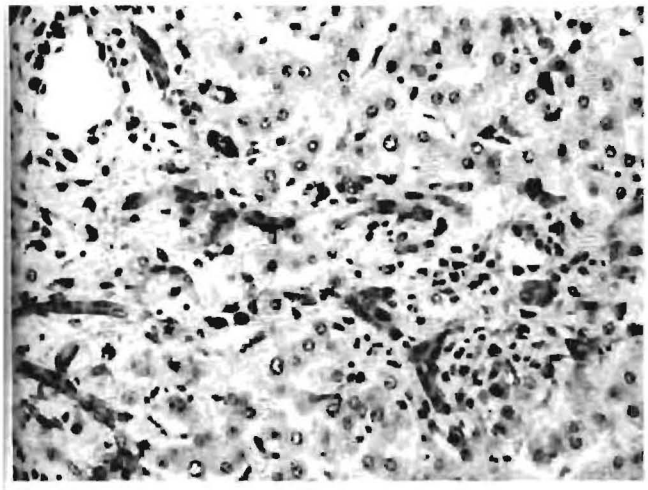
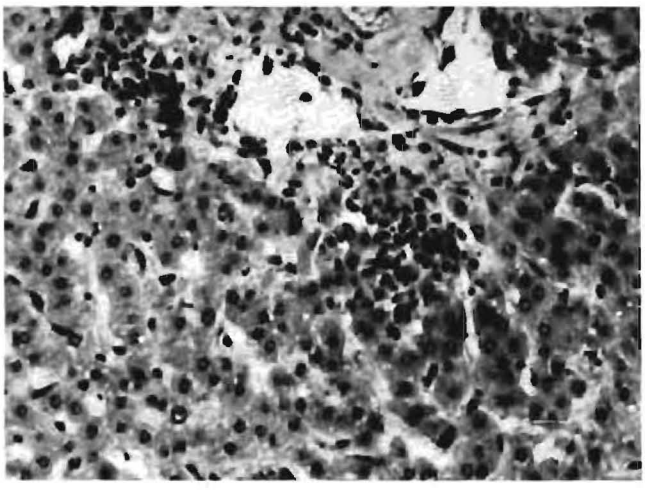
Contents/Inhoud (continued)

CORRIGENDA

1. "*Schistosoma mattheei* in the Ox: The chronic hepatic syndrome" – J.A. Lawrence: Vol 48 No 2 p 77. Figs. 3 and 4 on p 79 are reproduced for greater clarity below.





2. "The gastroscope as an aid in veterinary diagnostics" – S.W. Petrick: Vol 48 No 2 p 105. Table 2 is correctly reproduced below.

Table 2: ANATOMICAL STRUCTURES AND SPECIES EXAMINED

Species	Nasal passage	Larynx (L) Trachea (T) Bronchus (B)	Pharynx (P) Oesophagus (Oe)	Pro-ventriculus	Stomach	Duodenal bulb	Cervix Vagina	Uterus
Horses	35	35/10T	35P/6Oe	—	—	—	—	—
Cattle	5	5L/1T	5P	—	—	—	—	—
Sheep	1	1L	1P	—	—	—	—	—
Dogs	—	129/T/B	192P/Oe	—	192	4	37	1
Cats	—	6L	14P/Oe	—	14	1	—	—
Chimpanzee	—	—	1P/Oe	—	—	—	—	—
Birds	—	—	2P/Oe	1	2	—	—	—

3. "Ovarian autograft as an alternative to ovariectomy in bitches" Vol. 48 No. 2 p. 117–123 by P.H. le Roux and L.A. v.d. Walt: on p. 120 2nd column *Abolition of oestrus* para. 1:
". . . 160 μg/ml and occasionally over 200 μg/ml." should read:
. . . 160 pg/ml and occasionally over 200 pg/ml.

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AGENTS IN GREAT BRITAIN: **AGENTE IN DIE VERENIGDE KONINKRYK**

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THE LIFE-SPAN OF MAMMALS

S. W. PETRICK

ABSTRACT: Petrick, S.W. The Life-span of Mammals, *Journal of the South African Veterinary Association* (1977) **47** No. 3, 151–154 (En) Dept. Surgery. Fac. Veterinary Science, Univ. of Pretoria, Box 12580, 0110 Onderstepoort, Rep. South Africa.

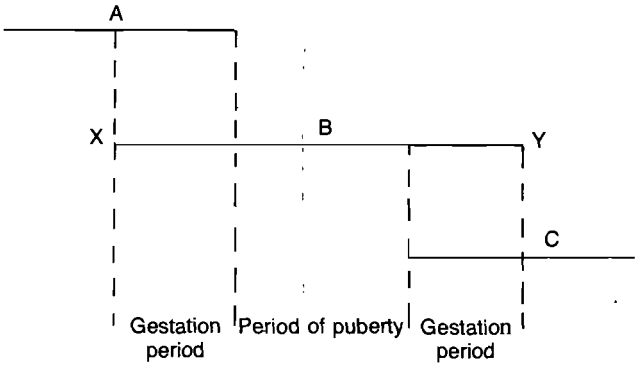
Various parameters in the life cycle of mammals were investigated to find a possible correlation between these parameters and the life-span. Twenty-two factors were calculated to determine the true life-span of any mammal. In addition a single formula, by means of which the life-span could be determined, was constructed. The life-spans of certain species, as calculated by means of the formula, are compared with authorative estimates.

INTRODUCTION

Man has long been fascinated by the length of his own life-span and that of other mammals and a large number of theories and formulae have been propounded. There are those who hold the opinion that the duration of life is related to the period of growth[6 13 16 18], while others found a correlation between life-span and metabolism[11 14 16 20]. Heredity[4 16], natural selection and evolution[5 17], and reproduction[17 22] have also been considered in finding a meaningful solution to this unresolved problem.

This contribution describes an investigation of various parameters in the life cycle of mammals and the possible correlation between these and life-span. A relation between the gestation period and life-span gave rise to the determination of 22 factors which can be used to calculate the life-span of mammals. This, however, was not satisfactory and with the construction of a single formula as a goal, the gestation period and the period of puberty were combined resulting in a parameter which represents the completion of the first life cycle.

Definition: The first life cycle extends from time of conception through gestation, puberty and until the first offspring is born. Fig. 1 explains the duration of the first life cycle.



A = the mother of B
B = the mother of C
XY = the first life cycle of B

Fig. 1. The duration of the first life cycle.

After the completion of the first life cycle the gestation period alone is repeated to the end of the reproductive cycle.

Portion of a thesis submitted in partial fulfilment of the requirements for the degree of DVSc, Faculty of Veterinary Science, University of Pretoria, May 1976.

INVESTIGATION 1

Materials and Methods

The class Mammalia consists of 19 orders, 92 families and approximately 5 000 species. The data available for the various parameters that were used are extremely few and differ from author to author.

It was thought that the gestation period of a mammal, a fairly constant parameter, could easily be correlated with the length of the life-span. Data on the length of this period is available for only slightly more than 300 species. The most important sources are listed in the references[2 3 8 19].

The ages recorded for mammals in captivity have been used as the second value necessary in these calculations. Data in respect of a mere 330 species have been recorded and the main contributors are listed in the references[7 8 11 12 17 19].

Determination of factors

Dividing the age (in months), by the gestation period (in months), gives rise to different factors for each species of a certain family. Finally these factors within a family were used to calculate a single factor. Each factor was divided by 12 thus making it possible to calculate the life-span of a mammal in years.

According to a standard classification of the class Mammalia the families were numbered from one to 96. The families of Veterinary importance have been numbered as follows:

Equidae	81
Bovidae	92
Caprinae	96
Suidae	84
Canidae	65
Felidae	72

Results

The results are presented in Table 1. Twenty-two factors were calculated for 79 families. Only the corresponding numbers of the families used in the original dissertation are presented in this table.

As an example, the life-span of a horse and a Mountain Zebra is calculated.

Family:	Equidae
Species:	Horse
Species:	Mountain Zebra
Factor (F):	2

$\therefore$ Life-span of horse = Gestation period × Factor (F)
= 11,2 (months) × 2
= 22,4 years.
Life-span of Mountain Zebra = 12 (months) × 2
= 24 years.

Table 1: FACTOR AND FAMILY GROUPING

Number	Factor	The numbers assigned to the various families
1	0,5	78
2	1	8 48 74 88 91
3	1,5	10 12 19 23 32 51 76 79 90
4	2	4 26 56 57 73 81 82 83 87 94 95
5	2,5	3 6 14 25 75 77 89 92
6	3	11 36 53 59 93 96
7	3,5	15 17 18 27 28 29
8	4	34 45 66 70 84
9	4,5	5 30 33 49 55
10	5	52 67
11	5,5	31 40 42 46 69 71 85
12	6	13 22 86
13	6,5	47 65
14	7	72
15	7,5	68
16	8	39 41 50
17	8,5	—
18	9	37
19	9,5	—
20	12,5	20
21	24,5	2
22	65,5	1

Discussion

Due to the fact that the greatest recorded ages had to be used the factors are frequently too high in some families and too low in others. This can be explained by the fact that certain species do extremely well in captivity and live a considerable time. Other species, however, survive for a shorter time than expected. Consequently the factors could be calculated more correctly by using the life-spans as determined with the formula instead of the greatest recorded ages.

FURTHER INVESTIGATIONS

In order to construct a universal formula, the following parameters were examined to find a possible correlation between these and the life-span:

Period of puberty
Implantation of the blastocyst
Chromosomal count
Life-span of ovum and sperm
Size and mass of the ovaries
Litter size
The eruption of the first permanent tooth.

Discussion

No correlation could be obtained between these parameters and the life-span.

THE FINAL INVESTIGATION

Insects complete their life-span after a single reproductive cycle[16] thus giving rise to the idea of a first life cycle in mammals. It was thought, therefore, that a correlation exists between the period of the first life cycle and the completion of the reproductive cycle as a whole. This complete period may therefore be considered the true life-span of a mammal. The average mammal lives for this specific time and no longer[22].

Method

The first life cycle has been determined for 128 species. With the aid of a computer and 6 types of mathematical functions a formula with a constant factor was calculated by a process of elimination.

The functions are the following:

1. $y = a + b\,x$
   A polynomial of the first degree
2. $y = ae^{b\,x}$
   The exponential function
3. $y = ax^b$
   A polynomial of the B'th degree
   With a b-value of 0,5 it can be written as follows:
   $y = a\sqrt{x}$
4. $y = a + \frac{b}{x}$
   A polynomial of the -1 degree
5. $y = \frac{1}{a + b^x}$
   A polynomial of the -1 degree
6. $y = \frac{x}{ax + b}$
   A polynomial of the -1 degree

Any of these functions can describe any normal physical process if no discontinuity can be attributed to the process. These functions can be graphically presented.

y = recorded ages (known values)
x = first life cycle (known values)
a and b = constants with different values
e = constant (2,71828)

THE FIRST CALCULATION

In the first calculation the following data were used:
1. The greatest ages recorded
2. The first life cycle (2 × gestation period + period of puberty)

Result

It was found that function number 6, where $y = \frac{x}{ax + b}$, was the best forced fit. The values of percentage difference between the 2 y-values were also calculated and showed that this function seemed to be worthless. Using this formula there was no correlation between the first life cycle and the greatest ages recorded. This, however, was expected because of the comparatively brief survival of some species and protracted survival of others.

THE SECOND CALCULATION

In the second calculation the following data were used:
1. Life-span determined with the various factors
2. The first life cycle

This was done because the use of the various factors gave a better overall picture of the life-span of mammals. For instance a horse lives for 22,4 years according to the use of a factor but has a greatest recorded age of 51 years[15].

Result

Function number 3 where $y = ax^b$, (the second best fit in the first calculation) was the best forced fit.

THE THIRD CALCULATION

A few more species were eliminated because of high and low percentage differences between the 2 y-values in the second calculation. Eighty-one species were used in this final calculation. They represent 12 orders from a total of 19, and 37 families from a total of 92. The data used, were the same as in the second calculation.

Result

Function number 3 was the best forced fit with a b-value of 0,50288. An approximate value of 0,5.

The function $Y = ax^b$ can now be written as $Y = a\sqrt{x}$

y = life-span
x = the first life cycle
a = 39,4813 (constant)

Homo sapiens evidently is the only mammal that completes its reproductive cycle and survives after its completion and therefore data from this species is of incalculable value. The formula and the parameters of the reproductive cycle of the human being were used to calculate the only acceptable constant.

$$y = a\sqrt{x}$$

$$\text{Life-span} = a\sqrt{\text{First life cycle}}$$

$$= a\sqrt{2 \times \text{gestation period} + \text{period of puberty}}$$

$$\therefore 570 = a\sqrt{2 \times 8,9 + 174}$$

$$= a\sqrt{191,8}$$

$$\therefore a = \frac{570}{13,849187}$$

$$= 41,1576$$

$$= 41,2$$

The 570 months used in the above calculation is the duration of the reproductive cycle of *Homo sapiens*. In other species this would represent the true life-span. The menopause of a woman begins and ends between the ages of 45 and 50 years[1 2 10 23]. A mean value of 47,5 years (570 months).

The pregnancy period of a woman is 8,9 months and the period of puberty is taken as 174 months (14,5 years)[21 23].

The result of this investigation and the value of the formula is presented by comparing in Table 2 the life-span of certain species, calculated with the formula, with authorative estimates[9]

The knowledge of the true life-span is of considerable importance not only to the Veterinarian but to every scientist involved with mammalian research. Even *Homo sapiens* might gain by the knowledge of his true life-span and recognise that the so-called population explosion, in so far as the birth-rate is concerned has little or no bearing on the global over-population.

Table 2: A COMPARISON BETWEEN THE LIFE-SPAN CALCULATED WITH THE FORMULA AND AUTHORATIVE ESTIMATES

Number	Species	Life-span (in years) calculated by means of the formula	Life-span based on estimates in years
1	Baboon	26	27
2	Beaver	21	13
3	Black bear	30	19
4	Brown bear	30	31
5	Polar bear	29,5	31
6	Buffalo	22–25	20
7	Camel	32	20
8	Cat	12	15
9	Cattle	18	18
10	Chimpanzee	38	30
11	Dog	12	16
12	Donkey	21	24
13	Elephant	45,5	47
14	Elk	20	22
15	Giraffe	29	10
16	Gorilla	35	25
17	Horse	22	27
18	Lion	21	15–29
19	Marmot	9	4
20	Moose	21	8
21	Mouse	5	4
22	Pig	13	14
23	Rabbit	9	5
24	Rat-Kangaroo	13	4
25	Rhinoceros	28–32	27
26	Sea Lion	28	19
27	Sheep	14	13
28	Squirrel	12	8
29	Tiger	23	19
30	Whale	30–63	37
31	Wolf	12	12
32	Zebra	24	20

CONCLUSION

To determine the true life-span of any mammal the following formula can be used:

$y = c\sqrt{x}$
y = Life-span
c = 41,2 (constant)
x = First life cycle

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BOOK REVIEW — BOEKRESENSIE

JONES'S ANIMAL NURSING

EDITED BY R. S. PINNIGER

ISBN 0 08 020596 8 Pergamon Press. Oxford 1976 pp XVII+481

The fully revised second edition of this classic on Animal Nursing is edited for the British Small Animal Veterinary Association with contributions from twenty-two authors.

When the first edition was published in 1966 the aim was stated to the provision of a background text for students undertaking the ANA course of tuition. The latest revised edition still fullfills this aim admirably. The expansion of both the quantity and depth of information follows on experience gained about the knowledge needed by the modern veterinary nurse.

The book is divided into ten chapters viz:

1. Anatomy and Physiology
2. The Principles of Animal Management, Hygiene and Feeding
3. First Aid
4. Diagnostic Aids and Laboratory tests
5. Theory and Practice of Nursing
6. Surgical Nursing
7. Obstetrical and Paediatric Nursing and the Principles of Breeding
8. Radiography
9. The Position of the Rana under the Veterinary Act of 1966
10. The Veterinary Profession

Here in the Republic, as everywhere else in the English speaking world, the contents of this publication forms the basis for the training of veterinary nurses and is also prescribed at our Faculty for Dip Cur Anim students.

I have to criticise one aspect which has persisted from the very first edition: the line drawings (sketches) in the chapter on Anatomy and Physiology are too small, not sufficiently annotated and so oversimplified in some cases that they are misleading (see Fig. 1.13 p 34).

This does however not detract from the great value of this edition. No veterinary nurse can afford to be without this book and I am sure that many veterinarians who employ lay people in their hospitals will derive benefit from encouraging their staff to study the latest edition of Jones's Animal Nursing.

