1944				1944 – 1945				Producer No.	1943 – 1944				1944 – 1945			
	Summer		Winter		Summer		Winter			Summer		Winter		Summer		Winter	
	Red.	Br.	Red.	Br.	Red.	Br.	Red.	Br.		Red.	Br.	Red.	Br.	Red.	Br.	Red.	Br.
500	0	1	3	1	5	3	2	3	523	–	–	–	–	5	0	1	0
501	1	0	2	1	–	–	–	–	524	–	–	–	–	1	0	2	2
502	5	4	5	3	5	3	3	1	525	–	–	–	–	7	5	3	1
503	4	3	4	0	6	5	2	1	526	–	–	–	–	5	4	4	4
504	0	0	1	0	–	–	–	–	527	–	–	–	–	5	3	3	2
506	3	4	1	0	1	0	1	1	528	–	–	–	–	5	3	5	4
508	–	–	–	–	5	2	4	2	529	–	–	–	–	7	5	3	0
509	–	–	–	–	6	5	3	3	530	–	–	–	–	3	0	3	2
510	–	–	–	–	6	3	4	4	531	–	–	–	–	6	4	3	2
511	–	–	–	–	6	3	4	2	532	–	–	–	–	4	0	2	2
512	–	–	–	–	4	1	3	3	533	–	–	–	–	7	5	5	3
513	–	–	–	–	7	3	5	5	534	–	–	–	–	5	1	4	3
514	5	4	3	2	3	5	5	4	535	–	–	–	–	7	6	5	2
515	–	–	–	–	7	6	3	3	536	–	–	–	–	7	3	1	1
516	2	3	2	0	4	2	3	1	537	–	–	–	–	5	2	3	2
517	–	–	–	–	5	0	3	2	538	–	–	–	–	3	3	2	2
518	–	–	–	–	6	2	3	3	543	7	5	2	1	–	–	–	–
519	0	1	1	0	4	0	2	0	544	3	4	1	0	–	–	–	–
520	–	–	–	–	7	5	3	2	545	3	5	1	0	–	–	–	–
521	–	–	–	–	6	1	3	3	546	3	4	0	1	–	–	–	–
522	–	–	–	–	2	1	2	2	547	4	4	2	1	–	–	–	–

N.B. — ★ Tentative SUMMER STANDARD Good:Bad ratio 2:1.
Tentative WINTER STANDARD Good:Bad ratio 5:1.

Red. = Methylene Blue Redactase.
Rr. = Breed Count.

TABLE 12.

Summary of Comparison of Breed Count and Methylene Blue Reductase Good : Bad Ratios.

Month.	Number of Producers.	Number of Producers Substandard according to ★	
		Reductase Test.	Breed Count.
Nov., 1942	126	117	97
Dec., 1942	127	98	92

N.B. — ★ Tentative Summer Standard Good: Bad Ratio 2: 1.

TABLE 13a.

Comparative Summary of Breed Count and Methylene Blue Reductase Good:Bad Ratios on Supplies to Raw Milk Shops (Excluding Producer-Distributors).

Test.	1943 – 1944									
	SUMMER					WINTER				
	Producers tested	★ % maintaining tentative stand.	% Producers Substandard			Producers tested	★ % maintaining tentative stand.	% Producers Substandard		
			One month	Two months	Three months			One month	Two months	months Three
Reductase . .	14	**21.4**	7.2	7.2	64.2	14	**7.2**	35.8	28.5	28.5
Breed	14	**14.3**	14.3	0	71.4	14	**50.0**	28.7	7.3	14

Test.	1944 – 1945									
	SUMMER					WINTER				
	Producers tested	★ % maintaining tentative stand.	% Producers Substandard			Producers tested	★ % maintaining tentative stand.	% Producers Substandard		
			One month	Two months	Three months			One month	Two months	Three months
Reductase . .	35	**0**	5.7	2.9	91.4	35	**0**	8.6	20.0	71.4
Breed	35	**20.0**	11.4	11.4	57.2	35	**8.6**	17.2	37.1	37.1

N.B. — ★ Tentative SUMMER STANDARD Good: Bad ratio 2: 1.
Tentative WINTER STANDERD Good: Bad ratio 5: 1.

TABLE 13.

MONTHLY CORRELLATION BETWEEN BREED COUNT RESULTS AND REDUCTASE TIMES OF PARALLEL TESTS DONE ON SAMPLES OF MILK CLASSED ON THE BREED BASIS AS BEING GOOD AND COMPARATIVELY GOOD.

MONTH / YEAR	1944. JAN.		FEB.		MAR.		APR.		MAY.		JUNE		JULY		AUG.		SEPT.		OCT.		NOV.		DEC.		1945. JAN.		FEB.		MAR.		APR.		MAY.		JUNE	
UCTASE TIME (IN HOURS).	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4	3½	4
E TESTS WITH D COUNTS BELOW 00,000 AND CING IN THE TES SHOWN *	0	97·8	0	99·0	2·0	97·0	7·4	90·4	1·2	98·4	4·5	92·0	5·1	91·9	13·8	76·1	13·2	75·9	38·2	49·1	8·8	74·4	11·5	82·5	12·4	73·5	18·0	58·0	23·1	54·1	13·3	69·3	4·1	93·1	4·2	94·0
E TESTS WITH D COUNTS BELOW 000,000 AND CING IN THE ES SHOWN. *	2·2	92·0	1·3	89·2	4·1	89·6	15·9	79·4	2·7	91·5	8·3	84·3	7·8	79·6	14·8	69·8	15·5	68·1	33·5	46·7	11·4	60·9	13·0	67·0	10·9	54·9	17·5	43·9	19·4	45·8	18·3	60·4	6·6	85·5	6·0	89·9
OF TESTS W 1,000,000	138		149		165		126		189		229		294		156		323		312		430		100		313		292		474		464		365		503	
AL SAMPLES TESTED	230		236		214		154		204		239		374		209		466		587		604		129		511		436		633		572		423		543	

THE PERCENTAGES ARE CALCULATED FROM THE TOTAL NUMBER OF TESTS WITH BREED COUNTS OF (a) UP TO 300,000 and (b) UP TO 1000,000; AND NOT FROM THE MONTHLY GRAND TOTAL OF TESTS, IRRESPECTIVE OF BREED COUNT

DIPHTHERIA AND MASTITIS.

D. H. PFEIFFER, M.B., Ch.B., D.P.H.,
M.O.H. Bloemfontein Municipality,

and

N. F. VILJOEN,
Veterinary Officer, Bloemfontein Municipality.

West Ridge, Tempe, consists of a double row of semi-detached wood and iron dwellings, 34 in number about 5 miles from the centre of the City of Bloemfontein.

Fourteen occupiers are cowkeepers ostensibly producing milk for their own consumption, but, as will be seen later, at least one cowkeeper has illegally supplied milk to other families. These 14 cowkeepers own 18 cows which graze on the adjoining town commonage and are brought home at night for milking under anything but hygienic conditions.

The Outbreak.

First Case: On 5/5/45 there was admitted to the Isolation Hospital, a European male patient aged 3 years, J.J.P., residing at 356 West Ridge, Tempe, suffering from laryngeal diphtheria and on whom a tracheotomy was performed.

A swab examined by the S.A. Institute for Medical Research on 5/5/45 was positive for diphtheria. The swab examined at the Municipal Laboratory was also positive.