K.v.d.W.

THE EFFECT OF SINGLE INTRACISTERNAL DRY COW ADMINISTRATION OF STAPHYLOCOCCAL ANTIGENS AND ANTIBIOTICS ON THE INCIDENCE OF STAPHYLOCOCCAL BOVINE MASTITIS

A. JANOVICS* AND R.E. ARMITAGE*

ABSTRACT: Janovics A., Armitage R.E. **The effect of single intracisternal dry cow administration of staphylococcal antigens and antibiotics on the indicence of staphylococcal bovine mastitis.** *Journal South African Veterinary Association.* (En) **48** No. 3 155–161. Vetlab, P.O. Box 5932, 2000 Johannesburg, Rep. of South Africa.

The incidence of staphylococcal mastitis was investigated in 3 large commercial Friesland herds before and after the single intracisternal administration, during the dry-period, of 1 of 4 formulations containing staphylococcal antigens, antibiotics and base alone or in combination.

Results suggest that the instillation of vaccine alone and vaccine plus antibiotics into fully involuted quarters very significantly reduced the incidence of staphylococcal mastitis in the subsequent lactation. Compared with antibiotics and base, each administered alone, the vaccine reduced the number of infected quarters in the subsequent lactation by 70,52% and 79,52% respectively, whereas the corresponding values for vaccine plus antibiotics were 62,22% and 71,22% respectively. The difference in results between vaccine alone and vaccine plus antibiotics is statistically insignificant, as is the difference between the results achieved by antiobiotics and base alone. The vaccine plus antibiotics is thought to possess combined therapeutic-preventive activity.

The investigation showed, however, that vaccine plus antibiotics consistently protected mastitis negative quarters against new attacks of staphylococcal mastitis during the subsequent lactation period about 1,43, 4,00 and 5,32 times more effectively than did vaccine, antibiotics and base used individually.

INTRODUCTION

Staphylococci, especially *S. aureus,* have been known for many years to cause several types of bovine mastitis[17 31]. In some areas, including the Republic of South Africa[14], *S. aureus* has become the most common mastitogenic micro-organism. Although its eradication from individual herds is presumably not impossible[28], control and prevention of mastitis caused by *S. aureus* by means of conventional methods appears to be unusually difficult in the average commercial dairy herd. The results of such measures can apparently be improved by means of intracisternal treatment with antibiotic formulations that are not readily affected by the staphylococcal betalactamase (i.e. penicillinase), have prolonged antibiotic activity in the mammary gland and are administered after the last milking at drying-off[10 33].

Such treatment offers a number of short-term advantages as a means of controlling subclinical mastitis and preventing new infections. It does, however, promote the more extensive use of antibiotics which are not necessarily harmless and may, in fact, decrease the efficacy of the udder's nonspecific and specific natural defence mechanisms. These mechanisms are probably of great practical importance. They are widely neglected and incompletely understood[12 16 30]. Such mechanisms, including the leukocytic barrier[31] and the local synthesis at least of specific Ig A-type antibodies[16], are acknowledged facts. Immunity of cows against *S. aureus* or other mastitogenic micro-organisms may thus indeed be natural or acquired in principle[32]. It seems rather unfortunate, therefore, that attempts at immunization against *S. aureus* have not yet gained any practical importance, although in an earlier review of the relevant literature it was pointed out that of 21 workers only 4 had reported poor results in their attempts at vaccination against staphylococcal mastitis[2].

*Vetlab, P.O. Box 5932, 2000 Johannesburg.

Whatever the problem related to immunization against *S. aureus*[2 4], the success of such vaccination would, of course, depend on a considerable range of variables including the antigens in the vaccine and the method of administration.

It is known that cattle immunized against *S. aureus* exhibit increased resistance to intramammary infection by homologous strains but not necessarily to heterologous strains[1 5 9]. Mice immunized with somatic antigens of *S. aureus* showed cross immunity between certain strains of different phage patterns and immunological differences between strains with comparable in vitro characteristics[7 8].

It was therefore decided to formulate a vaccine with antigens which are mostly nonspecific rather than absolutely specific to common pathogenic strains of *S. aureus.* Accordingly toxoided alpha-toxin, toxoided leukocidin and somatic antigens were used. Alpha-toxin is lethal, dermatonecrotic, leukocidal and lyses erythrocytes of the cow, sheep and rabbit. It is responsible for the gangrenous form of staphylococcal mastitis in cows, sheep and goats and also mobilises cellular defences in the early hours after infection[19]. It is the most dangerous of the staphylococcal toxins and common to most pathogenic strains of *S. aureus.*

Staphylococcal leukocidin consists of 3 factors. The first is identical to alpha-toxin, the second particularly active against both rabbit and human leukocytes and the third lytic to the leukocytes of all species except sheep[2]. The effect and course of staphylococcal infection are determined in the first 6 to 8 hours[27] and the result of infection depends on leukocidin and alphatoxin produced at the site of the lesion within the first 6 hours following infection[21].

The necessity of somatic antigens in staphylococcal vaccines is clearly indicated by the work of Cameron[2 3 4]. Somatic antigens produce, as a rule, immunity against homologous strains. The Smith strain is distinguished, however, by possession of a very broad spectrum of antigens which are common to most pathogenic strains.

The vaccine under investigation was originally de-

veloped for sublingual administration to human patients suffering from acne[18]. Having shown its usefulness for that purpose, the same vaccine was given to cows as a protection against mastitis. It was initially administered intranasally on 10 successive days. Though the results seemed encouraging[11 22 25], intranasal instillation of the vaccine was rather impractical, especially in large herds. Other routes of administration were therefore investigated. It was found that the vaccine could be safely administered intracisternally to completely dried-off bovine udders.

This report deals with the occurrence of bovine mastitis due to *S. aureus* in quarters immunized by means of a vaccine and a combination of vaccine and antibiotics during the dry period, and compares these results obtained with those obtained after dry cow treatment with the antibiotics and base only.

MATERIALS AND METHODS

1. *The vaccine* contained 3 antigens obtained from the strains of *S. aureus* indicates:
   (i) alpha-toxoid from strain WOOD, NCTC 7121;
   (ii) leukocidin-toxoid from strain OXFORD, NCTC 6571; and
   (iii) somatic antigens from strain SMITH, NCTC 10399.

Each of the 3 antigens was augmented by comparable antigen from strains of *S. aureus* isolated from mastitic milk.

2. *Fore-milk samples* were collected from individual quarters according to a prescribed technique[13] and milked directly into screw-capped bottles during the afternoon milking, immediately placed into a cooling container, and kept at 4°C until required for further processing.

3. *Laboratory examinations:* Somatic cell counts were determined by means of the Breed method using Leishman's stain[24 29]. For bacteriological examination, the milk was inoculated onto 3 culture media:
   (i) blood agar;
   (ii) selective staphylococcus medium consisting of bacto mannitol salt agar (B 30);
   (iii) Edwards' medium for the selective growth of streptococci.

Staphylococci were tested for the production of coagulase by means of both the conventional test tube and slide methods. Haemolysin was measured by means of the conventional haemolytic test method[26].

Where subclinical mastitis was suspected, rabbit anti-bovine, bovine serum albumin (BSA) serum was used as a confirmatory diagnostic criterium[15].

4. *Diagnosis of mastitis:* During sampling, the teats and udder were inspected, the cisterns and mammary parenchyma palpated and the physicial appearance of the milk noted. The results of the clinical and laboratory examinations were interpreted in terms of the criteria summarised in Table 1.

Any cases of staphylococcal mastitis (clinical or sub-clinical) which were found, were left untreated. At no stage during the trials was any treatment other than the antibiotics described in 5.IV *(vide infra)* used on any of the cows.

5. *Design of investigation*

(i) *Selection of herds:* After cytological and bacteriological screening of several herds, 3 were selected where the owners were co-operative, and the incidence of staphylococcal mastitis assured the probability of new cases during the trial.

(ii) *Selected herds:* At the beginning of the trial there were 452 Friesland cows in the 3 herds. The situation in the herds may be summarised as follows:

(a) *Herd 1:* 165 cows milked by machine; general hygiene relatively good; throughout trial udder washing with chlorine compound before and teat dipping with iodine preparation after milking; conventional dry cow antibiotic treatment used; incidence of staphylococcal mastitis in 16,4% = 27 cows;

Table 1: BASIS FOR DIAGNOSIS OF STAPHYLOCOCCAL MASTITIS

SYMPTOMS	MASTITIS					
	NEGATIVE	SUSPICIOUS	POSITIVE			
			SEPTIC		ASEPTIC	
			Clinical	Subclinical	Clinical	Subclinical
CLINICAL						
i. Negative	+	+	—	+	—	+
ii. Positive	—	—	+	—	+	—
CYTOLOGICAL						
i. 500 x 10^3 cells/ml	+	+	—	—	—	—
ii. 500 x 10^3 cells/ml	—	—	+	+	+	+
BACTERIOLOGICAL						
i. *S. aureus* absent	+	—	—	—	—	—
ii. *S. aureus* present	—	+	+	+	—	—
SEROLOGICAL						
i. 0,5 mg BSA/ml				—		—
ii. 0,5 mg BSA/ml				+		+

(b) *Herd 2:* 142 cows milked by machine; general hygiene fair throughout trial; udder washing with chlorine compound before but no teat dipping after milking; teat clusters dipped into water containing disinfectant between cows; conventional dry cow antibiotic treatment used; incidence of staphylococcal mastitis in 33,1% = 47 cows; and

(c) *Herd 3:* 145 cows milked by machine; general hygiene variable; conventional dry cow antibiotic treatment used; incidence of staphylococcal mastitis in 7,9% = 26 cows.

(iii) *Grouping of cows:* In the three selected herds the status of udder health of every cow was confirmed by re-examination of quarter samples. The cows of each herd were then randomly assigned to 4 groups (A to D) so that each group contained approximately equal numbers of healthy and mastitic animals. The stage of lactation of each cow was recorded and its udder health was monitored bacteriologically at regular intervals of 4 to 6 weeks until drying-off. Cows usually calved 3 to 4 weeks after the intracisternal instillations had taken place. Regular monitoring was resumed after calving.

(iv) *Treatment of cows:* The cows were dried-off without intramammary antibiotic treatment. When the udders were completely involuted 3 to 4 weeks later, all quarters of each cow in each of the four groups received 1 of the 4 following intracisternal formulations:

(a) *Group A (vaccine):* one dose of vaccine containing 80 i.u. alpha-toxoid, 60 i.u. leukocidin toxoid and somatic antigens derived from 1×10^{11} bacteria;

(b) *Group B (vaccine and antibiotics):* one dose of the above vaccine plus 300 000 i.u. procaine penicillin and 250 mg (as neomycin base) neomycin sulphate;

(c) *Group C (antibiotics):* one dose of the above antibiotics; and

(d) *Group D (base):* 5 ml of an aqueous solution of 0,85% NaCℓ and 0,2% agar.

The compounds administered to Groups A to C were suspended in 5 ml of the base. The 4 formulations were packed into 5 ml tubes or syringes to render a sterile ready-for-use product. The results of the tests and the instillations are summarized in Table 2.

Table 2: THE ABSOLUTE STATUS OF UDDER HEALTH IN 3 HERDS DURING 8 MONTHS BEFORE AND AFTER INTRACISTERNAL ADMINISTRATION DURING THE DRY PERIOD OF 4 TYPES OF FORMULATIONS

Treatments	Diagnosis of Staphylococcal Mastitis	MONTH BEFORE DRYING OFF						MONTH AFTER DRYING OFF					
		–8 to 7	–6 to 5	–4 to 3	–2 to 1	Totals	Average	Average	Totals	+1 to 2	+3 to 4	+5 to 6	+7 to 8
A	Total quarters	40	105	122	136	403	100,75	77	300	136	92	64	16
Vaccine	Negative	29	58	50	85	222	55,5	58	232	95	75	51	11
	Suspicious	3	9	9	10	31	7,75	8,75	35	20	9	5	1
	Septic	5	18	29	15	67	16,75	4,25	17	5	5	5	2
	Aseptic	3	20	34	26	83	20,75	6	24	16	3	3	2
B	Total quarters	76	100	136	148	460	155	110,5	442	148	136	94	64
Vaccine	Negative	33	51	65	70	219	54,75	77,25	309	105	97	64	43
and	Suspicious	10	4	8	8	30	7,5	11	44	16	9	10	9
Antibiotic	Septic	23	39	45	36	143	35,75	14,25	57	13	20	16	8
	Aseptic	10	6	18	34	68	17	8	32	14	10	4	4
C	Total quarters	87	117	127	140	471	117,75	101,5	406	151	123	88	44
Antibiotic	Negative	49	53	59	53	214	53,5	49	196	77	67	39	13
	Suspicious	4	3	1	11	19	4,75	10,25	41	18	11	8	4
	Septic	20	30	31	32	113	28,25	25,25	101	30	29	25	17
	Aseptic	14	31	36	44	125	31,25	17	68	26	16	16	10
D	Total quarters	52	80	102	112	346	86,5	75,25	301	115	91	67	28
Base	Negative	40	48	53	83	224	56	44	176	71	54	39	12
	Suspicous	—	—	3	5	8	2	10	40	18	10	8	4
	Septic	4	15	20	13	52	13	12,75	51	12	19	11	9
	Aseptic	8	17	26	11	62	15,5	8,5	34	14	8	9	3

6. *Statistical analysis:* To assess whether the mastitic quarters diagnosed during the 8 months before drying-off were indeed grouped at random, the corresponding values of Groups A to D were compared by means of a Chi-square (X^2) test using 2 × 4 contingency tables with 3 degrees of freedom and p-values. The results are summarized in Table 3.

An identical comparison was made on the number of septic mastitic quarters found in each group after calving (see Table 4).

7. *Presentation of data:* For the purpose of providing a clear presentation of the data, the results acquired in the 3 herds were pooled and synchronised according to the stage of lactation and the state of udder health as assessed during the clinical examination (see Tables 2 and 5).

RESULTS

The results are given in tabular form.

1. Udder health status before and after 4 intracisternal formulations were instilled during the dry period.

2. Random distribution before drying-off of quarters with mastitis

Table 3: THE STATISTICAL SIGNIFICANCE OF DIFFERENCES BETWEEN THE DISTRIBUTION OF QUARTERS WITH SEPTIC MASTITIS GROUPED AT RANDOM BEFORE DRYING-OFF

Groups compared	Between-group differences in terms of X^2-values	Statistical significances in terms of P-values
A/B	4,34	P<0,30
A/C	6,92	P<0,10
A/D	0,29	P<0,98
B/C	0,69	P<0,90
B/D	2,53	P<0,50
C/D	4,08	P<0,30

Table 4: THE STATISTICAL SIGNIFICANCE OF DIFFERENCES BETWEEN THE GROUP DISTRIBUTION OF QUARTERS WITH MASTITIS AFTER CALVING

Groups compared	Between-group differences in terms of X^2-values	Statistical significance in terms of P-values
A/B	2,99	P<0,10
A/B	22,78	P<0,001
A/D	16,75	P<0,001
B/C	10,73	P<0,001
B/D	13,04	P<0,001
C/D	0,13	P<0,80

Table 5: RELATIVE STATUS OF UDDER HEALTH BEFORE AND AFTER ADMINISTRATION OF FOUR TYPES OF INTRACISTERNAL FORMULATIONS DURING THE DRY PERIOD

Group & Treatments	Diagnosis of Staphylococcal Mastitis	MONTH BEFORE DRYING OFF						MONTH AFTER DRYING OFF					
		–8 to 7	–6 to 5	–4 to 3	–2 to 1	Totals	Average	Average	Totals	+1 to 2	+3 to 4	+5 to 6	+7 to 8
A		%	%	%	%	%	%	%	%	%	%	%	%
Vaccine	Negative	72,50	55,24	40,98	62,50	55,09	57,81	74,95	75,32	69,85	81,52	79,69	68,78
	Suspicious	7,50	8,57	7,38	7,35	7,69	7,7	9,64	11,36	14,71	9,78	7,81	6,25
	Septic	12,50	17,14	23,77	11,03	16,62	16,11	7,36	5,52	3,68	5,44	7,81	12,50
	Aseptic	7,50	19,05	27,87	19,12	20,60	18,20	10,0	7,80	11,79	3,26	4,69	12,50
B													
Vaccine	*Negative*	43,42	51,0	47,79	47,30	47,61	47,35	69,56	69,91	70,95	71,32	68,09	67,89
and	Suspicious	13,16	4,0	5,88	5,41	6,52	7,11	10,53	9,55	10,81	6,62	10,64	14,06
Antibiotic	Septic	30,26	39,0	36,89	24,32	31,09	32,62	13,25	12,90	8,78	14,71	17,02	12,50
	Aseptic	13,16	6,0	13,24	22,97	14,78	13,84	6,83	7,24	9,46	7,35	4,25	6,25
C													
Antibiotic	Negative	56,32	45,30	46,46	37,86	45,44	46,49	44,83	48,28	50,99	54,47	44,32	29,55
	Suspicious	4,60	2,56	0,79	7,86	4,03	3,95	9,76	10,10	11,92	8,94	9,09	9,89
	Septic	22,99	25,64	24,41	22,85	23,99	23,98	27,63	24,87	19,87	23,58	28,41	38,64
	Aseptic	16,09	26,50	28,34	31,12	26,54	25,59	21,97	16,75	17,22	13,01	18,18	22,72
D													
Base	Negative	76,92	60,0	51,96	74,11	64,74	65,75	55,54	58,47	61,74	59,34	58,21	42,86
	Suspicious	—	—	2,94	4,46	2,31	1,85	13,22	13,29	15,65	10,99	11,94	14,25
	Septic	7,69	18,75	19,61	11,61	15,03	14,41	19,97	16,94	10,44	20,88	16,42	32,14
	Aseptic	15,39	21,25	25,49	9,82	17,92	17,99	11,28	11,30	12,17	8,79	13,43	10,71

Table 6: THE OCCURRENCE OF NEW CASES OF MASTITIS DURING THE LACTATION PERIOD FOLLOWING INTRACISTERNAL ADMINISTRATION OF ONE OF FOUR FORMULATIONS DURING THE DRY PERIOD INTO QUARTERS CONSISTENTLY NORMAL DURING THE PRECEDING LACTATION

Normal quarters of previous lactation		No. of quarters with fresh mastitis and months of onset							Abs. Total group	As % of total No. of quarters treated
Group and Formulation	No.	1	2	3	4	5	6	7		
A: Vaccine only	155	3	1	—	—	—	—	1	5	3,23
B: Vaccine + Antibiotics	133	2	—	—	—	1	—	—	3	2,26
C: Antibiotics	155	8	2	2	—	1	—	1	14	9,03
D: Base	158	12	5	2	—	—	—	—	19	12,03

DISCUSSION

According to Table 2 Groups A to D contained 67, 143, 113 and 52 quarters with staphylococcal mastitis before and 17, 57, 101 and 51 similarly diseased quarters respectively after use of the intracisternal formulations. Staphylococcal mastitis was reduced, therefore, to 25,37%, 39,86%, 89,38% and 98,08% of its original incidence in Groups A, B, C and D respectively. This amounts to total reduction of the incidence of septic staphylococcal mastitis of 74,63% in Group A, of 60,14% in Group B, of 10,62% in Group C and of 1,92% in Group D respectively.

In terms of the average number of quarters affected by staphylococcal mastitis (Table 2), Groups A to D showed mean values of 16, 75, 35, 75, 28, 25 and 13,00 diseased quarters before and of 4,25, 14,25, 25,25 and 12,75 diseased quarters respectively after intracisternal administration of the formulations. Septic staphylococcal mastitis was thus reduced during the 8 months after calving to averages identical to the abovementioned percentage values.

Table 4 indicates no significant differences between the post-calving numbers of quarters with mastitis in Groups A and B and between Groups C and D, in the other comparisons the differences were highly significant.

The results summarized in Table 2 may appear doubtful because they were not established in groups of identical sizes. The effect of the 4 different intracisternal formulations was thus assessed, in terms of the relative values (Table 5).

From Table 5 it is apparent that, in terms of all the quarters in each of the individual Groups A to D, the total incidence of staphylococcal mastitis during the 8 months before drying-off equalled 16,62%, 31,09%, 23,99% and 15,03% respectively. The corresponding values observed in the first 8 months of the following lactation were 5,25%, 12,90%, 24,88% and 16,94% respectively. The incidence of staphylococcal mastitis in Groups A to D thus reached after intracisternal treatment values that were 33,19%, 41,49%, 103,71% and 112,71% respectively of the corresponding values determined during the preceding lactation. The relative total incidence of septic staphylococcal mastitis decreased, therefore, by 66,81% in Group A and 58,51% in Group B, whereas it increased by 3,71% in Group C and 12,71% in Group D.

In terms of the average incidence of septic mastitis, Table 5 shows that Groups A to D have mean values of 16,11%, 32,62%, 23,98% and 14,41% before drying-off and 7,36%, 13,25%, 27,63% and 19,97% respectively after calving. The incidence of septic mastitis changed, therefore, during the 8 months of lactation following the intracisternal administrations to 45,69% (Group A), 41,84% (Group B), 115,22% (Group C) and 138,49% (Group D) of its original level. In other words the disease incidence was reduced by 54,31% and 58,16% in Group A and B. It increased, however, by 15,22% and 38,49% in Groups C and D.

From all the abovementioned results it is apparent that instillation of each of the 4 different types of intracisternal formulations was followed by considerable changes of the incidence of septic mastitis. Such changes presumably resulted in favourable reductions of the disease in Groups A and B and its unfavourable elevation in Groups C and D. These changes could be related to therapeutic or preventive effects or defects of the formulations administered. An effective prevention of new cases of staphylococcal mastitis would be of great practical advantage.

Table 6 shows that new cases of mastitis reached a total incidence of 3,23%, 2,26%, 9,03% and 12,03% in the Groups A to D respectively. The incidence of mastitis in Groups A to C reached, therefore, only 26,85%, 18,79% and 75,06% respectively of the level observed in Group D. Hence it follows that:

(i) vaccine alone administered to Group A prevented new cases of septic mastitis 3,72 times more effectively than did the base administered to Group D;
(ii) vaccine plus antibiotic administered to Group B prevented new cases of mastitis 5,32 times more effectively than the base (Group D); and
(iii) antibiotics alone were only 1,33 times more effective than the base (Group D).

Calculated in terms of the new cases of septic mastitis observed on the quarters of Group C, the vaccine was 2,80 and vaccine plus antibiotics 4,00 times more effective than the antibiotics alone.

The vaccine plus antibiotics administered to Group B were 1,43 times more effective than the vaccine administered to Group A.

The results thus indicate that vaccine alone and vaccine plus antibiotics undoubtedly reduced the incidence of staphylococcal mastitis. Such a reduction could be due to either therapeutic or preventive activity of the various formulations. Practical experience suggests a combined rather than specifically therapeutic or preventive activity. Kielwein[23], for instance, treated with the same vaccine 16 quarters of cows suffering from penicillin resistant staphylococcal mastitis. To the vaccine was added the same dose of penicillin as he had previously used without success. After calving, the milk of 12 quarters was normal; in 2 quarters the milk showed a normal cell count, together with staphylococci, whereas the 2 remaining quarters remained mastitic.

In addition, the use of vaccine alone and the vaccine plus antibiotics both apparently effected a marked and prolonged protection against new cases of staphylococcal mastitis in mastitis negative quarters (Table 6). Other workers have discussed immunization against

staphylococcal infections,[1 9] or the intramammary production of certain antibodies[16]. The data in Table 6 suggest that the best protection resulted from instillation of the vaccine plus antibiotics formulation. Prevention of new cases of staphylococcal mastitis by this formulation was 1,43 times more effective than that resulting from use of vaccine alone. Both formulations were 4,00 and 2,80 times respectively more effective than antibiotics alone, whereas these 3 formulations were 5,32, 3,72 and 1,33 times respectively more effective than the base alone. In practice the introduction of infections during intracisternal administrations is possible, even when taking careful precautions. For these reasons it appears advisable to use the combined vaccine plus antibiotics formulation rather than the vaccine alone.

CONCLUSIONS

The results suggest that a single dose of the vaccine or of vaccine plus antibiotics administered intracisternally during the dry period to the completely involuted udder reduced very significantly the incidence of septic staphylococcal mastitis during the first 8 months of the subsequent lactation.

Both formulations reduced the total incidence of quarters with mastitis by 74,63% (vaccine) and 60,14% (vaccine plus antibiotics) respectively. The number of diseased quarters after use of both these formulations differed highly significantly from the corresponding values after use of antibiotics and base (Table 4). The lack of significant differences between the distribution of quarters with septic mastitis within experimental groups suggests that such quarters were distributed fairly evenly and unbiased. The favourable results observed are therefore not due to a biased selection of quarters but could be affected, at least partially, by variation in the sizes of the groups.

The results indicate that the decrease of staphylococcal mastitis which followed the use of the vaccine plus antibiotic combination results from both therapeutic and prophylactic actions. This formulation was found to be 1,43 times more effective in preventing new cases of staphylococcal mastitis in the subsequent lactation than was vaccine alone. Both formulations were 4 and 2,8 times more effective in this respect than antibiotics alone and respectively 5,32 and 3,72 times as effective as the base (placebo).

In order also to obviate the introduction of secondary infection during intracisternal instillation it is advisable to use the formulation which contains both vaccine and antibiotics.

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AAN DIE REDAKSIE

Geagte heer

AKABANE-VIRUS IN SUID-AFRIKA

Onlangse navorsing in verskeie lande het getoon dat aborsies, te vroeg gebore diere, doodgebore diere en die sindroom bekend as kongenitale artrogripose-hidranenkefalie in beeste, skape en bokke, onder andere die gevolg van 'n besmetting met Akabane-virus kan wees[6 7 13]. Waarnemings in Japan en in Israel dui ook op 'n seisoenale voorkoms van bogenoemde toestande[5 8].

Sedert 1961 is Akabane-virus uit verskeie insekte, naamlik *Aedes vexans niponnii* geïsoleer[3 9 11]. Teenliggaampies teen Akabanevirus is ook in beeste, skape, bokke, varke, perde en ape aangetoon[4 12]. Die aanwesigheid van Akabane-virus neutraliserende teenliggaampies in doodgebore en in vroeggebore kalwers voor inname van biesmelk het die vermoede gewek dat die virus 'n etiologiese rol by sulke toestande speel. Die hoë persentasie kalwers met die artrogripose-hidranenkefalie sindroom wat teenliggaampies teen Akabane-virus het, in teenstelling met normale kalwers, het die vermoede versterk[4 6 10].

In 1975 is Akabane-virus vir die eerste keer uit dragtige koeie en 'n geaborteerde fetus geïsoleer[7] en kon die sindroom ook eksperimenteel verwek word[5 13]. Ooie wat 30 tot 36 dae dragtig was toe hulle d.m.v. binne-aarse toediening met die virus besmet is se lammers het abnormaliteite soos atrogripose, hidranenkefalie, kifose, skoliose en porenkefalie getoon. Sommige van hierdie lammers het ook teenliggaampies teen Akabane-virus ontwikkel. Ooie wat langer as 36 dae dragtig was gedurende besmetting het normale lammers gehad[5].

Heelwat gevalle van hidranenkefalie in kalwers is sedert 1972 in Suid-Afrika waargeneem. Gedurende die 1974/5 lamseisoen het *hidrops amnii,* gepaard met hidranenkefalie en artrogripose ook in skaaplammers voorgekom. Soortgelyke gevalle kon eksperimenteel in beeste met bloutongvirus[1] en in skape met Wesselsbronvirus en Slenkdalkoorsvirus onderskeidelik verwek word[2]. Die koeie is op 126 tot 138 dae en die ooie op 42 tot 74 dae dragtigheid besmet. In die oorgrote meerderheid van gevalle van abnormale kalwers en lammers kon nie een van bogenoemde virusse as oorsaak van hierdie toestand uitgewys word nie. Gevolglik is ondersoek ingestel na die teenwoordigheid van Akabane-virus in Suid-Afrika.

Voorlopige resultate van 'n opname gebaseer op die teenwoordigheid van virus neutraliserende teenliggaampies in beeste en skape dui aan dat die virus algemeen voorkom in die hoëveldgebiede van Transvaal en die Oranje-Vrystaat. Vyf-en-negentig persent van die beesserums was positief teenoor 3% van die skaapserums, maar die beesserums was hoofsaaklik uit die hoëveldgebiede van Transvaal en die O.V.S. afkomstig, terwyl die skaapserums van die Kaapprovinsie afkomstig was.

Om die oorsaak van hidranenkefalie-artrogripose met 'n redelike mate van sekerheid aan Akabane-virus te koppel is dit noodsaaklik om serum van aangetaste kalwers en lammers wat nog nie biesmelk gesuip het nie, te ondersoek in 'n poging om die betrokke virus te isoleer. Die virus kan uit veral die brein en plasenta[13] geïsoleer word, maar is baie labiel. Materiaal vir virusisolasie moet die laboratorium gou bereik en koud gehou, maar nie bevries word nie.

Met agting

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TO THE EDITOR

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THE RESULTS OF A MASTITIS AWARENESS SCHEME IN DAIRY HERDS IN NATAL AND EAST GRIQUALAND

W. B. HOBBS

ABSTRACT: Hobbs, W. B. **The results of a mastitis awareness scheme in dairy herds in Natal and East Griqualand.** *Journal of the South African Veterinary Association* (1977) **48** No. 3, 163–166 (En) City Health Dept. Box 2448, 8000 Durban, Republic of South Africa.

Over a period of 3 years some 314 widely distributed producers of fresh milk were made aware of their mastitis situation by regularly reporting the results of electronic determination of somatic cell counts in their bulked herd milk. These reports were preceded by information on the significance of high cell counts and followed by information relative to herd control of mastitis.

The data are summarized in 2 figures and 1 table. Statistical analysis reflects a steady and significant improvement in the overall cell count picture over the duration of the programme. No differences could be established between counts on milk delivered in bulk and that delivered in cans. Regional differences existed. Of the herds in which the cell content was reduced to below 500 000/ml, 65% reported an increase in production and a decrease in the incidence of clinical mastitis. In the herds where no decrease in cell content was effected, only 20% reported an increase in production and 30% a reduction of clinical mastitis. Whatever the case, the consumers of the milk benefitted in receiving aesthetically more acceptable milk.

INTRODUCTION

During 1973 an electronic particle counter (Coulter Counter) was made available to the City Health Department of Durban, together with the ancillary equipment necessary for performing counts of the somatic cells in milk samples.

More than 400 fresh milk producers supply milk to Durban, and are situated largely in the midlands and southern Natal and in East Griqualand. They were made aware via newsletters of the relevance of the cell content of herd milk as regards the probable incidence of subclinical mastitis. They were told of the probable losses of profit at the different cell count levels and were advised to make it their aim to reduce their individual herd milk counts to below 300 000 cells per ml as speedily as possible. A circular letter was sent to each producer suggesting practical measures to be applied in order to cause an improvement in the herd mastitis situation. The measures particularly emphasised were the avoidance of "overmilking", regular teat dipping, early diagnosis and treatment of clinical mastitis, culling of cows repeatedly suffering from the clinical condition, proper milking machine maintenance and hygiene at milking time, dry cow therapy and the use of veterinary advice.

Following some initial difficulty regarding the calibration of the Coulter Counter, a start was made in October 1973 with the regular dispatch to each fresh milk producer of the figure reflecting the cell count of his herd milk. The intention was to make a cell count of each herd milk every month, but in practice the interval between sampling has generally been somewhat longer. Each 6 months, in April and October, the arithmetical mean cell count of all his bulk milk samples tested during the preceding half-year is sent to each producer. It was suggested to dairymen that this mean figure is of greater significance than the individual counts as the latter figures, in overseas experience, are frequently subject to wide variations due to a variety of reasons.

MATERIALS AND METHODS

At the outset it was decided to conform as far as possible with the methods employed by the British Milk Marketing Board in respect to the fixing of samples and the technique of presenting the dilutions to the Coulter Counter. This was done so that duplicate samples could be sent to the Board from time to time for counting as a check on the calibration of the Counter and the technique employed.

Samples representative of each producer's herd milk were collected at the bulking point in the case of farmers supplying milk in cans, or directly from bulk refrigerated tanks on the farms so equipped. Samples of can suppliers' milk were taken exclusively by the Dairy Inspectors of the City Health Department but many bulk tank samples had, of necessity to be taken by road tanker drivers. Instructions are that bulk tank milk is to be agitated for 5 minutes prior to sampling. In practice samples were received from each herd somewhat less frequently than monthly.