Second Case: On 11/5/45 there was admitted to the Isolation Hospital a European female aged 5 years, J.L.R., residing at 177 West Ridge, Tempe, suffering from diphtheria. Throat swab positive.

Third Case: On 15/5/45 a European male aged 2 years, P.P., was admitted from 356 West Ridge, Tempe. Throat swab positive.

Fourth Case: On the 25/5/45 there was admitted to the Isolation Hospital, a European female child, aged 11 years, M.v.V., residing at 188 West Ridge, Tempe, suffering from diphtheria. Throat swab positive.

Steps were taken to prevail upon the residents living in this area, and not previously immunized, to submit themselves to preventive inoculation against diphtheria, and a fair number presented themselves on 16/5/45.

As milk is known to be a common vehicle of spread, attempts were made to trace the source of the milk supply in each particular case, but it was found that the residents were unwilling to disclose the source

of their milk supply, and after three attempts, we were informed that condensed milk was being consumed.

We were of the opinion that quite a number of the residents in West Ridge, Tempe, were obtaining milk supplies from one or more of the 14 abovementioned cowkeepers, but it was not possible to obtain definite information until the last patient was admitted to the Isolation Hospital on 25/5/45, from whose information we gathered that the households concerned had been obtaining limited milk supplies from a Mr. V.L.O., residing at 194 West Ridge.

Mr. V.L.O. has since admitted that he had on occasions supplied milk to some of the families in question. It was therefore deemed advisable to examine all the cows in West Ridge. This inspection was made by our veterinary surgeon, Dr. N. F. Viljoen, in conjunction with members of the Municipal Health staff on 28/5/45 and all the milk examinations were carried out in the Municipal Laboratory. Eighteen cows were examined. Of these, 2 cows showed chronic mastitis. The one cow a Friesland, "Bontrok" belonging to Mr. V.L.O., showed mastitis in the right hind udder quarter. The other cow, of mixed origin, "Kolletjie," belonging to J.G.C.S., showed mastitis in both hind quarters. We could obtain no confirmation that milk from this cow had been supplied direct to any of the families in whose households diphtheria had occurred.

There being no visible external ulceration, swabs were taken from the exudate obtained from the 3 infected quarters of the 2 cows. None of the mastitic quarters was being milked, but one of the quarters was actually secreting pus.

FINDINGS.

"Bontrok."

(a) A 24 hour culture on Loeffler inspissated blood serum showed organisms morphologically indistinguishable from C. diphtheriæ.

(b) A virulence test was performed using 2 guinea pigs of 400 grammes each; the protected guinea-pig receiving, in addition to 0·5cc. of a saline culture suspension, 4,000 units P.D. & Co. concentrated Diphtheria Antitoxin. The unprotected animal died within 36 hours — the protected animal survived and was only killed 3 weeks later — virulence test positive.

"Kolletjie."

(a) A 24 hour culture on Loeffler inspissated blood serum showed organisms morphologically indistinguishable from C. diphtheriæ.

(b) A similar virulence test was performed, using 2 guinea-pigs of 360 grammes each — the protected animal surviving, whilst the unprotected animal was dead within 48 hours — the protected animal was killed after 3 weeks — virulence test positive.

In view of the above findings, an attempt was made to trace the possible source of infection in the two cows, by swabbing the throats of every member of the two households owning the cows. None was found positive. We did, however, ascertain that on occasions, the two cows had a common milker; flies too might, under the prevailing conditions, possibly have conveyed the infection.

All users in West Ridge, Tempe, were advised to boil their milk supplies pending further instructions and our findings were reported to a special meeting of the Public Health Committee of the Bloemfontein City Council, recommending that action be taken in terms of Section 33 of the Municipal Dairy Regulations which reads as follows:

" If it appears to the Public Health Committee on the certificate of the Medical Officer of Health, that the consumption of any milk or milk products from any source within or outside the Municipality is likely to cause the outbreak or spread of any infectious or contagious disease, the Public Health Committee may forthwith prohibit the introduction, distribution, storage, sale or use within the Municipality, of such milk or milk products for a period to be specified by such Committee, and any person introducing or distributing or storing or selling or using within the Municipality, any milk or milk products in contravention of this prohibition shall be liable to the prescribed penalties."

The period which was recommended was " until such milk could be regarded as free from Diphtheritic infection."

The official notice addressed to each of the two owners, reads as follows—:

„Aangesien die Komitee vir Openbare Gesondheid, Mark en Maatskaplike Welsyn, die mening toegedaan is dat die melk van u koei moontlik Witseerkeelbesmetting kan te weeg bring is ek deur die gemelde Komitee gelas om u, kragtens Artikel 33 van die Melkery Regulasies, te verbied om sulke melk vir menslike verbruik te gebruik, totdat u dit kan bewys dat die melk van die betrokke koeie vry van Witseerkeelbesmetting beskou kan word."

The reason for fixing the period as above was the result of discussions which the authors had with one of the Government Veterinary Officers in Bloemfontein and with Dr. B. M. Horwitz, the Veterinary Officer, employed by the Cape Town Municipality who happened to be in Bloemfontein at the time.

All were of the opinion that the possibility of permanently curing the 2 cows under the prevailing conditions and with the facilities available, would be remote. It was our considered opinion, therefore, that in the interests of public health the City Council should purchase the two infected animals, for slaughter, at a mutually agreed price — there being no provisions in the Stock Diseases Act for otherwise dealing with such infected animals.

Mr. V.L.O. was willing to dispose of his animal for £30, whilst Mr. J.G.C.S. was prepared to accept £25.

These values were considered too high for animals suffering from mastitis, whilst the question of creating a precedent required very careful consideration.

Negotiations were therefore entered upon between the City Council and the respective owners who, after a stormy interview agreed to the removal of the infected animals to the Municipal Stables for further investigation, which was carried out by Dr. Viljoen on 15/6/45. Culture again positive. In the case of one of the cows, namely "Kolletjie" from one of the infected udder quarters organisms morphologically indistinguishable from C. diphtheriæ were isolated.

The following letter was thereupon addressed to the owners: —

" Met betrekking tot my brief aan u van 1 deser, is my opgedra u mee te deel dat verdere toetse gemaak is, wat die vorige bevinding, betreffende die gevaar van besmetting soos reeds aan u meegedeel, bevestig. Ons moet derhalwe herhaal dat die bepaling van Artikel 33 van die Melkery Regulasies nog toegepas moet word.

Dit word in belang van die openbare gesondheid wenslik geag dat u koeie geslag word. By ontvang van 'n brief van u dat u hiermee instem, sal ek namens u by die Vleiskontroleur hiervoor aansoek doen en by ontvangs van die nodige permit, sal die koeie namens u en vir u eie voordeel geslag word.

Geliewe my dadelik in kennis te stel of u verlang dat ek namens u by die Vleiskontroleur aansoek moet doen vir die slag van u koei."

The respective owners thereupon agreed in writing to the slaughter of the two animals which was carried out under permit from the local representative of the Meat Control Board at the Municipal Abattoir on 21/6/45.

No other disease was found present except in the udders which in both cases showed a septic mastitis. The teats of the infected quarters were atrophied and also showed a thickened endothelium.

The cow " Kolletjie " whose owner valued her at £25 made grade 3 and he received £9.3.3.

Since the admission of the last case of diphtheria to hospital on 25/5/45, and the taking of the foregoing measures, no further cases of diphtheria have been reported from West Ridge, Tempe.

SUMMARY:

(1) An outbreak of diphtheria in a localized community is recorded.