Cell counts were recorded as reflected by the Coulter Counter without any corrections being made after ensuring acceptably low background counts of particles in the electrolyte. These results were posted to individual owners as were each herd's arithmetical mean count for each 6 month period. The results, together with newsletter information sent from time to time and coupled with film shows, farmers' meetings and farm visits served, as far as possible, to generate and maintain the enthusiasm of producers in continuing with a mastitis control programme within their own herds.

Only those herds that have been cell counted since the inception of the scheme in October 1973 to March 1977 have been included for consideration of the results achieved as regards trends of the cell content of herd milks. This means that herds that went out of production or came into production during that period are excluded from analysis. In all 314 herds have been continuously cell counted since October 1973. Of these, 160 farms are equipped with refrigerated bulk milk storage tanks and 154 farms supply milk in cans. Sixty-two of the herds are situated in East Griqualand and 252 are in Natal.

RESULTS

Table 1 shows the successive 6-month distribution of the participating herds into 4 cell count groups. Also shown are the mean herd cell counts together with the percentage each represents of the mean count for the first 6-month period. It is clear that during the fifth

Table 1: MILK CELL COUNT DATA OF 314 NATAL AND EAST GRIQUALAND FRESH MILK PRODUCING HERDS OVER A 42-MONTH PERIOD

		October 1973 to March 1974	April 1974 to September 1974	October 1974 to March 1975	April 1975 to September 1975	October 1975 to March 1976	April 1976 to September 1976	Octob 19 to Marc 197
Somatic cells per ml milk	<500 000	17 5,4%	33 10,5%	30 9,5%	40 12,7%	31 9,9%	55 17,5%	74 23,6
	500 000 to 750 000	96 30,6%	147 46,8%	148 47,1%	142 45,2%	126 40,1%	138 43,9%	139 44,1
	750 000 to million	140 44,6%	81 25,8%	92 29,3%	90 28,7%	96 30,6%	81 25,8%	69 22,0
	>1 million	61 19,4%	53 16,9%	44 14,0%	42 13,4%	61 19,4%	40 12,7%	32 10,2
314 Herds Natal and E. Griqualand	Mean cells per ml	831 213	770 513	765 277	752 576	802 541	728 417	685 47
	% of first mean	100%	92,65%	92,06%	90,54%	96,55%	87,63%	82,47
92 Natal Herds (Cans)	Mean cells per ml	878 543	820 283	746 413	793 609	840 402	754 880	725 50
	% of first mean	100%	93,37%	84,96%	90,33%	95,66%	85,92%	82,58
62 East Griqualand Herds (Cans)	Mean cells per ml	780 935	669 774	740 339	706 629	632 516	651 452	633 53
	% of first mean	100%	85,77%	94,80%	90,48%	80,99%	83,42%	81,12
160 Herds Bulktanks	Mean cells per ml	823 481	780 225	785 788	746 788	846 656	743 025	682 58
	% of first mean	100%	94,75%	95,42%	90,69%	102,81%	90,23%	82,89
154 Herds Cans	Mean cells per ml	839 247	759 688	743 968	758 591	756 708	713 240	688 47
	% of first mean	100%	90,52%	88,65%	90,39%	90,17%	84,99%	82,03

6-month period (October 1975 to March 1976) there was a deterioration in the overall cell count picture. It is suspected that the reason for this is that the summer in question produced extraordinarily heavy and protracted rains throughout the milkshed, resulting in almost every farm having a mud problem that lasted for weeks on end, constituting a stress and hygiene factor. Difficult to understand, however, is why the herds in East Griqualand as a whole did not suffer a similar setback.

Fig. 1 is a graphic representation of the cell count trends of the 3 groups comprising the 314 participating herds viz. 160 Natal farms equipped with bulk tanks, and 92 Natal and 62 East Griqualand farms supplying milk in cans. Unfortunately fresh milk producers were stimulated to introduce more comprehensive mastitis control measures into their herds prior to regular cell counting commencing, so that cell counts made during the first 6-month period probably reflect some improvement over the pre-project situation. However, the counts made during this initial period have to be used as the starting point for making comparisons so

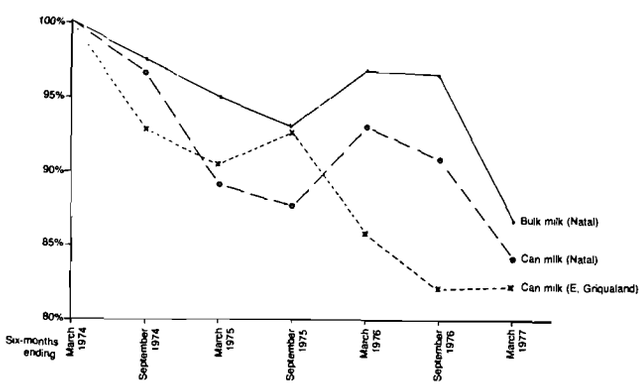

Fig. 1. Rolling mean cell counts as percentages of first mean cell count.

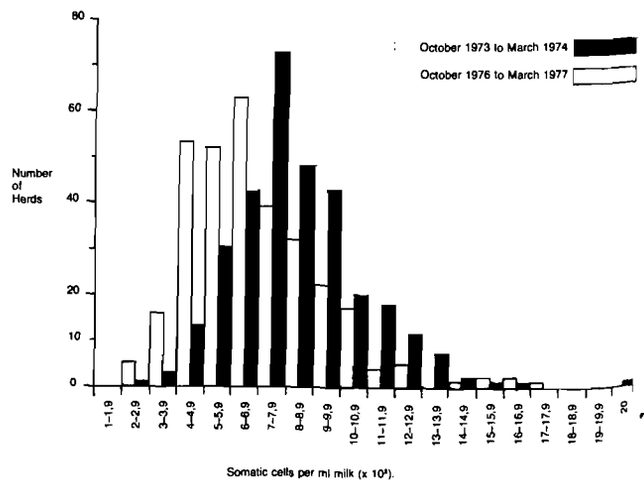

Fig. 2. Distribution of 314 Natal and East Griqualand herds into cell count groups.

that any improvement is measured over 36 months only and not the 42 months the programme had run to March 1977.

Fig. 2 is a histogram indicating the distribution of herds in cell count groups in the initial 6-month period and in the comparable 6-month period 3 years later. The fairly general movement of herds to the left is well illustrated.

The available data have been statistically evaluated and there appears to be a significant improvement in the overall cell count picture over the duration of the programme. It is, of course, impossible to say that the improvement achieved has been due entirely or in part to the institution of this mastitis awareness scheme and the associated control propaganda and advice given to dairymen. However, if it may be assumed that other factors affecting the cell content of milk have remained unaltered during the 42 month period, it could be concluded that the implementation of the programme has brought about this improvement.

Based on the October 1976 to March 1977 figures, there is no evidence to suggest that cell counts differ according to whether milk is supplied in bulk or in cans. Also, taken as a whole, East Griqualand herds have all along exhibited a mean cell count substantially lower than herds in Natal. The overall picture is one of a slow reduction in the cell content of milk derived from the majority of participating herds.

DISCUSSION

Westgarth[5] has stated that the objective of mastitis awareness schemes is to encourage the adoption of control measures, but that some tangible indication of progress is necessary and bulk milk cell counting provides a useful and convenient method. Up to the present time there is no better alternative and cell counting serves as a useful but imperfect means of measuring progress. When a group of herds is involved, any long-term reduction in the percentage of animals affected by subclinical mastitis is accompanied by a downward trend in bulk milk cell counts.

The scheme among fresh milk producers in Natal and East Griqualand registered to supply the Durban market, whereby they have been made aware of the extent of the mastitis problem in their herds, and which was launched in late 1973 and is still in operation, differs fundamentally from some overseas awareness schemes based on milk cell counts. Many of the latter schemes[4,2] comprised only herds whose owners had indicated their willingness to co-operate in applying the recommended control measures, and consequently relatively bigger improvements were recorded over a shorter period.

The programme as described in this paper embraces all registered milk producers supplying Durban, and as such includes many who from the outset have shown no interest in implementing any but the most elementary control measures. A major problem too has been the maintenance of enthusiasm for the scheme among herd owners. Many expected quick results and lost interest, when improvements in cell counts did not quickly materialise. Others, influenced by the wide fluctuations of counts from month to month, lost confidence in the accuracy of the Coulter Counter and consequently lost interest in the continued application of control measures.

Another problem has been that for a long time it was necessary to use milk samples from farm bulk tanks that had been taken by the collection tanker drivers. Sampling errors were frequently suspected and particularly the adequacy of agitation of the milk immediately prior to sampling. In the United Kingdom bulk tank herds have cell counts on average 12% higher than herds supplying in cans[1]. This project has shown that the mean cell count of herds supplying milk in bulk has all along been somewhat higher than that of herds supplying can milk. Since mid-1976 sampling from farm bulk tanks has not been a function of tanker drivers and the mean cell counts of bulk and can milk at the end of March 1977 were very nearly the same. Whether this is due to better sampling procedure or to other factors is not known.

Overseas investigators have reported unexplained regional differences in average cell counts[1,3] and a similar phenomenon has been found to pertain here. The East Griqualand herds, all supplying in cans, commenced with a mean cell count some 100 000 cells/ml lower than the Natal herds supplying milk in cans and this difference has been more or less maintained throughout. Furthermore, the East Griqualand count during the fifth 6-month period did not show the pronounced rise shown by the Natal herds and which has been put down to the exceptionally wet weather experienced. These findings cannot be explained on climatic differences. It is possible that latitude plays a part as workers in the northern hemisphere have reported similar findings.

Reduced cell counts may be due in part to a greater awareness of the disease on the part of producers, resulting in earlier diagnosis of clinical cases and therefore the exclusion from the bulk supply of more grossly diseased milk than previously. Also, the willful addition of unsound milk to the milk supply may have been reduced as a result of the scheme.

In a practical programme such as this it has not been possible to measure the benefits derived from achieving a low herd milk cell count. However, some 65% of herds that have experienced a reduction of count to below 500 000 per ml report increased milk production per cow and approximately 70% of these herds report a definite decrease in the incidence of clinical mastitis. Of course, these improvements may be attributable to management and feeding changes unrelated to measures aimed at reducing the cell count. It is interesting, however, that only some 20% of farmers whose herds have shown *no* decrease in cell content report an increased milk production per cow and only some 30% report an estimated decrease in the number of cases of clinical mastitis.

Whatever the benefits to the dairyman, it is evident that the milk consumer benefits from a programme such as that described as he receives a more aesthetically acceptable product and one which must have a better keeping quality.

ACKNOWLEDGEMENTS

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QUESTIONS AND ANSWERS — VRAE EN ANTWOORDE

Q: *The California Mastitis Test (CMT)*

Many dairy farmers are now using this test periodically to assess the mastitis situation in their herds and to select cows for treatment.

How good is the test in detecting bacterial mastitis? Are there any particular points concerning application and interpretation of the test in a herd mastitis control programme?

A: The CMT is based on the presence of DNA liberated from somatic cells present in the milk and on the pH of the secretion.

Prof. O W Schalm originated the CMT and considered it as a screening test primarily intended to detect managemental faults influencinng the incidence of mastitis in a herd. Subsequently it has been shown that there is a relationship between the CMT and the type of bacteria isolated from the milk concerned.

In using the test, the following must be borne in mind:

1. The optimal proportion of reagent to milk is 1:1. Too little reagent precludes full development of positive reactions; too much does not significantly alter results. The reactions should be properly graded as negative, trace, and 1 to 3 t.
2. The same fraction or aliquot of milk should always be used. The cell content of foremilk, succeeding fractions and strippings can vary greatly. Positive reactions are more intense with foremilk and tend to become weaker or negative in succeeding streams. Generally; foremilk (first 2-3 jets) is preferred.
3. The milk from all 4 quarters of a cow should be examined and the results compared in order to distinguish between systemic or physiological causes for an elevated cell content and pH on the one hand and true mastitis on the other. It is rare for all 4 quarters to be mastitic.
4. The CMT cannot distinguish between septic and aseptic forms of mastitis, nor between physiological and pathological causes of elevated cell content and pH. In small hand-milked herds up to 8,1% of quarters yielded milk giving 2+ and 3+ CMT reactions and yet free of bacteria. In large machine-milked herds this figure rose to 17,7%.
5. The CMT gives a distinctly positive reaction only when the number of somatic cells exceeds 800 000/ml. Not all quarters affected with bacterial mastitis will yield milk containing such high cell counts. In large machine-milked herds only 87,7% of quarters known to be infected with *Streptococcus agalactiae* produced milk which was scored 2+ or 3+ by the CMT. In small hand-milked herds the figure was as low as 55,7%.
6. Quarters infected with relatively apathogenic bacteria such as *Staphylococcus epidermidis* may hield milk scoring 2+, 1+ and "Trace" to the CMT.
7. The following relationship has been found to exist between CMT scores and the isolation of at least one type of potentially mastitogenic organism from the milk:

CMT Score	Neg	Trace	1+	2+	3+
Bacteria	6,0%	6,5%	27,3%	64,7%	71,3%

One of the more important ways in which the CMT is incorrectly used is its application to assess the success of recently applied intramammary therapy. Such therapy usually lasts for two to four days, and the farmer may expect the CMT to become negative where therapy has been successful. It is, however, rare for the cell content and pH to fall to normal levels within a few days after treatment even if the quarter has been freed of the organism originally responsible for the inflammation. The intramammary administration of any substance in itself will elevate the cell content of the milk, and tissue inflammation and repair is not instantly concluded after removal of the aetiological agent. Return to normal cell content and pH usually takes 7-10 days or longer, depending on factors such as severity of inflammation and stage of lactation. Unless this is fully realised, intramammary treatment may be unnecessarily repeated – at the expense of the owner and with the risk of superimposed yeast and fungal infections long after the original bacterial cause has been eliminated.

In conclusion it may be said that when properly performed and intelligently interpreted, the CMT is a most useful cowside test for abnormal pH and cell content of milk. This may be, and frequently is, the result of bacterial mastitis – but not necessarily so. It may miss some cases of true bacterial mastitis. It may result in unnecessary and harmful use of intramammary antimicrobial preparations. It cannot be used to judge the success of recent treatment. It cannot altogether replace full laboratory examination of milk samples. In experienced hands it can play an important role in an organised mastitis control programme.

When carefully interpreted, the CMT provides a valuable indication of the percentage loss of milk yield of a quarter subclinically affected with mastitis. For this purpose the following scheme is used:

CMT Reaction	*Percentage loss*
0	0
T	9
1+	18
2+	27
3+	36

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June 1977

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Die mees belangrike 21 dae in 'n koei se jaar.

Die Probleem.

'n Hoë persentasie koeie het 'n residuele infeksie aan die einde van laktasie.

Daarby is alle koeie vatbaar vir 'n nuwe infeksie gedurende die vroeë stadia van die droë periode. Met 'n paar uitsonderings sal dit gedurende die eerste 10 tot 21 dae voorkom.

Die Antwoord.

Orbenin Droë Koei is ontwerp om beide hierdie probleme te oorbrug. Dit is geformuleer as gevolg van aanhoudende navorsing, beide in die laboratorium en in die veld.*

Orbenin Droë Koei is bakteriedodend teen streptokokke, penisillien sensitiewe en penisillien weerstandbiedende staphylokokke, die mees oorsaaklike organismes wat in residuele en nuwe infeksies gevind word.

Dit was duidelik uitgewys dat infeksie tydens kalwing gewoonlik van NUWE oorsprong en meesal 'n omgewings, of Gram -we infeksie is. Behandeling tydens daardie tyd met 'n breëspektrum Lakterende Koei produk soos Ampiclox L.K. is nodig om genoegsame antibiotiese konsentrasies te bereik om mastitis tydens kalwing te voorkom.

Orbenin Lakterende Koei en Ampiclox L.K. is bedoel om mastitis gedurende laktasie te beheer. Ampiclox word veral aanbeveel wanneer coliforme vermoed word.

Orbenin (kloksasillien) en Ampiclox (ampisillien/kloksasillien) is Beecham handelsmerke.

*Die jongste kliniese proef het 507 kuddes oor 'n tydperk van 3 jaar ingesluit – Brander G.C., Watkins J.H., en Gard R.P., Vet Rec. (1975) 97. 300-304.

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VAGINAL CYTOLOGICAL CHANGES IN THE CYCLING AND ANOESTROUS ANGORA GOAT DOE

P. S. PRETORIUS

ABSTRACT: Pretorius, P.S. **Vaginal cytological changes in the cycling and anoestrous Angora goat doe.** *Journal South African Veterinary Association* (1977) **48** No. 2 169–171 (En) Faculty of Agric, University O.F.S., Bloemfontein, Rep. South Africa.