(2) An associated infection of diphtheritic mastitis in two cows belonging to owners in this area is described.

(3) The absence of provisions in the Stock Diseases Act to deal with such cases is mentioned.

CONCLUSIONS:

(1) The connections between an apparent simple mastitis in cows and human diphtheria should not be overlooked when investigating an outbreak of diphtheria.

(2) The provisions of the Stock Diseases Act should, in our opinion, be extended to embrace all infectious and contagious diseases transmissible from animal to man, so as to avoid the laborious procedure described in this report.

ABSTRACT.

THE STERILIZATION, USE AND CARE OF SYRINGES*

This pamphlet, itself a summary, should be read in the original by all veterinarians who wish to reduce to an absolute minimum the "accidents" that occasionally occur after subcutaneous of intravenous medication.

Complete bacteriological sterility can be achieved only by sterilization in the autoclave or in the hot air oven, because boiling cannot be relied upon to kill spores. However, since accidents due to spore-bearing bacteria are rare, a boiled syringe may be accepted as reasonably safe.

Procedure in the Consulting Room:

Syringes and needles must be *thoroughly* cleaned before being boiled. This will involve adequate rinsing under tap water and the use of the stylet in the needle, but some syringes may have to be scrubbed with warm (not hot) soapy water. Syringes containing traces of pus, blood, serum, or tuberculin must be cleaned before being placed in the sterilizer.

An electrically-heated sterilizer is very satisfactory and should be provided with a perforated, raisable tray. The water must be soft (rain or distilled water) otherwise chalk will be deposited. The syringe and needle are boiled for *at least 5 minutes.* The lid is then removed and the tray containing the syringes is lifted out (preferably with sterile forceps) and placed in the lid. The water in the sterilizer is poured off, the tray returned and the lid replaced.

When the syringe is cool and dry, the barrel, piston and needle are assembled with *sterile* forceps or clean, *dry* fingers, care being taken to touch only the outside of the barrel and the head of the piston. The assembled syringe should be replaced in the empty sterilizer and should remain there until required.

*"The Sterilization, Use and Care of Syringes" by a Committee appointed by the Medical Research Council, Medical Research Council War Memorandum, No. 15, 1945. (H.M. Stationery Office, pp. 23. Price 4d.)

Disinfection by alcohol:

Sterilization by alcohol cannot be recommended, because its action is slow and it cannot be guaranteed to penetrate crevices and corners or to destroy spores. It is justifiable to disinfect with alcohol only when *all-glass* syringes employed only for the purpose of injecting sterile fluids, such as insulin, are used. The syringe and needle should be clean and immersed in 70 - 75 per cent. v/v alchohol for at least 5 minutes. The alcohol should not be used for more than a few times in succession. The common practice of attempting to disinfect a syringe by alternately filling it with spirit and discharging is to be condemned.

Other points brought out in the report are — separate marked, syringes should be used for tuberculin, serum (anti-toxin), sterile fluids, and for the aspiration of pus.

If pus, infected blood, or other contaminated material has entered the syringe, the syringe should be immediately washed with a *cold* solution of 2 per cent. lysol.

Care should be taken to sterilize the surface of the rubber caps of rubber-capped bottles before the needle is introduced (tincture of iodine or 75 per cent. v/v alcohol). A useful rubber-capped bottle is depicted (Makers: Britton Malcolm & Co., Southwark Bridge Road, London, S.E.) in which the rubber cap is in constant contact with a pad impregnated with a 10 per cent. solution of chloroxylenol contained in a Bakelite screw cap.

The care and sharpening of needles, mass injections and a syringe service for a hospital are dealt with.

[NOTE BY ABSTRACTOR]:

The memorandum does not deal with the sterilization of syringes to be taken by a practitioner on his " rounds." This presents practical difficulties in the absences of an autoclave or hot air oven, but the following is suggested as a reasonably safe method. The requisite number of syringes, marked for the injection of sterile fluids, serum or for aspiration, together with needles, test tubes, rubber stoppers, and cut down rubber stoppers are boiled. They are dealt with as previously described. When everything is dry, a cut down stopper is introduced to the bottom of a test tube, the assembled syringe is introduced needle downwards and a rubber stopper pressed in so that it holds the syringe firmly.

If a sterile syringe is used it is but commonsense to inject the medicament through sterile skin, or at least through clean skin. This demands the removal of hair, the application of a disinfectant and *a lapse of time for the disinfectant to act.* In dogs a relatively hairless clean site, seldom, in the abstractor's experience, used in South Africa for subcutaneous injection is the groin. The disadvantage is that the animal has to be " cast " and held. J.H.M.

THE BRUCELLOSIS PROBLEM.

E. M. ROBINSON,
Onderstepoort.

From time to time it serves a useful purpose to review the more recent work on a subject. The writer has previously reviewed the work done on brucellosis on more than one occasion and feels that the time is opportune to review the latest work on the subject, more particularly with reference to methods of combating the disease. Contagious abortion has become very widespread in South Africa and it is safe to say that very few farms in some parts of the country, such as the Transvaal bushveld, are free from the disease. Our agglutination test records show what a wide distribution the disease has and what little progress we have made in our fight against it. Our policy in the past has been to encourage farmers to adopt the policy of testing, with isolation or slaughter of reactors. Where this policy could not be carried out, vaccination was recommended after it had been definitely determined that the disease existed on the farm. The isolation policy has not proved very successful and in view of the success which has attended the use of vaccination, particularly during calfhood, in the United States of America, it has been decided to recommend vaccination on a big scale.

Crawford (1944) mentions that in the United States of America the isolation method with slaughter of reactors was attended with some degree of success during the period when there was a surplus of cattle, but with much less when the surplus disappeared and replacements were more difficult to obtain. In Great Britain the policy has not been very successful, chiefly on account of reinfection after herds had been cleaned up, due frequently to laxity in continuing testing.

Crawford states that during the ten years the test and slaughter policy has been followed the incidence of the disease was reduced by about 50 per cent. With the entry of the United States into the war, slaughter of reacting cattle was discontinued as all the surplus cattle were required, particularly for dairy products. The personnel to supervise the scheme was no longer available, but the framework of the Federal State Control programme is still intact and it is hoped to resume it, with modifications, in the post-war years.

The eradication scheme was commenced in 1934 and was termed " The Federal State Co-operative Programme for the Control of Bang's Disease." Most of the states came in under it and there was at that time an estimated incidence of 10 per cent. of infection. The scheme was at first voluntary but later on " the area plan " of eradication was

adopted. For a country to become " modified accredited " the incidence had to be reduced to not more than 1 per cent. of the total cattle population, and not more than 5 per cent.of the herds should show infection. In April, 1944, out of 3,070 counties, 591 in 22 states were on the " modified accredited " list.

At present there are three control schemes in existence under the aegis of the U.S.A. Bureau of Animal Industry. These are as follows:

(A) Test with slaughter of reactors.

(B) Test with slaughter, combined with calfhood vaccination.

Under both these schemes an indemnity was paid for the slaughtered animals.

(C) Test with retention of reactors, with calfhood vaccination. Under this scheme the reactors are eliminated when vaccinated replacements become available.

Under scheme (A) which was the basis of the " modified accredited herd " scheme 386,000 herds with 5,235,000 cattle were concerned, 4 per cent. of reactors were found, but actually 75,000 of these were not killed but were retained in the herds, and calfhood vaccination was adopted. 392,000 Calves were vaccinated under supervision, many more without any.