The general smear pattern in the oestrous doe was characterised by a copious flow of thin clear mucus which formed distinct fernlike crystallisation patterns. Following ovulation the cervical secretion became a thick white cheesy mass containing large numbers of cellular elements and debris. The luteal period, as well as anoestrus was marked by a scant serous secretion which formed no crystallisation patterns. Leukocytes occurred in varying quantities throughout the cycle. Desquamation of the vaginal epithelium reached a high level during late oestrus when large numbers of cornified cells occurred in the smear. It is concluded that the cytological changes in the vaginal epithelium of the Angora doe appeared to be influenced by cyclical ovarian activity and could be used to assess ovarian oestrogenic activity.

INTRODUCTION

Striking differences occur in the physical characteristics of cervical secretions during different reproductive stages in the female and are mainly related to ovarian oestrogenic activity. Various workers have also investigated the cytological changes which occur in the vaginal epithelium of several animal species during the successive stages of the oestrus cycle.

In laboratory animals changes in the vaginal smear pattern were described by Stockard & Papanicolaou[1] (guinea pig); Allen[2] (mice) and Long & Evans[3] (rat). In farm animals Alliston, Patterson & Ulberg[4] reported on the cow; Wilson[5] on the sow; Cole & Miller[6], Radford & Watson[7], McDonald & Raeside[8], Sanger, Engle & Bell[9] and Raeside & McDonald[10] on the ewe. Hamilton & Harrison[11] and Parer[12] investigated the histological changes in the vaginal epithelium of goats. The aim of these studies was to develop a quantitative assay for oestrogenic activity or to investigate the vaginal rhythm in various age and breeding groups.

In the course of a study on the gonadotrophic hormone activity of the anterior pituitary in Angora goats data also became available on the cyclical rhythm of the vaginal epithelium and its relation with ovarian activity. No such observations in this goat breed seem to have been reported. The object of this paper is to report on these changes.

PROCEDURE

Reproductive stages

Mucus samples were collected from does displaying normal periodicity of oestrus. Six collections were made, one from each doe, during the following reproductive stages: Pro-oestrus (Day -1); early oestrus (Day 0, viz. 4h following the onset of behavioural oestrus); late oestrus (Day 1, viz. 36h following the onset of oestrus; early luteal stage (Day 6); mid luteal stage (Day 12); late luteal stage (Day 18) and early, mid and late anoestrus (the date of collection determined by that of the previous anoestrous period). Oestrus was detected twice daily with the aid of vasectomised teaser Angora rams.

Collection of mucus and preparation of smears

Samples of cervical mucus were collected from the *fornix* of the vagina with the aid of a sterilized cotton wool swab and speculum. The collected sample was spread into a thin layer onto 2 separate clean dry glass slides. One slide was fixed immediately in equal parts of petroleum ether and 95% alcohol for 2 min., while the other was dried on a hotplate for evaluating crystallisation patterns ("ferning").

Evaluation of mucus and cell types

Subjective values ranging from 0 to 3, were used to designate the variation in the viscosity of the mucus which ranged from a scant and relatively dry secretion to a watery thin and copious flow of mucus.

Crystallisation patterns ("ferning") in the dried mucus smears were assessed microscopically (X500) according to the following gradation scheme:

(i) 0 = No crystallisation visible
(ii) 1 = Small scattered patterns
(iii) 2 = Typical fernlike patterns, scattered over the slide area
(iv) 3 = Distinct fernlike crystallisation patterns covering almost whole of the slide area.

Fixation and staining of the smears were carried out according to the method described by Shorr[13]. This staining procedure provided a sharp differentiation between cornified and non-cornified elements in the smear. Cornified cells stained a brilliant orange-red and non-cornified elements shades of green according to their age. Leukocytes stained a purplish-blue.

The number of cellular elements was quantitatively counted in 10 microscopical view fields (X500) in such a way that the whole slide area was covered. Epithelial cells were differentiated by their size and shape as well as colour. Three types of epithelial cells were distinguised, viz. nucleated round (round medium sized cells with distinct outlines and well defined nucleus), nucleated squamous (larger angular, thinner and flatter cells with continuous outline and granular nucleus) and cornified cells (largest, thinnest and flattest of all cells, angular with fragmented outline, nucleus absent).

RESULTS

The general smear pattern in the cycling doe was characterised by a copious flow of thin clear mucus. This formed strong fernlike crystallisation patterns during pro-oestrus (Day -1) and shortly following the onset of behavioural oestrus (Day 0) (Table 1). Following ovulation the quantity and viscosity of the mucus decreased rapidly towards late oestrus (Day 1) and the presence of large numbers of cells gave the secretion a dry cheesy appearance, which displayed no crystallisation (Table 1).

The luteal period and anoestrus were characterised by the presence of very limited amounts of secretion and no crystallisation occurred. A secretion with a slightly cheesy appearance was, however, recorded towards the end of the anoestrous period (Table 1).

The number and frequency distribution of epithelial cells and leukocytes recorded are graphically illustrated in Figs. 1, 2 and 3.

From Fig. 1 where the total number of cellular elements present in the smear are given it is evident that the oestrous period (Day -1 to Day 1) is characterised by the presence of relative large numbers of cells, while the luteal period is marked by a general decrease in cell numbers. From the late luteal phase (Day 18) until pro-oestrus of the next cycle (Day

Table 1: VISCOSITY AND CRYSTALLISATION PATTERNS IN CERVICAL MUCUS OF ANGORA GOAT DOES DURING DIFFERENT STAGES OF THE OESTRUS CYCLE AND IN ANOESTRUS

Reproductive stage	Viscosity (0 to 3) (n = 6)	Crystallisation pattern (0 to 3) (n = 6)
Oestrus cycle		
Pro-oestrus (Day -1)	3,0	2,8
Early oestrus (Day 0)	3,0	2,7
Late oestrus (Day 1)	1,5	0,0
Early luteal phase (Day 6)	0,0	0,0
Mid luteal phase (Day 12)	0,0	0,0
Late luteal phase (Day 18)	0,0	0,0
Anoestrus		
Early anoestrus	0,1	0,0
Mid anoestrus	0,1	0,0
Late anoestrus	0,2	0,0

-1) a sharp increase in cell numbers occurred. This increase was mainly due to an increased leukocyte count (Fig. 2a). Fig. 1 also illustrates that the major part of the anoestrous period is characterised by relative low cell counts. During early and mid anoestrus the number of cells were equal or less than that recorded during the late luteal phase in the cycling doe. A sharp increase in number of cells was, however, evident towards the end of anoestrus.

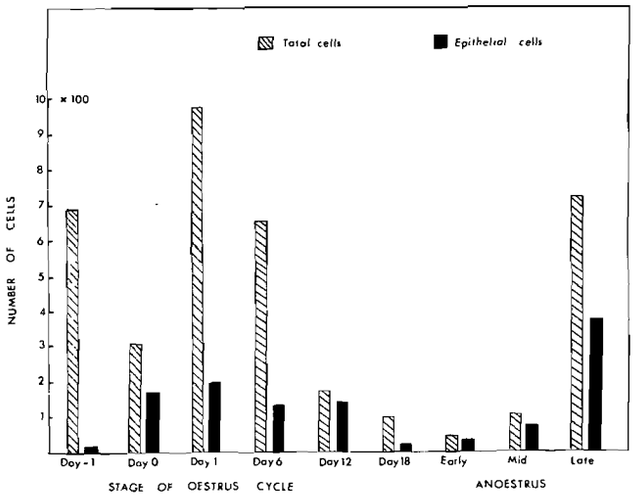

Fig. 1 – Vaginal cytological changes during different stages of the oestrous cycle and anoestrus in Angora goat does

Epithelial cells constituted a relative small part of the cellular elements present in the smear during pro-oestrus (Day -1), while leukocytes made up the larger part of the total cell count (Fig. 1). Following the onset of oestrus (Day 0 to Day 1) increased numbers of epithelial cells were recorded, while a declining tendency became evident as the luteal phase advanced (Day 6 to Day 18). The period of anoestrus was marked by a progressive increase in the occurrence of epithelial cells as anoestrus advanced. This tendency was especially noticeable towards late anoestrus (Fig. 1).

From Fig. 2a in which the different cell types are quantified, it is clear that leukocytes contribute almost 97% to the total cell count during pro-oestrus (Day -1). Nucleated round and nucleated squamous cells constituted the predominant epithelial cell types during this stage. Little cornification of cells had occurred (Fig. 2b). Following the onset of behavioural oestrus (Day 0) a sharp increase in the number of epithelial cells became noticeable. This was accompanied by a decrease in the number of leukocytes (Fig. 2a). Nucleated round and squamous cells were still predominant although signs of increased cornification became evident (Fig. 2b). Following ovulation during the later half of oestrus (Day 1) a mass influx of leukocytes occurred. This persisted until Day 6 of the luteal period (Fig. 2a). The number of nucleated round epithelial cells declined to a low level at Day 1, while squamous and cornified cells displayed a concomitant increase (Fig. 2b). Cornification reached a maximum during this stage in the cycling doe.

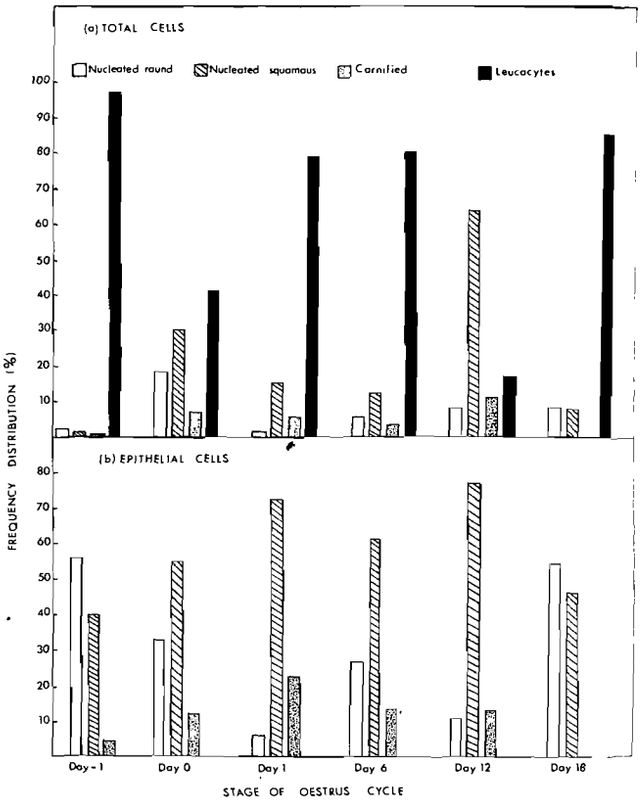

Fig. 2 – Frequency distribution of epithelial cells (nucleated round, nucleated squamous and cornified) and leucocytes in the vaginal smears of Angora goat does during different stages of the oestrus cycle

During the early luteal period (Day 1 to Day 6) the proportion in which leukocytes and epithelial cells occurred remained almost unchanged (Fig. 2a). Of the epithelial cells present in the smear only nucleated round cells displayed an increase (Fig. 2b). Squamous and cornified cells, on the other hand, declined in numbers during the corresponding period (Day 1 to Day 6). According to Fig. 2a relatively few leukocytes occurred during the mid-luteal phase (Day 12) of the cycle compared to epithelial cells. Large numbers of squamous cells in proportion to other epithelial cell types were recorded during this stage of the cycle (Fig. 2b). It is also evident from Fig. 2 that the second half of the luteal period (Day 12 to Day 18) was characterised by an increased leukocyte count although the total number of cellular elements present in the smear remained relatively low. No cornified cells were present on Day 18, while nucleated round cells displayed a proportionally sharp increase.

During the period of anoestrus epithelial cells constituted a larger part of the total cell count compared to leukocytes as was recorded in the cycling doe (Figs. 2 and 3). Of the epithelial cell types recorded in the anoestrous female, nucleated round and squamous cells constituted the main types. Cornified cells appeared in limited numbers during the period of anoestrus (Fig. 3).

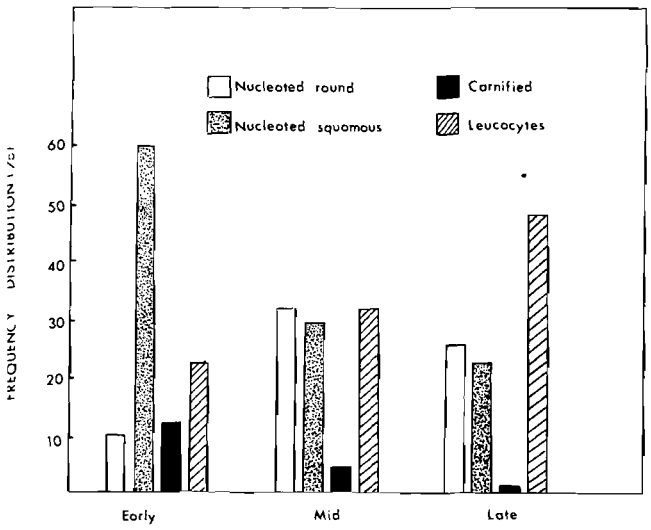

Fig. 3 – Frequency distribution of epithelial cells and leucocytes in the vaginal smears of Angora goat does during anoestrus

DISCUSSION

The cyclical changes in the physical properties (viscosity and crystallisation patterns) of the cervical secretions from the Angora doe recorded in the present study are in close agreement with similar observations in other female farm animals[5 7 8 9 11 15].

It was not only the physical properties of the cervical secretions which displayed changes but various cytological changes of the vaginal epithelium were also evident.

Cornification and stratification of vaginal epithelial cells are 2 of the major responses of the vaginal epithelium to oestrogen[7 9 15]. Following a period of increased ovarian activity leading to ovulation (Pretorius[16]) essential levels of oestrogen decrease and desquamation of the epithelium occurs. This results in increased numbers of cornified cells in the smear. During the luteal phase of the cycle, when ovarian follicular activity is low and in anoestrus (Pretorius[16]), when there is usually only slight oestrogenic activity in the ovaries, desquamation did not occur to a significant extent and few cornified cells appeared.

These cytological changes in the vaginal smear pattern of the Angora doe correspond to the histological changes of the vaginal epithelium reported in some other goat breeds by Hamilton & Harrison[11]. They also followed the general smear pattern reported in the African dwarf goat[12] and various sheep breeds[6 9 17].

From the physical properties of the cervical secretions as well as cytological picture of the vaginal epithelium it is clear that it could be used to describe ovarian oestrogenic activity in the Angora goat doe.

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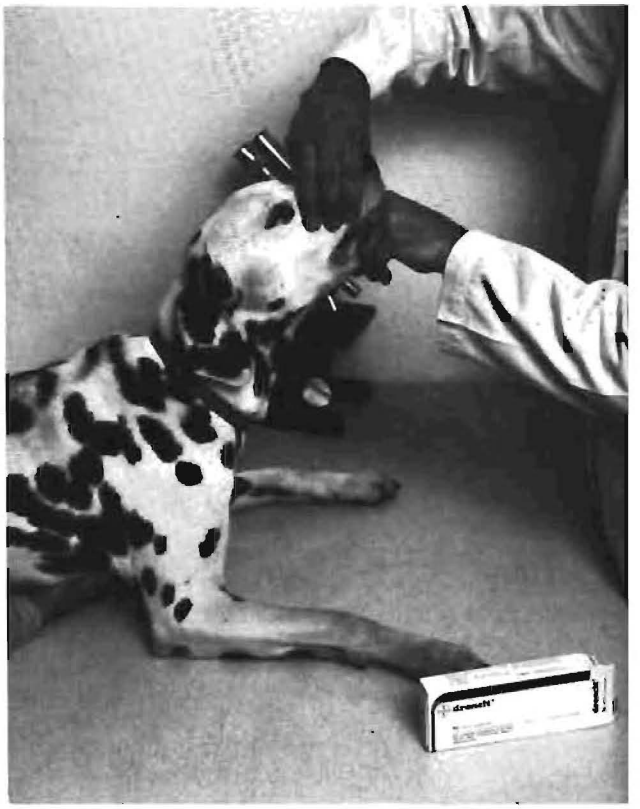

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A. P. SCHUTTE

ABSTRACT: Schutte A.P. **Examination for infertility in cattle.** *Journal South African Veterinary Association* (1977) **48** No. 3 173–175 (Afr) Sect. Reprod., Vet. Res. Inst., 0110 Onderstepoort, Rep. of South Africa.

In order to evaluate clinically recognisable manifestations while undertaking examinations for fertility in cattle it is necessary to take cognizance of the physiological events taking place during the *puerperium*. The frequently incorrect diagnoses of cystic degeneration of the ovaries during this period can be avoided if the mechanisms controlling ovarian activity are properly understood. The close interaction between the ovaries, the hypothalmus, the hypophysis and adrenals as well as the luteolytic mechanism controlling ovarian activity is discussed. Attention is focussed on the effect of various pathogens on the endometrium, the influence of nutrition on the reproductive cycle and the consequent ovarian changes.

The necessity to institute fertility examinations on a herd basis is stressed rather than attempts at treating the individual animal which, according to the owner, requires veterinary attention. By doing so a much more satisfactory service can be rendered. The existence of competent diagnostic centres, where the practitioner can obtain a metabolic or infection profile, is absolutely essential when fertility examinations on a herd basis are considered.

Inleiding

Waar die veearts ondersoeke na voortplantingsteurnisse onderneem, word dikwels van hom verwag om gedurende 'n enkele besoek 'n diagnose te stel, die etiologie oor die kraalmuur te eien en subiet 'n aanvaarbare oplossing aan die hand te doen. Dis te betwyfel of daar wel veeartse is wat hiertoe in staat is. Ondersoek toon dat hierdie diens dikwels diepgaande studies behels en dat die probleem slegs na wense opgelos kan word indien die klinikus deur goed toegeruste dianostiese laboratoria gerugsteun word.

Onvrugbaarheid is slegs 'n samevattende term wat die onvermoë van die dier omskrywe om binne 'n vasgestelde periode te reproduseer. Die redes waarom sekere diere van hierdie patroon afwyk is nie maklik identifiseerbaar nie. Gewoonlik is dit moonlik om met enkele ondersoeke die steriliteitsprobleem by vroulike diere as funksioneel of as besmetlik van oorsprong te klassifiseer. Eweso is dit ook dikwels moontlik om by die manlike dier 'n diagnose van gebrek aan *libido,* of *impotentia coeundi,* of *impotentia generandi* te maak. In teenstelling is dit nie so maklik om die etiologie uit te wys en om oplossings te formuleer nie.

Die praktisyn word gekonfronteer met gevalle wat in een van twee groepe ingedeel word, naamlik (1) die individuele dier met sekere teelafwykings en wat volgens die eienaar buite kuddeverband staan, of (2) diere met teelafwykings, wat soms, maar nie noodwendig deur die eienaar as 'n kuddeprobleem gesien word nie. By nadere ondersoek blyk hierdie klassifikasie gewoonlik verkeerd te wees omrede die individuele diere waarmee die praktisyn gekonfronteer word, selde los van die kudde staan.

Die veearts besit 'n indrukwekkende terapeutiese armamentarium om funksionele steurnisse die hoof te bied en die lys van middels word al hoe langer. Groot verwarring heers oor die doeltreffendheid (en die noodsaaklikheid) van terapeutiese ingryping in sulke gevalle. Terwille van helderheid en die individuele geval wat aandag regverdig is dit wenslik om 'n werkshipotese vanuit basiese fisiologiese aspekte van voortplanting saam te stel om die abnormale geval te identifiseer. Uitkenning van die abnormale geval berus op kennis van hoe die normale dier funksioneer.

1. Die ovariese-hipofiseale-adrenale as[4 15]

In soverre dit die endokrinologiese aspekte aangaan, is dit nie verbasend dat al hoe meer inligting gedokumenteer word wat daarop dui dat die bynierskors 'n belangrike rol speel t.o.v. vrugbaarheid nie. Dis veral so as gelet word op die feit dat beide die ovaria en die byniere dieselfde embriologiese oorsprong het.

Beide besit die vermoë om steroïede te produseer wat die geslagstelsel direk beïnvloed; beide beskik oor ensiemstelsels wat progesteroon, androgene en estrogene (in hierdie volgorde) vanuit asetaat kan produseer. Hierbenewens beskik die byniere ook nog oor ensiemstelsels wat progestagene na kortikoïede kan ombou en by uitstek die steroïede, kortisol en kortisoon, tot stand bring. Die follikulêre wand bevat ensiemstelsels wat progesteroon verder na androgene en estrogene verbou terwyl die *corpus luteum* progesteroon as sulks vrystel omrede soortgelyke ensiemstelsels ontbreek.

Indien enige van hierdie ensiemstelsels om een of ander rede ontbreek, of oormatige stimulasie van 'n betrokke aktivator plaasvind, kan dit 'n aansameling van ongewensde hormonale fraksies tot gevolg hê. Dit kan weer aanleiding gee tot kliniese waarneembare afwykings soos bv. sistiese *corpora lutea.*

2. Die hipotalamus as kontroleur

Die hipotalamus beïnvloed of beheer die vrystelling van gonadotropiene vanuit die hipofise deur middel van vrystellingsfaktore (FSH/RF en LH/RF). Die gonadotropiene (LH en FSH) stimuleer die ovaria om estrogene of progesteroon te produseer en vry te stel na gelang die stadium van die siklus. Estrogene het 'n direkte en inhiberende invloed op die hipotalamus.

Volgens resente werk blyk daar twee kerne in die hipotalamus te wees wat die hipofese en derhalwe vrystelling van FSH en LH beheer. Kern A, geleë in die meer mediale gedeelte van die hipotalamus, is verantwoordelik vir die konstante (en deurlopende) vrystelling van gonadotropiene wat vir basale ovariese aktiwiteit benodig word. Die tweede (kern B), geleë in die pre-optiese area van die anterior hipotalamus, sorg vir periodieke vrystelling van groter hoeveelhede van gonadotropiene soos bv. gedurende ovulasie.

Hierdie kerne is ook in die manlike dier teenwoordig. Kern B funksioneer egter nie. Derhalwe is daar net 'n konstante en deurlopende vrystelling van gonadotropien vir basale benodigdhede. Geen "pieke" of "golwe" van produksie soos in die geval van die vroulike dier kan aangetoon word nie. Die rede hiervoor is dat die androgene wat in groot hoeveelhede in die manlike dier geproduseer word, kern B onderdruk en funksioneel uitskakel.

Die totstandkoming van organiese letsels in die hipotalamus sal alleenlik reproduksie beïnvloed indien kerne A en B hierby betrokke raak. Gewoonlik is dit so dat met ligte ontaarding kern B eerste uitgeskakel word en dat anovulatoriese siklusse, en veel later sistiese ontaarding van ovariese strukture, die enigste klinies waarneembare afwyking sal wees. As beide kerne uitgeskakel word, is die uiteinde fibrotiese en totaal onaktiewe eierstokke.

Referaat gelewer tydens die Jaarkongres van die Vrystaat en Noordkaaplandse Tak, SAVV, Kimberley, 1976.

3. Die baarmoeder-ovarium verhouding[4 10 12]

Gedurende 'n spesifieke periode van die estrussiklus tree 'n meganisme in werking wat regressie van die *corpus luteum* tot gevolg het. Hierdeur kom die huidige siklus tot einde en die ovaria berei voor vir die ontwikkeling van nuwe follikels en verder ovulasies.

Eweso word aanpassings gemaak indien daar gedurende hierdie spesifieke periode 'n embrio in die baarmoeder teenwoordig is en die *corpus luteum* behoue bly. Hierdie aanpassing is natuurlik van die grootste belang omrede die *corpus luteum* gedurende die eerste 150 dae van dragtigheid funksioneel moet bly om dragtigheid instand te hou.

Basies werk hierdie luteolitiese meganisme deur een van twee bane, naamlik die sistemiese-utero-hipofiseale baan, of die plaaslike en eensydige utero-ovariese baan. Indien hierdie meganisme om die een of ander rede onklaar raak, is die resultaat weereens sistiese ontaarding van die ovaria.

In die praktyk kom dit daarop neer dat indien die endometrium, waar die uterolitiese substans prostaglandine geproduseer word, vroeg in die siklus beskadig of irriteer word, dit aanleiding gee tot verkorte estrus-siklusse. Dit volg dan ook op infeksie met *Campylobacter fetus* en *Trichomonas fetus.*

Hierteenoor word ondervind dat irritasie van die endometrium gedurende die latere gedeelte van die estrussiklus, d.w.s., gedurende die stadium wanneer die luteolitiese meganisme normaalweg in werking sou getree het, aanleiding gee tot verlengde siklusse. (Die *corpus luteum* bly behoue).

Waar ligte beskadiging van die endometrium aanleiding gee tot abnormale siklusse word ondervind dat anestrum volg op chroniese prosesse of erge beskadiging – bloot deurdat die *corpus luteum* nie regressie ondergaan nie.

4. Die puerperiumfase[1 3 4 10 11 16]

Sonder 'n volledige kennis van die fisiologiese aspekte van die *post partum* periode by die koei kan die voorgestelde werkshipotese nie volledig saamgestel word nie. Dit is juis gedurende hierdie periode waar die meeste empiriese behandelings uitgevoer word.

Koeie wat normaal gekalwe het en geen komplikasies gedurende die onmiddellike *post partum* periode ondervind het nie, ondergaan reeds so vroeg as 15 dae na kalwing sekere ovariese veranderinge. In sulke gevalle kan reeds 18 dae *post partum* 'n *corpus luteum* d.m.v. rektale ondersoek vasgestel word. In ongeveer 80% van hierdie eerste siklusse en bykans die helfte van die daaropvolgende siklusse, kom stilovulasies voor en is estrus derhalwe nie klinies waarneembaar nie. Die lengte van die siklusse gedurende die puerperiumfase is ook heelwat korter (15-16 dae) as die normale estrussiklus. Die rede vir hierdie "abnormale" estrussiklusse word toegeskrywe aan die vrystelling van FSH en LH wat eers enkele weke na *partus* weer op 'n normale peil ingestel word.

So dikwels word 'n diagnose van *corpus luteum*-retensie gemaak. Met bogenoemde inligting as agtergrond is dit ook te wagte dat solank daar nie kennis geneem word van die normale fisiologiese veranderings wat gedurende die puerperium plaasvind nie, foutiewe diagnoses steeds gemaak word.

Indien retensie van die *corpus luteum* van dragtigheid wel plaasvind, moet dit in gedagte gehou word dat hierdie *corpus luteum* prakties geen progesteroon bevat nie en derhalwe ook nie die aanvang van die eerste siklus wesenlik kan beïnvloed nie. In die verlede is die *corpus luteum* van die eerste estrussiklus dikwels verkeerdelik as die van dragtigheid geklassifiseer en behandeling daarvolgens ingestel. Let egter daarop dat met *post partum* – komplikasies en met beskadiging van die endometrium, retensie van die *corpus luteum* van die eerste siklus wel kan plaasvind en dit kan tot anestrum aanleiding gee.

Van nog groter belang is die voorkoms van sistiese follikels en sistiese *corpora lutea* gedurende die *post partum* periode. In 22% van melkkoeie kan sistiese follikels na die eerste siklus gediagnoseer word terwyl die toestand in 6% van normale koeie selfs na die tweede estrussiklus aangewys is.

Benadering tot die behandeling[1–3 6 9 13–15 17 18]

Dit is ongelukkig so dat die verskeidenheid van biologiese, biochemiese en chemiese toetse wat uitgevoer kan word om hormonale afwykings in die mens te identifiseer buite die bereik van die praktiserende dierarts is. Hy moet derhalwe op sy kliniese vernuf staatmaak. Uit die aard van die saak moet die moontlike invloed van wanvoeding, besmetlike toestande, produksiesteurnisse en erfbare afwykings nagegaan en uitgeskakel voordat 'n diagnose van 'n funksionele steurnis wat aan 'n hormonale afwyking toe te skrywe is, gemaak word. Daar durf nie uit die oog verloor word dat mens onder hierdie omstandighede hoogstens in staat is tot 'n kliniese diagnose – wat nie noodwendig korrek is nie.

Sistiese follikels

Die diagnose van sistiese follikels berus noodwendig op die herhaalde identifikasie van 'n fluktuerende struktuur of strukture tydens 2 tot 3 ondersoeke oor 'n periode van 10 dae. Wat reeds gesê is betreffende die voorkoms van ovariese siste gedurende die vroeë puerperiumfase moet in gedagte gehou word. Hierbenewens moet kennis geneem word van gevalle wat spontane genesing ondergaan. Herstel by hierdie gevalle word gewoonlik onbewustelik aan die doeltreffendheid van 'n middel toegeskryf.

Verskeie middels word vir die behandeling van sistiese degenerasie van die ovaria aanbeveel en algemeen gesproke, blyk dit dat ongeag die middel redelik goeie resultate verkry word. Ongelukkig is dit egter nie altyd duidelik uit die resultate soos gedokumenteer hoe die diagnose van sistiese follikels gemaak is nie en gedurende watter stadium van die teelsiklus die siste wat behandel is, voorgekom het nie. Desnieteenstaande is die gebruik van gonadotropiene of progesteroon of dan wel prostaglandine sekerlik van waarde indien die diagnose van sistiese ontaarding korrek is. Een metode wat egter nie aanbeveel kan word nie, is die dreinering of ruptuur van die siste deur rektale manipulasie. Hier is die gevaar van iatrogeniese steriliteit veels te groot.

In soverre dit die behandeling van sistiese degenerasie van die *corpus luteum* en luteale siste aangaan, is dit ook belangrik om die voorkoms hiervan met die stadium van die teelsiklus te koppel. Gedurende die puerperiumfase is hierdie afwykings van geen belang nie. Hierteenoor is behandeling geregverdig indien die afwyking met latere estrussiklusse in verband gebring kan word. 'n Sistiese *corpus luteum* word omskrywe as 'n struktuur in die eierstok wat rektaal identifiseer kan word – hoofsaaklik op 'n vloeistof-gevulde holte van ±10 mm of meer in deursnee.

Die kuddebenadering[1 2 4 5 7–9 13 16]

Met kennisname van die individuele geval waarmee die praktisyn gekonfronteer word en waarvoor hy oplossings moet formuleer, moet die vraag gestel word of die veearts werklik die veebedryf dien deur slegs 'n diens ten opsigte van die enkele dier aan te bied. Anders gestel, wat moet meer gedoen word om die boer te help in sy strewe tot optimale produksie?

Sou ons 'n meer omvattende diens wil aanbied, dan is een van die eerste aspekte wat reggestel moet word die benadering tot kudde ondersoeke. Laat ons maar aanvaar dat die veearts van beperkte waarde vir die veebedryf is indien hy voortploeter met die geykte idees van "brandweer veeartsenykunde". Ons moet wegkom uit die situasie waar die boer besluit wanneer 'n dier van die normale teelpatroon afwyk en wanneer veeartsenykundige ingryping nodig is. Die boer moet tot die besef gebring word dat die veearts, ekonomies gesproke, nie in sy boerdery-sisteem kan inskakel as hy net uitgeroep word na diere wat volgens die siening van die eienaars veeartsenykundige hulp nodig het nie. Ek wil dit aan die hand doen dat die gevalle in Tabel 1 geneem, op 'n bloot roetinegrondslag ondersoek en indien nodig, behandel moet word.

Tabel 1: DIERE WAT SPESIALE AANDAG TYDENS ROETINE-ONDERSOEK VAN DIE KUDDE VERG

(a) Alle vroulike diere 30 dae *post partum*.
(b) Alle vroulike diere 60 dae na dekking of kunsmatige bevrugting.
(c) Alle vroulike diere met 'n versteurde *puerperium*.
(d) Alle vroulike diere wat abnormale estrussiklusse ondergaan het.
(e) Alle vroulike diere wat herhaaldelik in estrum kom.
(f) Alle vroulike diere wat 50 dae na partus nog in anestrum verkeer.

Tabel 2: MONSTERS ONTVANG EN ONDERSOEK GEDURENDE DIE PERIODE 1971/76

Skedespoelings van bulle	12 933
Baarmoedermonsters	2 354
Fetale materiaal	2 768
Serummonsters	51 725

Om die boer se denkwyse op 'n kuddebasis ingestel te kry, is op sigself geen gemaklike taak nie. Nieteenstaande moet ons eenvoudig aanhou en aanhou om hierdie benadering te propageer. Die boer moet net eenvoudig oortuig word dat veeartsenykundige dienste, gebaseer op 'n kuddebenadering, baie meer ekonomies is en veel meer waarde inhou.