Scheme (B) was a very acceptable plan. Along with the eradication of reactors, a resistance to reinfection is acquired through the calves as a result of vaccination over a few years. It is valuable in localities where there is a relatively high incidence of infection.

The (C) scheme permits the retention of productive reactors until vaccinated replacements are available. It is known that some reactors become negative in 2 to 4 years, so can be kept in the herd permanently. The addition of negative replacements to herds under test is known to be risky. The residual herd consisting of the more resistant animals may remain free from infection while the replacements may become infected and abort.

Miller, Wight and Crawford (1944) mention that the test and slaughter method involved the destruction of 2,000,000 cattle. From the disease control point of view it was not free from criticism. It was not very well suited to ranching conditions and the disease reappeared in up to 5 per cent. of the herds. In dairy herds it is still a very useful method if milk has to be supplied from non-reacting cows and is most valuable where the incidence of the disease is low. It could be used where infected animals are kept until vaccinated replacements are available.

Calfhood Vaccination.

Robinson (1942) reviewed some of the work done on vaccination of calves against contagious abortion. Mention was made of an experiment conducted in the United States from 1936 - 1940 in 260 heavily infected herds, where the calves were vaccinated. Only 1 per cent. of the calves aborted later, during adult life, as a result of exposure to

infection. Four years after the experiment was concluded it was found that out of 220 of the herds, 179 were still in existence. The owners were continuing calfhood vaccination and were pleased with the results.

Bonynge (1942) gives the results obtained with calfhood vaccination in certified herds where the testing scheme had been carried out for some years with severe breakdowns in some cases. In 1939 in a herd of 1,000 cattle a calfhood vaccination scheme was commenced. At the time the reactors averaged ·37 per cent. In 1940 there were 28 reactors. In 1941 there was only 1 reactor in three herd tests. As a result, other large dairies had commenced calfhood vaccination.

From experience in various countries there is little doubt that calfhood vaccination will greatly reduce the incidence of infection. At ages earlier than four months the response to vaccination is progressively poorer the younger the animal. The next point to consider is the effect of vaccination on heifers and adult cows.

Vaccination of Adult Cattle.

All the evidence points to the resistance developed by adult cattle after vaccination being equal to if not better than that in calves. In the United States many whole herds have been vaccinated with satisfactory results. The only real drawback to it is that in adult animals the reaction to vaccination may persist for some time, making it impossible to carry out any testing and isolation scheme in conjunction with it. Vaccination of adult cattle in outbreaks of contagious abortion in beef cattle and under ranching conditions has found much favour. The infection of the cattle is of little danger to human beings.

Vaccination of Pregnant Cows.

Experimental evidence has shown that there is an element of danger in vaccination of pregnant cows as abortion may result, though it is usually only in a few cases. There is one experiment on record where 23 out of 60 pregnant vaccinated animals aborted. The vaccination was done at 5 to 6 months. The general finding is that it is more dangerous to vaccinate late in pregnancy. In an experiment at Onderstepoort 8 cows in advanced pregnancy were vaccinated and all calved normally except one which had a calf born dead at full term. The vaccine strain was isolated from the stomach of the calf.

Although vaccination of pregnant cattle should not be encouraged and should be avoided if possible, the position does sometimes arise where wholesale vaccination has to be done. Where this is carried out the results vary somewhat. If the disease is just commencing in the herd, losses usually stop, but in any case losses are greatly reduced after a year. Adult vaccination should not be practised in negative herds. Whole herd vaccination should only be undertaken where other methods fail. It is recommended as advantageous in (1) incipient infection (2) beef herds where the crop is of primary importance and

cows are not in calf or only in early pregnancy (3) problem herds, where the disease has recurred (4) large infected dairy herds where calves are not kept and there is a constant exchange of animals. In this latter case all replacements should be vaccinated.

Calfhood Vaccination in Comparison with Adult Vaccination.

The average cattle owner is primarily interested in obtaining a normal calf crop and it is unimportant to him if he has some reactors to tests. Where there is exposure to infection a large percentage of heifers in their first pregnancy will abort. Calfhood vaccination takes some years to produce its full effects in a herd so there is a tendency to go in for whole herd vaccination.

The Vaccinated Animal as a Source of Infection.

Crawford (1944) mentions an experiment where a pregnant cow was inoculated intravenously with a dose of the vaccine strain about twenty times as large as the vaccine one. Abortion resulted and the vaccine organism was isolated from the foetus and reinoculated into another pregnant cow which again aborted. This was done in a series until seven cows had been inoculated and aborted. At each abortion, which took place in a small enclosure, one or more susceptible pregnant cows were placed in contact with the infected animal, exposure to infection being made as marked as possible.

In all, 9 pregnant susceptible cows were added but none became infected. All 16 of these cattle again became pregnant in the same enclosure and all calved normally. In the 7 vaccinated animals the organism could not be found at the second calving, showing that it had been completely eliminated. In practice there have been hundreds of instances where calves were vaccinated in clean herds and no infection occurred.

Stability of the Vaccine.

A number of experiments have been carried out in the attempt to increase the virulence of the vaccine strain but without success. On account of the fact that the vaccine contains living organisms it will not remain effective for long, as the bacteria die off. Recently a time expiry date of 3 months has been put on the vaccine for issue in the United States of America. A good deal of work is being carried out at present in the attempt to find a preservation method capable of practical application for use with the vaccine. Dried vaccines are being tried, made by lyophilization and the results are promising.

Persistence of Immunity in Vaccinated Cattle.

It is not definitely known how long immunity after vaccination will persist. In a big field test in the United States, involving 260 herds, the abortion rate became lower every year during the seven years of its duration. This fall may to some extent be explained by the decrease in exposure through recoveries from the disease and the

augmentation of the resistance of vaccinated animals by contact with reactors.

Crawford (1944) mentions that in the United States, breaks in immunity have occurred in vaccinated herds after six to nine years. There were herds in which test and slaughter was practised but later calfhood vaccination was carried out. The breaks occurred in older animals. The indication is that immunity diminishes. In the field trials where there was constant exposure to infection, immunity persisted for at least six years.

These observations would indicate that a second vaccination at some period not yet determined, should be given. In Great Britain a second vaccination in heifers inoculated as calves is recommended just after the first calving (Cattle at the Cross roads, 1944).

Experiments are now in progress in America with cattle vaccinated as calves and exposed to infection at the third, fourth and fifth pregnancies, being kept uninfected in the meantime. These experiments should yield valuable information.

Birch, Gilman and Stone (1944) record the results of an interesting experiment carried out by them in which 157 cows were used, with 91 controls. The animals were put into the experiment in different lots over six pregnancies and the exposure to infection was made by contact with infected animals which spread a large amount of infected material about at abortion in a special barn. After calving or abortion the vaccinated animals and controls were removed. They concluded from the experiment that vaccination produced an immediate reduction in losses and a valuable protection. Despite a few failures, vaccination prevents, delays or mitigates a high percentage of brucellosis.

It is more effective in delaying the development and softening the effects of infection than actually preventing it. Half the vaccinated animals in the experiment eventually acquired infection and became spreaders of it without actually showing as a group any outward manifestations of the disease. An advantage is the delaying of infection to later pregnancies but the chief one is the aid in establishing clean herds.