Dis egter ook belangrik om kennis te neem van die feit dat die waarde wat kudde-ondersoeke vir die boer inhou grootliks bepaal word deur die veearts se vaardigheid. Daar behoort ook geen twyfel te bestaan dat selfs die veearts wat oor meesterlike talente beskik weinig sonder kudde rekords kan vermag nie. Daar is seker weinig aspekte van veeartsenykunde wat so frustrerend kan wees as om 'n kudde-ondersoek te doen waar die boer nog nooit van rekords gehoor het nie. Eweso, in situasies waar die essensiële inligting soos deur die praktisyn benodig, oplaas nog van die staljong se geheue afhanklik is.

Rekords kan op verskillende maniere gebruik word om parameters saam te stel waarvolgens voortplantingsdoeltreffendheid gemeet kan word. Dit is derhalwe absoluut noodsaaklik dat die praktisyn vertroud moet wees met die mees algemene formules wat in gebruik is om voortplantingsteurnisse uit te wys.

So byvoorbeeld kan die tussenkalfperiode belangrike inligting t.o.v. die voortplantingsdoeltreffendheid van die individuele koei weerspieël. In wese behels dit ook die aantal dae wat die koei nie dragtig is nie. Die optimum waarna die boer moet mik is 'n 12 maande kalfinterval en 'n nie-dragtige periode van 86 dae. Hierbenewens moet daar met die samestelling van kuddegemiddeldes nie meer as 5% van die koeie buite hierdie kader val nie en mag nie meer as 5% van die diere 'n nie-dragtige periode van 60-100 dae oorskrei nie. Hou egter in gedagte dat hierdie parameters slegs die vorige teelseisoen uitbeeld en relatief min waarde vir die huidige situasie inhou. Die rede hiervoor is dat die herhaalbaarheid van voortplantingsdoeltreffendheid besonder laag is. Dit is egter nogtans noodsaaklik dat hierdie analise gedoen moet word sodat die boer weet wat binne sy kudde aangegaan het anders weet hy nie waar om te verbeter nie.

Dikwels gebeur dit dat die boer wel bewus is van sekere produksieprobleme binne sy eie kudde maar hy weet nie hoe sy kudde se produksie met die van ander in sy eie omgewing, of met die res van die land vergelyk nie. As hy hiervan bewus gemaak word, sal dit hom tot groter dinge aanspoor.

Die daarstelling van diagnostiese laboratoria

Alvorens die boer:veearts verhouding op 'n kuddebasis ingestel kan word, moet praktisyns wat hierdie dienste wil onderneem gerugsteun word deur goed toegeruste diagnostiese laboratoria. Of die kuddebenadering gaan slaag, sal afhang of die praktisyn binne redelike tydsbestek en teen redelike kostes 'n metaboliese of infeksieprofiel van die betrokke kudde saamgestel kan kry.

Hier bestaan egter nog groot leemtes en ons vertrou dat dit spoedig reggestel sal word. Maar laat dit nie ondersoeke na onvrugbaarheid by beeste demp nie. Met die dienste huidiglik tot ons beskikking is reeds pragtig daarin geslaag om 'n groot aantal boere se samewerking te verkry en sodoende 'n beter diens te lewer. Soos in Tabel 2 aangedui, is gedurende die afgelope 5 jaar 'n groot aantal monsters vir besmetlike oorsake van onvrugbaarheid ondersoek. Prakties al die skedespoelings is deur veeartse geneem en die meeste hiervan is deur die eienaar (soms teen groot koste) by die laboratorium ingedien. Sodoende was die laboratorium verseker van monsters wat volgens voorskrif geneem is en het die eienaar ook geleentheid gehad om aktief deel te neem aan ondersoeke wat op sy kudde uitgevoer word.

Dit is egter noodsaaklik dat die skakeling tussen die laboratorium en die boer via die praktisyn moet plaassind. Direkte kontak tussen boer en laboratorium werk net nie. Die laboratorium kan hoogstens 'n diagnose stel en sekere aanbevelings maak, maar dit is alleenlik die praktisyn wat in staat is om die aanbevelings sinvol te implementeer en kuddeproduksie op 'n optimale peil ingestel te kry.

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BRUCELLOSE IN SUID-AFRIKA EN DIE ROL VAN DIE VEEARTS

A. P. SCHUTTE

ABSTRACT: Schutte A. P. **Brucellosis in South Africa and the role of the veterinarian.** *Journal of the South African Veterinary Association* (1977) **48** No. 3 177–181 (Afr) Sect. Reprod., Vet. Res. Inst., 0110 Onderstepoort, Rep. South Africa.

Some of the factors which enhance the dissemination of *Brucella* organisms in animals and man in South Africa are briefly reviewed. These include: (i) the resistance and age of the animal exposed and the virulence and infective dose of the organism involved. The ability of *Brucella* organisms to survive outside body cells for a considerable time is pointed out. (ii) The problems associated with diagnosis, especially when related to clinical symptoms, are noted. (iii) The incubation period in pregnant animals is inversely proportional to the stage of foetal ontogenesis: a cow infected in the last stage of pregnancy, for example, may not abort but give birth to congenitally infected offspring. (iv) The build up of humoral and cellular immunity. (v) Laboratory identification related to factors including the smooth, intermediate and rough strains.

Attention is focussed on the prevalence of brucellosis in domestic species as well as wild animals. *Bovine:* the widespread occurrence of brucellosis in the national herd is discussed in relation to *B. abortus, B. melitensis* and *B. abortus* Strain 19. From available figures an incidence of 12-15% within the national herd appears a conservative estimate. The problems of control, and the use of vaccination in control, are discussed. *Sheep/goats:* Although accurate incidence data are not available, it appears that *B. melitensis* infection is confined to certain regions, e.g., Karakul in the N.W. Cape, and Boergoats in Sekhukhuniland. The significance of *B. melitensis* in the female and *B. ovis* in the male is outlined. The effective use of half the recommended dose of *B. melitensis* Rev I vaccine or *B. abortus* 45/20 water-in-oil type vaccine in pregnant does is highlighted. *Pigs:* the Republic of South Africa should be considered as free of *B. suis* at present. *Dogs:* the role of dogs as biological spreaders is noted. The recent diagnosis of *B. canis* in this country is recorded. *Horses:* the incidence of *B. abortus* as a result of lateral spread from cattle is briefly discussed. *Wild animals: B. abortus* biotype I has been incriminated in most recorded cases to date indicating that the infection of game is highly likely a lateral spread from domestic animal contact. *Man:* The danger of man becoming infected on exposure to all of the *Brucella* strains encountered in this country is stressed. The problems associated with the hypersensitive individual are accentuated. Difficulties in diagnosis of the disease in man are mentioned.

Apart from the immediate loss due to abortion amongst livestock, the short term, as well as long term effect on the national economy as result of the birth of weak offspring, the effect on fertility, the economics of management, and overall costs both direct and indirect are discussed. The responsibility of the veterinary surgeon to the national herd, to the national health of the community, and above all to himself are detailed. The role and duty of the veterinarian in disseminating information to the owner is stressed.

INLEIDING

Brucellose is by uitstek 'n dieresiekte wat toevallig die mens besmet. Hierdie siekte het 'n wêreldwye verspreiding en in Suid-Afrika word al 70 jaar lank met brucellose geworstel. Alhoewel daadwerklik vordering gemaak is ten opsigte van die diagnostiek is daar nog heelwat ruimte vir verbetering. Veral die vroegtydige identifikasie van kongenitale besmette diere skep wesenlike probleme en bemoeilik die beheer van brucellose.

Vir baie jare lank was alle aandag net op *B. abortus, B. melitensis* en *B. suis* toegespits. Sedert die resultate van Buddle[3 4] se ondersoeke by skape gedokumenteer is, het dit egter noodsaaklik geword om *B. ovis* by bogenoemde in te skakel. Carmichael[5] en Moore[23 24] het enkele jare later daarop gewys dat die lys van *Brucella* spesies waarby die veearts direkte belang het alleenlik as volledig beskou kan word indien *B. canis* hierby toegevoeg word.

Alvorens die voorkoms en verspreiding van die verskillende *Brucella* spesies in die veestapel hier ter plaatse bespreek word, is dit noodsaaklik om sekere eienskappe en kenmerke van die *Brucella* organisme en die faktore wat indringing en verspreiding begunstig, te beklemtoon.

(i) Indringing van *Brucella* organismes hou verband met weerstand en ouderdom sowel as virulensie en die besmetlike dosis. Besmetting geskied by uitstek *per os* en met slymvliesindringing. Derhalwe is dit noodsaaklik om hiervan kennis te neem asook van die feit dat *Brucella* organismes onder gunstige toestande vir 'n geruime periode buite die liggaam kan lewe en steeds besmetlik kan wees. *Brucella* moet ook as 'n intrasellulêre parasiet wat voorkeur aan die retikulo-endoteelsisteem verleen, gesien word. Na indringing blyk *B. abortus, B. melitensis* en *B. suis* 'n soortgelyke siektetoestand in die primêre gasheer te verwek.

(ii) Deurgaans is die diagnose van brucellose uitsluitlik op klinies waarneembare simptome baie moeilik aangesien hierdie, behalwe vir fetale verwerping, orchitis en vesiculitis, baie wisselvallig kan wees. Die neiging van *Brucella* organismes om in sekere weefsels of organe te lokaliseer is 'n welbekende verskynsel. Die limfkliere en uier is bekende foci vir die toekomstige vermenigvuldiging van Brucella organismes, alhoewel lokalisering in laasgenoemde net gebeur as volwasse diere die besmetting opdoen. Dieselfde geld ook vir die geslagstelsel.

(iii) Die inkubasieperiode van brucellose by dragtige diere is omgekeerd eweredig aan die stadium van fetale ontogenese. Vroulike diere wat gedurende die laaste trimester van dragtigheid besmet raak sal nie noodwendig aborteer nie maar gee geboorte aan lewendige *Brucella*-besmette nageslagte.

(iv) 'n Humorale weerstand ontwikkel in alle diere na indringing van die *Brucella* organisme of na die toediening van entstowwe. Die liggaam se immuunstelsel reageer deur opsonien-, presipitien-, agglutinien-, onvolledige- en komplementbindingsteëlliggame te produseer. Die meer doeltreffende weerstand wat na blootstelling tot stand kom is

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egter sellulêr van oorsprong. Die weerstand teen brucellose wat met entstowwe in mens en dier wek kan word is egter geensins volledig. nie.

(v) Alhhoewel die karakteristieke waarvolgens die verskillende spesies van mekaar onderskei kan word kwantitatief is, is daar tog wesenlike verskille ten opsigte van virulensie en gasheerspesifisiteit. Die S — I — R-kolonie morfologie* is 'n welbekende verskynsel en het 'n besondere betekenis in soverre dit *Brucella* spesies aangaan. Die S-stamme is deurgaans hoogs virulent terwyl die R-stamme as relatief minder patogeen beskou kan word. Al die S-stamme bevat 'n endotoksien wat indien dit vrygestel word, verband hou met hipersensitiwiteit.

BRUCELLOSE BY BEESTE[1 2 15 16 20 25 26 29 31]

Beesbrucellose word veroorsaak deur *B. abortus*. Alhoewel 9 biotipes van *B. abortus* erken word kan hierdie siektetoestand in Suid-Afrika slegs met biotipe I en tot baie geringe mate met biotipe II in verband gebring word. Onlangs is egter ook *B. melitensis* van 'n beesfetus afgesonder. *Brucella abortus* S19 is in die verlede ook van beesfetusse afgesonder. Hier blyk dit hoofsaaklik beperk te wees tot kuddes en gevalle waar Stam 19 entstof onbekend en onoordeelkundig gebruik word.

Beesbrucellose kom wyd verspreid in Suid-Afrika voor maar juiste syfers om die werklike insidens in die nasionale beesstapel aan te dui ontbreek nog. Volgens gegewens soos deur die Streekslaboratoria van die Afdeling Veeartsenydiens en die Navorsingsinstituut vir Veeartsenykunde (N I V) gedurende die afgelope paar jaar versamel is, blyk dit dat die insidens in die orde van 12-15% kan wees. Dit beteken dat in Suid-Afrika tussen 600 000 en 1,3 miljoen besmette vroulike diere moet wees en dit nieteenstaande die verpligte versinentingsprogram wat sedert 1968 in werking is. Hierdie situasie beklemtoon net weereens die feit dat die beheer van beesbrucellose veel meer as net 'n amptelike inentingsprogram behels.

Dit is egter interessant om daarop te wys dat uit die Departement van Landbou se jongste jaarverslag dit blyk dat gedurende 1974/75 2,3 miljoen en gedurende 1975/76 2,7 miljoen dosisse *B. abortus* Stam 19 entstof deur die N I V verkoop is. Die vraag kan gestel word wat word van die entstof en waarvoor word dit gebruik aangesien net ±750 000 of net die helfte van alle verskalwers geënt word en dat die Afdeling Veeartsenydiens net 2 000 dosisse vir die enting van volwasse diere gedurende die afgelope jaar gebruik het. Dit is dus baie duidelik dat ons nie net op die entstof kan staatmaak nie maar veel meer in werking sal moet stel indien ons beesbrucellose onder beheer wil bring. Die vrywillige Akkreditasieskema waarmee reeds begin is en 'n sisteem van gekontroleerde *Brucella* diagnostiek soos deur die Afdeling Veeartsenydiens beplan en wat binnekort in werking sal tree, is derhalwe te verwelkom. Hierdeur kan by uitstek die smousery met *Brucella*-besmette diere die nek ingeslaan word en derhalwe behoort hierdie maatreëls die steun van elke veearts te geniet.

'n Verdere aspek wat aandag regverdig is die probleem wat ontstaan by die identifisering van diere wat kongenitaal besmet geraak het. Diesulke gevalle kan nie met die diagnostiese metodes tot ons beskikking uitgewys word nie. Verse wat in hierdie groep val kan derhalwe 'n wesenlike gevaar vir *Brucella*-vry kuddes inhou.

Dit is sekerlik die plig van elke praktisyn om dit baie duidelik aan sy kliënt tuis te bring dat die doeltreffende beheer van brucellose benewens inentingsprogramme ook streng disipline verg, en dat die sukses van beheermaatreëls afhanklik is van hoe doeltreffend draers identifiseer kan word en die spoedige verwydering van besmette gevalle uit die kudde.

BRUCELLOSE BY SKAPE EN BOKKE[2 3 4 14 17 31]

Hier blyk *B. melitensis* die belangrikste te wees. Net soos in die geval van die bees ontbreek hier ook die nodige statistieke en bly die insidens van brucellose by skape en bokke 'n twyfelagtige syfer. Nieteenstaande, wil dit voorkom dat die besmetting beperk is tot sekere streke. Karakoelskape in die Noordwes-Kaap en boerbokke in Sekhukhuniland is bekende foci. Die moontlikheid dat die besmetting met verskuiwing van diere uit buurstate die land binnekom, bly 'n aktuele probleem.

B. melitensis kom gewoonlik vatbare kuddes binne deur die aankoop van besmette bokke of met die verskuiwing van vatbare diere na besmette weidings. Die verloop van die siekte is soos dié vir beeste, behalwe dat dit selde gebeur dat meer as 10% van die ooie aborteer. Verspreiding tussen die ooie in dieselfde kudde vind plaas deur die inname van besmette fetale materiaal en kontamineerde weiding. Laterale disseminasie vind plaas veral waar diere saam gehok word onder ongunstige en onhigiëniese toestande.

Brucellose by bokke word ter plaatse dikwels gekoppel aan die gebruik van *Brucella melitensis* Rev 1 entstof in dragtige diere. Hier dien dit vermeld te word dat indien dit nodig blyk om dragtige diere te ent, kan *B. melitensis* Rev I entstof teen die helfte van die voorgeskrewe dosis gebruik word sonder die gevaar van aborsies. Die *B. abortus* 45/20 water-in-olie tipe entstowwe kan eweneens met goeie resultate vir hierdie doel gebruik word.

B. abortus wat by uitstek aborsies in beeste veroorsaak kan slegs met uitsondering van skape afgesonder word en speel slegs 'n ondergeskikte rol. Die infeksie word gewoonlik op plase aangetref waar beesbrucellose ook voorkom. Laterale verspreiding is egter uiters beperk en aborsies onder skape kom slegs in individuele gevalle voor.

Wat *B. ovis* betref wil dit voorkom dat hierdie organisme, wat ernstige verliese onder die manlike diere veroorsaak, weinig gevaar vir die vroulike dier inhou. Waar uitgesproke epididymitis en testikulêre letsels in die ram met *B. ovis* indringing tot stand kom, is dit slegs met uitsondering dat aborsies of steriliteit in die vroulike dier aangeteken word. *B. melitensis* Rev. 1 entstof gee uitstekende beskerming teen *B. ovis* besmettings by skape.