It is doubtful whether brucellosis can resist the combination of calfhood vaccination and carefully applied sanitary measures with the eventual elimination of stray reactors. A great advantage of vaccination lies in preventing even ordinary exposure. Vaccinated animals are semi-immune, but are less likely to succumb to small infective doses than susceptible ones. Vaccination probably prevents much natural infection and is therefore a valuable sanitary measure. It also has dangers as a sanitary measure as it may lead to the production of unsuspected and unidentified spreaders of the disease if it is the only one applied. These are a menace to herds into which they are moved or to animals introduced into the herd.

Huddleson (1942) in a review on immunity in brucellosis discusses resistance in calves and states that it has been shown that calves of uninfected cows show just as much natural resistance as do those from infected ones. He quotes an experiment in which 56 calves from infected cows were kept under observation until maturity and none became carriers. It is known however that a small percentage of calves do become infected during calfhood and remain infected in maturity. Non-pregnant cows and heifers have a strong resistance to infection and rarely become permanent carriers after infection. The resistance remains after exposure to infection in the second pregnancy, probably as a result of the previous exposure.

Some cattle probably have a marked natural resistance as in a big dairy herd observed over some years, 18 per cent. of the cows remained uninfected in spite of heavy exposure to natural infection.

In natural cases of infection the agglutination titre of the serum, if followed over a number of years, will only be found to become negative in about 8 to 10 per cent. of the animals. Huddleson remarks that a method for accurately testing immunity in contagious abortion has not yet been devised.

Other Vaccines.

Edwards, de Ropp and McLeod (1945) describe some tests carried out by them with McEwen's vaccine strain Br. abortus 45/20. This strain is a rough one and does not cause agglutinin production. McEwen claimed good results in cattle inoculated with a vaccine made from it. In the tests quoted ten heifers vaccinated before pregnancy were ex-exposed to infection when pregnant, with 150,000,000 organisms of a virulent strain. The virulent strain was isolated from the milk and colostrum of six. One of these aborted and one had a premature calf, so 9 living calves were obtained. Two living calves were obtained from the nine controls.

With a smaller test dose using 8 vaccinated heifers, 7 living calves were obtained. In the control group of 9 there were 3 premature calves but all nine calves survived.

An interesting observation made was that in 11 non-pregnant cattle vaccinated with this strain the organism persisted for up to 80 days in the tissues of 4 of them.

In nine lactating cows vaccinated with this strain before service, Br. abortus was isolated from the colostrum and afterbirth of five after calving and was fully virulent. The suggestion is made that the strain had become virulent in the tissues. If this was the case then the vaccine is dangerous.

Beach, Irwin and Ferguson (1942) carried out experiments with "ceased reactors" which were re-exposed to infection. Only one out of sixteen of these animals aborted on exposure to natural infection and one became infected but calved normally. It was concluded that an active immunity persisted and was of relatively long duration.

There are a few common questions on vaccination which are often asked. They are:— (1) Is it necessary to do a blood test of the calf before vaccination? It is not at all essential. (2) Is it necessary to do a blood test after vaccination? The only value is to prove that the animal has been vaccinated and is not an indication of immunity. (3) Is vaccination of a 4 months old calf as effective as that of an 8 months old one? The older the better, 6 months being probably the most satisfactory age. Vaccination at 1 month is not very effective. (4) Is vaccination of calves in a clean herd safe? Yes. (5) Should vaccinated calves be identified? It is advisable. (6) Should bull calves be vaccinated? Yes if they are to be retained or used as sires later. (7) Should reactors be vaccinated? It serves no useful purpose.

In dealing with the subject of brucellosis in general, a number of papers of interest have been published recently. Seit (1944) refers to an outbreak of contagious abortion traced to a certain bull which had been used for artificial insemination. From the semen of this bull 921 cows were inseminated but only a few of a lot of 49 inseminated over a period of two days became infected. The infection in the bull was transitory and at post mortem four months later, infection could not be traced but signs of a previous inflammation of the left ampulla were seen.

Emminger and Schalm (1943) showed that milk samples from infected udders did not differ significantly from those from normal ones. No gross lesions were observed in the udders, but histopathological changes were noted in 17 out of 19.

Hofstad (1942) states that when the infection of the udder is low, less than 100 organisms per cc. of cream, changes in the milk are slight or absent. Changes occur when the count is high. In a highly infected quarter lesions occur in the intra-alveolar tissue. They consist of focal areas with marked infiltration with mononuclear and polynuclear leucocytes.

Thomsen (1943) considers that the part played by the bull in the spread of the disease is negligible. Four bulls excreting Br. abortus in their semen were used to serve twenty-seven uninfected heifers. No infection resulted in any of the heifers. Three bulls were used to serve a group of 22 heifers immediately after the bulls had served a recently aborted cow which was excreting Br. abortus in the uterine discharge. None of the heifers became infected.

Danks (1943) records a case of a bull inoculated at 6 months old with Br. abortus strain 19, which developed swelling of one testicle some months later. A strong reaction to the agglutination test developed. The testicle was removed and cultures of Br. abortus obtained from it. As gross lesions did not develop in guinea-pigs inoculated with the cultures, it was concluded that they were of the vaccine strain.

Pagnini (1939) investigated the possibility of fowls playing a part in the spread of brucellosis. Cultures were fed to fowls daily for seven days in large doses. They reacted to the agglutination and 6 out of 50 guinea-pigs inoculated with faeces developed brucella infection. It did not appear in the eggs. It was concluded that fowls are unimportant as spreaders of the infection.

Selmi (1941) records the occurrence of positive agglutination reactions in 7 out of 35 wild rabbits captured in one of the Royal Game Preserves in Italy.

Milunoric (1941) tested 300 dogs by serological methods 260 being country dogs and the rest included clinic patients; nine of the former and two patients reacted positively.

Hedström and Olson (1943) examined 1717 blood samples from horses, sent in for pregnancy diagnosis. Only five gave positive reactions. Material from 85 cases of poll-evil and fistulous withers. In 36 brucella organisms were isolated and 43 reacted positively. Olson investigated 45 cases of poll-evil and other similar conditions in horses. Of these, 32 were associated with Br. abortus.

Fulton (1941), in discussing undulant fever in man, mentions that Br. abortus may survive in sterile milk for 18 months in a refrigerator and 10 months at room temperature. In sour milk it did not survive 5 days. It survived for 13 months in unsalted butter and for 6 and 7 months respectively in butter containing 2·1 per cent. and 1·7 per cent. of salt.

Mitchell and Moore (1942) determined the effect of storage on Br. abortus strain 19. The effect of pH, various containers, temperature conditions, desiccation and suspension in saline or distilled water were tried. The results indicate that a much higher percentage of organisms remain viable for a longer time when the vaccine is adjusted and buffered to a pH between 6 and 7 and stored at 1° c. Freezing and drying under the conditions described are rapidly fatal.

Love and Mingle (1942) showed that with strain 19 a pH of 5·9 to 6·8 maintained viability for 9 months, 6·3 being the optimum. Concentration of the bacilli was less important. Buffered 0·85 per cent. saline was the best solution. Temperature was found to be very important and the necessity for refrigeration at all times was emphasized.

In this article an attempt has been made to review some of the more important articles on contagious abortion which have appeared in recent years, and to put the subject into perspective. The chief problem has been the establishment of a satisfactory immunity in the disease and the articles reviewed have mainly dealt with vaccination, which it is hoped will enable contagious abortion in all countries to be brought under better control.

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CASE REPORT.

TWO UNUSUAL CASES OF STRYCHNINE POISONING.

L. W. VAN DEN HEEVER,
Pretoria.

Recently I was called upon to do a post mortem examination on two dogs which had died under unusual circumstances. The two dogs belonged to different owners living far apart. The second case occurred ten days after the first.

The first case was that of a male Dobermann, aged eighteen months. The owner had not noticed anything unusual about the dog and had seen it go into the street, where it had remained for a few minutes. It then returned, jumped over a two-foot wall, ran a few yards, gave a short cry and fell down dead.

A post mortem examination revealed a severe haemothorax, with an extensive subpleural haemorrhage in the precardiac mediastinum. In spite of a careful search, no defects could be found in the walls of the larger vessels concerned. The rest of the post mortem was negative. Specimens of the stomach, its contents, and the liver were sent to the Toxicology Department at Onderstepoort, and the report came back " positive for strychnine."

The second case was that of a Sealyham, four years old, which had been left in a room by its owner for a few minutes. On his return, it was found to be breathing rapidly and it died a few minutes later.

The autopsy was very similar to the previous case, also revealing an extensive haemothorax, with the exception that the origin of the haemorrhage could not even approximately be determined. The rest of the post mortem showed nothing unusual. Liver and stomach specimens examined by the Toxicology Department at Onderstepoort, contained large amounts of strychnine.

COMMENT.

It is notable that, if one can rely on the history given by the respective owners, none of these two dogs showed any of the typical symptoms of strychnine poisoning. Both showed severe intra-thoracic haemorrhage, which however could not be accounted for. I consider the haemorrhage to have been the immediate cause of death. Had the dog shown any tonic spasms, one could have explained the haemorrhages as resulting from rupture of one or more vessels during the strain of such a spasm. Careful inquiry has ruled out this possibility. One has to bear in mind, that the jump over the wall, though improbable, could have caused the mediastinal suggilation. The presence of strychnine in appreciable quantities, even if one remembers the role of coincidence in these cases provides food for thought and speculation.

CASE REPORT.

HYPERMASTIA, SHOWING UNUSUAL FEATURES, IN A HEIFER.

J. S. WATT,
Johannesburg.

The accompanying photographs illustrate a most unusual case which came to my notice.

The subject was a three-year-old heifer which was first seen by me on the farm Merino in the Windhoek district. She had a fairly well-developed udder situated on the middle of her back, but as she was of a very wild disposition it was not possible to examine her closely.

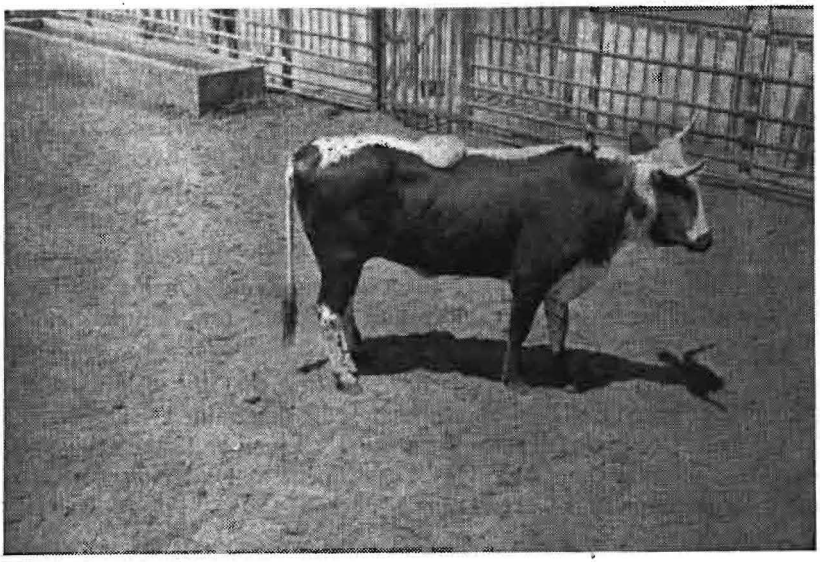

Fig. 1(a).

Subsequently she was consigned to market with a batch of oxen and the owner was asked if he would be prepared to present her to Onderstepoort, and this he agreed to do. However, the Director considered that the expense of getting her there could not be justified. The owner then decided to slaughter her in Windhoek. An examination carried out after slaughter showed that the udder was composed of mammary tissue and that it was loosely attached over the dorso-lumbar region. Three rudimentary nipples were present, each associated with mammary tissue. Two of these nipples can be seen in the photographs. This tissue was surprisingly well developed, even when compared with

the degree of development one would expect in a normal udder of a heifer of this type.

In the inguinal situation there were small nipples, but glandular tissue if present, was so poorly developed as to be invisible macroscopically. Its place was taken by fat. Microscopic examination was not carried out.

Fig. 2(b).

Examination of the genital organs failed to reveal any abnormality, but as these cattle were kept under ranching conditions this heifer had not been bred, as it was considered that she would not have been capable of rearing a calf.

EDITORIAL COMMENT.

When considering this anomaly, difficulties arise to account satisfactorily both for the degree of development of the heterotopic udder, and its site. Regarding the former point, the common observation of hypoplasia of the super-numerary structure — commented upon by

Burckhard (1897) in respect of supernumerary teats — appears reversed. One could argue that the supernumerary anlage, in this case far removed from the normal mammary region, had a more favourable developmental environment, unhampered by inhibiting influences emanating from the normal developing gland. It thus probably had a longer "specific critical period" during which it could make full use of the forces of growth and differentiation. Similarly, if one could conceive of a medio-lateral axial gradient, as to some extent appears borne out by the development of the hairy coat, this site of the abnormal udder is a favoured one.

When the peculiarity of the site itself is considered, one is at a greater loss for an explanation. Records of hypermastia and hyperthelia in the cow always concern structures closely associated topographically with the milk line of the embryo, being either cranial or caudal to the normal udder, or intercalated between its fore and hind quarters. One is tempted to compare the topographical features of this heterotopic udder with those of the mammary glands as sketched by Murray (1908) for the mouse, and by Turner (1939) for the mouse and rat. In these species there are dorso- lumbar extensions of the abdominal mammae, almost meeting in the midline over the back. These extensions, however, arise from mammary sprouts developing in the embryonal milk line, and no matter what their extent, they are primarily abdominal in position.

The only alternative is to regard this case as one of unequal conjoined, pygopagous twinning. The unusual features are then easily explained as being due to a parasitic, very unilaterally developed twin. The lumbar region is by no means unknown as an area of attachment of parasitic twins in cattle. The case described by Turner (1936), where a complete, well-developed udder and some other structures were attached to the dorso-lumbar area, constituting a pygopagus parasiticus, makes it feasible that the explanation of the above case might be found in an extreme form of unilateral development affecting a parasite of this type.

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OBITUARY.

JAMES CHALMERS.

The death of Mr. James Chalmers, M.R.C.V.S., occurred in Johannesburg on Friday, 2nd November, 1945. (1945)

Mr. Chalmers, a graduate of the London College, obtained his diploma in 1900 and came to South Africa with the British forces at the time of the South African War. He joined the Veterinary Division of the Transvaal Department of Agriculture in 1903, and when Union took place was transferred to the Union Department of Agriculture.

He retired from Government service in 1930 on reaching the age limit and took up private practice in Johannesburg. In addition he held the appointments of Veterinary Officer to the South African Institute for Medical Research and Quarantine Officer for the outlying territories — Swaziland, Rhodesia, South-West Africa, and Bechuanaland.

In spite of the serious physical disability of rheumatoid arthritis, Mr. Chalmers was always cheerful and active, and managed an extensive practice in addition to his other duties. His death at the age of 70 removes from the ranks of South African veterinarians a man of wide experience and varied interests — a loss the profession can ill afford.

He is survived by his widow, a son and a married daughter, to whom the profession extends its sincere sympathy.

SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION.

Council Meeting held at Velra House, Pretoria, on 22nd October, 1945, at 8 p.m.

Present: Col. C. J. van Heerden (Chairman), P. S. Snyman, P. J. du Toit, E. M. Robinson, A. C. Kirkpatrick, J. G. Boswell, A. D. Thomas, R. Alexander, J. H. Mason, D. G. Steyn, A. M. Diesel and S. W. J. van Rensburg (Hon. Sec.-Treas.).

(1) *Minutes* of meeting held on 23rd August, 1945, were read and confirmed.

(2) *Arising from these minutes:*

(a) *Doping of racehorses:* Dr. Alexander submitted the report by the Sub-Committee appointed to investigate this question. The following recommendations by this Committee were unanimously approved of:—

A. That it be a recommendation of the Council of the South African Veterinary Medical Association to veterinarians in South Africa:

i. That the following drugs, namely: strychnine, caffeine, cocaine, novocaine, heroin, and coramine be not prescribed for racehorses in training for administration within 48 hours prior to a race in which the horse is engaged.

ii. That if it is considered necessary to prescribe these drugs for administration within that period the local executive be advised of the action taken.

iii. That the attention of veterinarians be directed to the extreme dangers attendant upon the indiscriminate use of hormone therapy, which should be prescribed only with the greatest care.

B. It is a recommendation to the Pharmaceutical Board that hormones for veterinary use should be sold only to registered veterinarians or on a prescription of such veterinarians.

C. It is suggested to the Executive of the Jockey Club: (a) that if any of the drugs mentioned in A. i. above be found in samples of saliva or preferably in urine without prior notification from a veterinarian, that the case be regarded as one of doping; (b) that the administration of hormones except under the directions of a veterinarian be regarded as a malpractice.

D. It is suggested that a delegation from the Council be appointed to lay these recommendations before the Executive of the Jockey Club.

Drs. R. Alexander, D. G. Steyn and J. G. Boswell were appointed to submit these recommendations to the Jockey Club.

(b) *Sale of Penicillin:* Letter dated 27th September, 1945, from the Secretary of the Medical Association was read. It was resolved to submit the views of this Association to the Federal Council of the Medical Association and to await the decision of this body.

(c) *Telephone Directories:* Dr. Mason advised that the application of the Witwatersrand branch to have the names of Veterinarians inserted in the body of the directories under "Veterinary Surgeons" has been refused. It was decided that the Postmaster-General be approached direct with a request that this classification be made in all telephone directories in the Union.

(d) *Veterinary Training:* Dr. Thomas drew attention to the various courses in veterinary science which are now being contemplated such as the proposed training for stock inspectors and for natives. After discussion a Committee consisting of Drs. A. D. Thomas, J. H. Mason and D. Coles was appointed to examine the whole question and to report to Council.

(3) *Natal Branch:* Resolutions passed by the July meeting of this branch were considered. It was decided that the result of the referendum on the adoption of the courtesy title be conveyed to the Secretary for Agriculture with a request that this be transmitted to the Director of Veterinary Services and that effect be given to the decision taken by the profession in this respect.

Council could not support a suggestion by the Natal Branch that local authorities be asked to extend special driving and parking facilities to veterinarians.

(4) *Finances:* The action taken by Finance Committee with reference to subscriptions due by members who were on active service or were interned was confirmed.

A recommendation that additional loans of £20 and £50 be granted to two students was approved.

Payment of £12.12.0. bonus plus honorarium of £3.3.0. for auditing was approved.

(5) *Standing Committees:* The following were elected for 1945-'46.

Editorial: E. M. Robinson (Editor), P. J. du Toit, R. Clark, H. P. Steyn and C. Jackson.

Finance: R. Alexander (Convenor), B. S. Parkin and A. D. Thomas.

Library: G. de Kock (Convenor), E. M. Robinson, D. G. Steyn, A. D. Thomas and C. Jackson.

General Purposes: P. J. J. Fourie (Convenor), R. Alexander, A. M. Diesel, P. S. Snyman and A. C. Kirkpatrick.

Book Fund: W. D. Malherbe (Convenor), A. D. Thomas and D. Haig.

(6) *General:* (a) *Resignation:* It was decided that acceptance of the resignation of Miss R. Datnow on account of her impending departure from South Africa be recommended to the General Meeting with regret.

(b) *Publication of Veterinarians' names:* The proposal of the Johannesburg branch of the S.P.C.A. to publish the names of all veterinarians practising in that city in a calender to be issued to the public by that body was referred to the Veterinary Board for a ruling.

(c) *Press Articles:* The publication of a series of articles on stock diseases in the lay press by a member was also referred to the Board.

(d) *Publicity:* The proposal of a commercial firm to publish a "write up" of a veterinarian who has joined its staff was similarly submitted to the Board for a ruling.

(e) *Johannesburg S.P.C.A.:* It was decided to publish a note in the journal advising veterinarians who contemplate applying for the post of veterinary surgeon to the S.P.C.A. to first consult the Witwatersrand branch of the Association.

(f) *Returned Soldiers:* A discussion took place on the handicap imposed on those returned soldiers who only finished the first year course in January and are on that account debarred from commencing the second year course in veterinary science in 1946. It was resolved "that this Council requests the University of Pretoria to afford candidates in the special course at Witwatersrand and other Universities at least equal facilities for commencing the second year of study as other ex-volunteers."

The meeting adjourned at 11.30 p.m.

S. W. J. van Rensburg,
HON. SEC.-TREAS. S.A.V.M.A.

SOUTH AFRICAN VETERINARY MEDICAL ASSOCIATION.

40th General Meeting held at Onderstepoort on 23rd & 24th October, 1945.

Present: C. J. van Heerden (President); P. S. Snyman; E. M. Robinson; P. J. du Toit; G. Martinaglia; A. D. Thomas; J. G. Bekker; M. C. Robinson; L. W. Rossiter; W. J. Wheeler; J. J. van der Westhuizen; P. J. Meara; R. Clark; J. G. van der Wath; J. Quin; F. B. W. du Casse; T. N. Osborn; M. J. N. Meeser; G. D. Sutton; B. S. Parkin; J. Thorburn; M. W. Henning; S. L. Snyders; P. J. Goosen; A. A. Albertyn; W. D. Malherbe; J. A. Badenhorst; J. W. A. Brookes; C. Jackson; L. T. Edwards; N. T. van der Linde; T. F. Adelaar; J. H. R. Bisschop; W. C. Viljoen; I. Mowat; B. M. McIntosh; L. L. Daly; R. K. Loveday; R. J. Heydenrych; J. W. Smit; J. F. Fick; M. Bergh; R. B. Osrin; L. C. Blomefield; V. Cooper; A. M. Diesel; M. C. Lambrechts; C. F. B.

Hofmeyr; G. L. Muller; O. T. de Villiers; J. Quinlan; J. R. Scheuber; J. Nicol; J. G. Townsend; M. de Lange; J. M. Fourie; J. R. Frean; N. Barrie; J. G. Williams; W. G. van Aswegen; J. H. Mason; M. H. V. Brown; D. E. Osbourn; P. J. J. Fourie; J. S. Watt; D. Haig; D. G. Steyn; L. von Maltitz; G. J. de Wet; W. O. Neitz; R. E. Hartig; K. Schultz; H. P. A. de Boom; W. Hay; H. Theiler; P. G. Joubert; Campbell Dickson; S. G. Turner; E. J. Pullinger; L. W. van der Heever; T. A. T. Louw; C. C. Wessels; I. P. Marais; J. G. Boswell; B. C. Jansen; A. J. Louw; N. C. Starke; S. W. J. van Rensburg (Hon. Sec.-Treasurer).

Among the visitors were Messrs. A. S. McChlery (S. Rhodesia), Smith (Bayer Pharma), Ashton and Bradley (Maybaker), and Shoebotham (Cooper & Nephew).

Apologies for absence: S. T. Amos, G. de Kock, R. du Toit, W. G. Barnard, J. G. Keppel and A. Mathew.

Obituary: The President referred to the loss the Association had sustained during the past year through the deaths of Messrs. F. J. Carless, A. McNae and Mrs. J. Robinson. The meeting passed a vote of condolence with the relatives of these members and of the late Mr. C. F. Hinds, formerly Chief Clerk at Onderstepoort.

Minutes: of General Meeting held on 10th and 11th October, 1944, were confirmed.

New Members: The following were proposed and accepted: Campbell Dickson, B. C. Jansen, P. G. Joubert, F. W. Langbridge, W. M. Mc Hardy, L. W. van der Heever and T. C. W. Wessels.

Resignation: Miss R. Datnow tendered her resignation on account of her impending departure for Great Britain. This was accepted with regret.

Election of Council: The following were declared elected for 1945-1946:—

President: Col. C. J. van Heerden, *Vice-President:* Dr. J. H. Mason, *Hon. Sec.-Treas.:* Dr. S. W. J. van Rensburg, *Members of Council:* Drs. R. Alexander, J. G. Boswell, A. M. Diesel, P. J. du Toit, A. C. Kirkpatrick, P. S. Snyman, D. G. Steyn and A. D. Thomas.

Presidential Address: Owing to the absence on account of illness of the retiring President, Mr. S. T. Amos, his presidential address was read by Dr. Alexander.

Honorary Life Vice-President: Proposing the election of Mr. S. T. Amos as Honorary Life Vice-President of the Association the President said he regretted the inability of Mr. Amos to attend as he would have liked to tell him personally how much members valued the sterling services rendered by him to the Association during his long term as President. Amongst other things Mr. Amos was the originator of the Benevolent Fund and has thus established for himself a permanent monument in the Association.

The proposal was passed unanimously and with great enthusiasm.

Standing Committees: Dr. Alexander presented the report of the Finance Committee which was accepted. The President expressed the hope that in future the other Committees would also give a short account of their activities at the General Meeting.

Retiring Age: The Secretary stated that the Public Service Commission of Inquiry had asked representatives of the Association for an expression of opinion on a suggestion which had been made to the effect that the retiring age of professional officers in the State Service should be increased to 65 years in order to enable them to obtain a higher pension. It was now desired to have the view of the meeting on this.

After full discussion the following resolution proposed by Dr. Alexander and seconded by Dr. Quinlan was unanimously adopted:

"That this meeting of the S.A.V.M.A. does not favour the suggested extension of the pensionable age from 60 to 65 years, but requests that consideration be given to a request that

(1) The years of academic study be included for calculation of pensions;

(2) That retirement at the age of 55 be optional and at 60 compulsory.

General: Specialization: Dr. Hofmeyr stated that the time had arrived for the recognition of specialization in certain branches of veterinary science, and suggested that this be investigated. The matter was referred to the General Purposes Committee for a report to be submitted to the next General Meeting.

Biological Products: Dr .Mason complained that the Division of Veterinary Services did not seem to have a definite policy with regard to the issue of biological products like mallein, tuberculein, etc.

Exhibits: Dr. Hofmeyr suggested that commercial firms supplying drugs and instruments for veterinary use in future be asked to put up exhibits at General Meetings. This was referred to the Programme Committee for consideration.

After the tea interval the following papers and demonstrations were submitted and discussed:

11.00 a.m. Equine abortion: M. W. Henning.
11.45 a.m. The brucellosis problem: E. M. Robinson.
12.30 p.m. Results obtained with the double intradermal tuberculin test: O. T. de Villiers.
1.00 p.m. Lunch.
2.15 p.m. Exhibition of films at Impala House, Pretoria:
(a) Introduction: Game and stock diseases: P. J. du Toit.
(b) Film: Kruger National Park.
(c) Film: Foot and Mouth Disease.
(d) Short Talk: The present foot and mouth disease position: A. M. Diesel.
7.30 p.m. Dinner and Dance at Swartkops Club.

Wednesday, 24th October.

9.00 a.m. Mixing tetram: R. Ortlepp.
9.15 a.m. Lumpy Skin Disease.
(a) Pathology (demonstration): A. D. Thomas.
(b) The field position: A. M. Diesel.
(c) Laboratory investigations: T. F. Adelaar.
11.00 a.m. Tea.

11.00 a.m. The use of gonadotrophic substances in the treatment of reproductive disorders amongst farm animals: J. I. Quin.

12.15 p.m. Herd control with special reference to Fertility: J. G. Boswell.

1.00 p.m. Lunch.

2.00 p.m. Would a well-timed and concerted plan of calfhood immunization and management covering protozoon and bacterial diseases as well as feeding and other contributory factors reduce calf mortality in the bushveld ranching areas? A. D. Thomas.

2.30 p.m. *Resolutions:*

1. Proposed by Dr. Quin and seconded by Dr. Clark: In view of:—

(a) the great urgency of improving animal health in South Africa through better methods of propaganda and education amongst legislators, stock owners, students, natives and the general public alike,

(b) the tremendous significance and scope offered by the scientific film in achieving this object in a manner more convincing and less time consuming than any other methods applied thus far, this meeting of the South African Veterinary Medical Association respectfully requests the Minister for Agriculture to urge for the provision of the necessary technical staff, equipment and other facilities for the production and distribution of films of veterinary interest on a more extensive scale as is already being done with great success in various countries overseas including some of the Dominions.

Passed unanimously.

2. Proposed by Dr. Snyman and seconded by Dr. Alexander:

That the following resolution be telegraphed to Mr. Amos: "This meeting deeply regrets Mr. Amos' inability to attend owing to ill health and assures him of its best wishes for a speedy and complete recovery."

Passed unanimously.

3. Proposed by Dr. van der Wath and seconded by Dr. Fourie:

"Kongres is van opinie dat die probleem van Tuberkulose steeds vererger — beide van die oogpunt van die gesondheid van die veeindustrie en van publieke gesondheid. Kongres versoek die Departement om sonder versuim die nasionale skema van tuberkulose bestryding in die Unie, wat as gevolg van die oorlog uitgestel is, noukeurig te hersien en dit dan so gou moontlik in werking te stel."

Accepted with one dissentient.

4. Capt. Heydenrych suggested that invitations to Municipal Veterinarians to General Meetings be sent through the Municipalities concerned.

5. The President suggested that papers be made available to members before General Meetings. Dr. Clark said papers should be printed prior to the meetings. This was referred to the General Purposes, Editorial and Finance Committees.

The meeting closed at 4 p.m. with a vote ofthanks to the President.

S. W. J. van Rensburg,
HON. SEC.-TREAS. S.A.V.M.A.

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