BRUCELLOSE BY VARKE[2 30]

Brucellose by varke word veroorsaak deur *B. suis*. Klinies kan, soos in die geval van *B. abortus* infeksie by beeste, aborsies en orchitis vry algemeen aangeteken

*S=gladde-, I=intermediêre-, R=rowwe-

word. Hierbenewens blyk dit dat varke ook vatbaar is vir *B. abortus* maar dat laterale verspreiding tussen varke minimaal is.

Alhoewel deeglik gekontroleerde ondersoeke na die voorkoms van *B. suis* by varke nog nie van stapel gestuur is nie, blyk dit tog volgens roetine-ondersoeke soos onderneem word om die oorsake van perinatale vrektes by varke te monitor, dat die varkbedryf in Suid-Afrika daarin geslaag het om as vry van *Brucella* geklassifiseer te kan word. Dit dien egter vermeld te word dat enkele isolate wat baie nou met die *B. suis* spesie ooreenstem, reeds in die verlede van skape afgesonder is.

BRUCELLOSE BY HONDE EN PERDE[2 5 23 24]

Dit is reeds vir baie jare bekend dat honde as meganiese en biologiese verspreiders van *B. abortus, B. suis* en *B. melitensis* kan optree. Deurgaans raak honde besmet deur *Brucella* besmette materiaal soos plasentas en fetusse te vreet. Dragtige tewe aborteer na die inname van die smetstof en kan vir varierende periodes draers bly.

Enkele jare gelede is aborsies by honde in die V S A aangeteken wat aan *Brucella* toegeskrywe is en wat later geblyk het 'n nuwe spesie te wees wat tans as *B. canis* geklassifiseer word. Alhoewel hierdie stam van die R-variante blyk te wees en as redelik gasheerspesifiek geklassifiseer kan word, blyk dit tog dat die mens vatbaar is en moet die praktisyn hiervan kennis neem.

Ondersoeke na die voorkoms van *B. canis*-infeksie by honde ter plaatse word op 'n *ad hoc* basis deur die Instituut behartig maar deurgaans het hierdie ondersoeke negatief geblyk te wees. Onlangs egter is die teenwoordigheid van *B. canis* wel serologies bevestig in monsters ontvang van die Fakulteit van Veeartsenykunde wat versamel was van 'n ingevoerde reun met chroniese orchitis en ingevoerde Rotweilertewe met steriliteitsprobleme en enkele wat aborteer het. (Pers. mededeling*).

Aborsies in perde en donkiemerries wat aan *Brucella abortus* toegeskryf kan word, kom klaarblyklik dikwels voor. In Suid-Afrika is brucellose nog slegs met kopkroonverswerings en skoffistulas in verband gebring. Enkele gevalle waar *B. abortus* biotipe I as die etiologie van afwisselende mankheid en gewrigontsteking by perde, is ook aangeteken. Perde raak heelwaarskynlik besmet deur kontak met besmette beeste. Geen laterale verspreiding vind plaas nie. *B. abortus* S19 entstof in 'n inaktiveerde vorm kan blykbaar met goeie gevolge vir die behandeling van *Brucella* besmetting in perde gebruik word.

BRUCELLOSE BY WILD[2 8 10 21 22]

Aanduidings van brucellose in verskillende wildsoorte in Suidelike Afrika is reeds gedokumenteer. Serologiese ondersoeke dui daarop dat veral buffels die besmetting huisves. So byvoorbeeld, volgens die opname wat deur De Vos en Van Niekerk in die Kruger Nasionale Wildtuin van stapel gestuur is, blyk dit dat in 14,2% van buffels en 13,7% van seekoeie getoets, *Brucella* teenliggame gedemonstreer kan word[8]. Enkele gevalle van higromata, orchitis en purulente endometritis is ook aangeteken. Heel onlangs het Gradwell en sy medewerkers *Brucella* van buffels afgesonder[10]. Hierdie isolate, asook die wat van waterbokke en elande afgesonder is, het almal *B. abortus* biotipe I geblyk te wees.

Volgens die werk van Margaret Meyer blyk dit baie duidelik dat die stamvader vanwaar alle *Brucella* spesies evaleer het, 'n *B. abortus* van biotipe II moes gewees het[21]. Dit is dan ook interessant om te spekuleer oor die oorsprong van brucellose by wildsoorte in Suid-Afrika. Al hierdie stamme het tot die biotipe I behoort en nie tot die biotipe II groep soos verwag nie. Hierdie bevinding dui daarop dat buffels nie as bron van besmetting vir beeste dien nie maar dat die omgekeerde heelwaarskynlik die waarheid is.

BRUCELLOSE BY DIE MENS[2 6 7 9 11 12 13 18 19 28 31 32]

Die diagnose van brucellose by die mens is geensins 'n gemaklike taak nie. Kliniese simptome is berug vir hulle afwesigheid en die medikus is dikwels genoodsaak om 'n battery van serologiese toetse in te span om 'n diagnose te kan maak. Dit is noodsaaklik om kennis te neem van die feit dat *Brucella* teenliggame nie noodwendig op 'n akute *Brucella* infeksie dui nie en dat die afwesigheid van teëliggame eweneens nie 'n *Brucella*-vry toestand waarborg nie.

Die mens is vatbaar vir al die *Brucella* stamme wat normaalweg in plaas- en huisdiere voorkom. Dit word aanvaar dat besmetting hoofsaaklik deur kontak òf met die inname van besmette materiaal soos besmette bok- òf beesmelk geskied. (Of die stelling ook van toepassing is op die veearts, is egter twyfelagtig. Veeartse staan dikwels met hulle arms tot by die skouers in besmette beesbaarmoeders en werk met totale minagting van die gevare wat *Brucella* inhou en dit is ook nie bekend in watter mate veeartse melk as 'n deel van hulle vloeibare verversings klassifiseer nie).

Die reaksie wat die verskillende *Brucella* stamme in die menslike liggaam kan ontketen is afhanklik van die virulensie van die betrokke stam, die mens se vatbaarheid en die graad van hipersensitiwiteit wat teenwoordig mag wees. *B. melitensis* en *B. suis* het oor die algemeen 'n hoë invalswaarde in die mens en word gekenmerk deur 'n langdurige vestiging in sekere weefsels of organe. *B. melitensis*-infeksies gaan egter met minder weefselverlies gepaard. Dit is belangrik om daarop te let dat veral *B. suis* in die hipersensitiewe individu geweldige weefselverlies teweeg kan bring.

Hierteenoor blyk *B. abortus* en *B. ovis* slegs 'n lae invalswaarde en kortstondige vestiging met geringe weefselverlies te bewerkstellig. Hier weereens, is die simptome afhanklik van die graad van hipersensitiwiteit wat teenwoordig mag wees. Dieselfde is ook van toepassing op besmettings met *Brucella abortus* S19 en *B. abortus* 45/20 entstowwe. Veral eersgenoemde kan in die hipersensitiewe individu 'n hewige reaksie uitlok.

In die breë blyk dit dat die mens nie noodwendig klinies waarneembare afwykings toon nie en dat latente infeksies dikwels voorkom. Derhalwe word brucellose soms verkeerdelik as 'n aanval van malaria, rumatiekkoors of griep gediagnoseer. Dit is egter van kardinale belang dat veral veeartse gereelde mediese ondersoeke moet ondergaan en attent gemaak word op die verskynsel van vertraagde hipersensitiwiteit en die gevare wat hiermee verband hou.

*Dr S. Herr, Departement Geslagskunde, Fakulteit Veeartsenykunde, Universiteit van Pretoria.

Wat besmettings met entstofstamme en die noodsaaklikheid van behandeling betref, moet kennis geneem word van die besmetlike dosis, die penetrasiediepte van die naald of roete van besmetting en die tipe entstof. Indien nodig moet kortisone tesame met breë-spektrum antibiotika gebruik word. Te dikwels word antibiotika weens foutiewe diagnose in dosisse voorgeskrywe wat onvoldoende is om die *Brucella*-infeksie onder beheer te bring maar wat net genoegsaam is om simptome te onderdruk en uiteindelik tot chroniese gevalle aanleiding gee.

In soverre dit die voorkoms van brucellose by die mens in Suid-Afrika aangaan, is daar geensins duidelikheid nie. Hierdie situasie kan gekoppel word aan die feit dat brucellose by die mens weens omstandighede òf nie as sulks gediagnoseer word nie òf nie aangemeld word nie. Serologiese ondersoeke dui egter op 'n baie groter insidens as wat die Dept. van Gesondheid se statistieke openbaar. Coetzee bv. het in sy ondersoeke daarop gewys dat in 11% van die algemene publiek en in 61% van veeartse en abattoirpersoneel onvolledige teenliggame opgewys kan word en dat die besmettingsyfer vir die nie-blanke bevolking heelwaarskynlik veel hoër is[6]. Die enkele positiewe gevalle wat by die Departement van Gesondheid aangemeld word, klop ook nie met die werklikheid nie as die data soos deur Sacks en Van Rensburg[27] beskikbaar gestel, in ag geneem word.

DIE ROL VAN DIE VEEARTS EN DIE EKONOMIESE BELANG VAN BRUCELLOSE

Te dikwels word brucellose beskou as 'n siektetoestand wat net aborsies by beeste verwek. Dit is dan ook duidelik die plig van die veearts om hierdie wanindruk reg te stel. Aspekte soos die volgende verdien daadwerklike aandag en behoort duidelik aan die boer uitgewys te word:

(i) Aborsies by beeste het 'n nadelige invloed op langtermyn beleggings. Die perinatale vrektes omskrywe 'n verlies aan potensiële volwasse diere wat vir vervangingdoeleindes in die kudde gebruik kon gewees het. Eweneens beteken aborsies 'n verlies aan eiewitte vir menslike gek. (Vleis, melk en ander produkte).

(ii) Brucellose benadeel ook korttermyn beleggings waar die siekte vir lang periodes reeds in kuddes gevestig is. In sulke gevalle is aborsies nie meer 'n wesenlike probleem nie, maar die klemverskuiwing wat plaasgevind het met die geboorte van swak ontwikkelde kalwers beinvloed sekerlik die produksiepotensiaal van die veestapel.

(iii) Die effek van brucellose op die vrugbaarheid van 'n kudde word dikwels buite rekening gelaat. Veral met betrekking tot die produksiepotensiaal van die betrokke kudde is dit belangrik dat hierdie faset die nodige aandag geniet. Daar moet eweneens rekening gehou word met die verliese wat gely word deurdat nasionale sowel as die internasionale bemarkingsorganisasies al hoe strenger vereistes t.o.v. brucellose stel.

(iv) Die gevolg van *Brucella*-besmettings kring baie wyer as net die enge invloed op die individuele dier. Die verlies aan weiding en kostes wat aangegaan moet word om die besmette diere van vatbare diere te skei, kan groot finansiële stremminge inhou maar word selde deur die produsent in berekening gebring.

(v) Eweso kan die kostes wat aangegaan moet word om die nasionale veestapel teen brucellose te beskerm enorme afmetings aanneem. Dit is dan ook dringend noodsaaklik dat kostes ten opsigte van navorsing, doeltreffende kontrole en uitroeiingskemas, die vergoeding aan vee-eienaars, kostes van voorligtingsprogramme en kostes met betrekking tot die produksie en gebruik van doeltreffende entstowwe ook in berekening gebring word.

(vi) Van ewe veel belang is mediese kostes ten opsigte van die mens waar met direkte sowel as indirekte kostes rekening gehou moet word. Kostes met betrekking tot hospitalisasie en mediese ingrypings kan enorme bedrae omskrywe terwyl die verlies aan inkomste as gevolg van verlore manure en produktiwiteit eweneens aandag regverdig.

Die veearts het nie net 'n verpligting t o v die ekonomiese belang van brucellose nie maar hy het sekerlik ook 'n verantwoordelikheid teenoor die gemeenskap en die veebedryf in soverre dit voorligting aangaan. Hy behoort op hoogte van sake te wees om 'n klimaat vir die beheer en uitwissing van die siekte in sy bedieningsgebied te skep. Laat daar geen twyfel bestaan nie, die beheer van brucellose is 'n langtermyn onderneming en kan maklik 20 jaar in beslag neem. Maar eweso is dit 'n langtermyn belegging en moet ook in die lig gesien word. Eienaars van *Brucella*-vry kuddes sal eventueel hoër pryse vir hulle produkte kan eis.

Die veearts het benewens sy verpligtinge teenoor die veestapel en die gemeenskap wat hy dien, ook 'n verpligting teenoor homself en sy personeel. Besondere klem moet gelê word op die hantering van entstowwe. Dit is bekend dat besmetting met *B. abortus* S19 entstof tot 'n goedaardige maar nogtans hinderlike besmettingsreaksie aanleiding gee. Ongelukkig kan nie dieselfde vir die veearts wat hipersensitief is, gesê word nie. Hier kan die gevolge dramaties wees.

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TO THE EDITOR — AAN DIE REDAKSIE

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BLOOD LEVELS OF OXYTETRACYCLINE IN DOGS AFTER ORAL ADMINISTRATION

A. IMMELMAN

ABSTRACT: Immelman A. **Blood levels of Oxytetracyclines in Dogs after Oral Administration.** *Journal of the South African Veterinary Association* (1977) **48** No. 3 183–186 (En) Department Physiology, Pharmacology and Toxicology, Faculty of Veterinary Science, Onderstepoort 0110, Republic of South Africa.

Blood levels of oxytetracycline in dogs were determined by a spectrofluorometric method. Doses of 10, 50 and 100 mg/kg body mass were administered as single doses per os. A single dose of 100 mg/kg body mass gave adequate blood levels and the 10 mg dose was inadequate. When doses of 10 and 50 mg/kg body mass respectively were repeated after 12 hours the higher dose gave adequate blood levels. Blood levels after dosing with 3 different commercial products containing oxytetracycline proved the non-equivalence of these products.

INTRODUCTION

Oxytetracycline was isolated in 1950 from the fungus *Streptomyces rimosus*[7]. This broad spectrum antibiotic is still frequently used in veterinary medicine. It is relatively non-toxic and has an LD 50 in mice of 192 mg/kg body mass when given intravenously[7]. If large doses are repeatedly administered, hepatic damage may result[15]. If the drug is administered to young children, it causes mottling of the teeth due to a deposition of a chelate of calcium and oxytetracycline in the developing bone[6].

The susceptibility of bacteria to the action of oxytetracycline varies not only between species but also between strains within the same species. It was found that some strains of *Pseudomonas* could be inhibited *in vitro* with concentrations as low as 0,2 μg/ml whereas certain strains of *Proteus vulgaris* could only be inhibited at concentrations of 800 μg/ml[9]. In veterinary medicine a blood concentration of 0,5-1μg/ml is accepted as a therapeutic level[3].

Oxytetracycline is incompletely absorbed from the gastro-intestinal tract. Absorption is a passive process taking place mainly in the duodenum[16]. Data have been presented to show that the blood levels in humans could not be increased by increasing the dose[11]. This does, however, not correspond with the findings of Pindell *et al.*[16] who demonstrated in dogs that the amount absorbed depends on the concentration of oxytetracycline in the gastro-intestinal tract.

The absorbed drug is distributed to other tissues with the degree of distribution depending on the plasma protein binding of the drug as only free drug can move through membranes. In the dog 20% of the oxytetracycline will become protein bound. Schach von Wittenau and Yeary[18] compared blood levels with tissue levels and found that tissue concentration is not only dependant on the amount of free drug available but also on the fat solubility of the compound. The more fat soluble the compound the higher the tissue concentration.

The purpose of these trials was to determine the blood levels of oxytetracycline in dogs after oral administration. Different doses were used and blood levels determined after single and repeated doses. A comparison is also drawn between blood levels using three different available products.

MATERIALS AND METHODS

The method used for the determination of oxytetracycline in the plasma was the fluorometric method described by Ibsen *et al.*[12] This technique was also used to study oxytetracycline levels in urine and bronchial mucus obtained from humans[14]. A Perkin-Elmer, model 204, spectrofluorometer was used for the purpose. Through scanning the maximum wavelength for activation was determined to be 380 nanometers, and for the analizer 480 nanometers. These settings were used throughout the trials.

A standard curve was drawn with concentrations of 0,25; 0,5; 1,2; 3; 4 and 5 micrograms per millilitre in dog plasma. Eight determinations were done at each concentration and the average of each concentration was plotted. This curve formed a straight line.

In an attempt to control the biological variation in these experiments the dogs used were litter mates and the same 6 dogs were used in all the experiments. These were adult animals consisting of 2 male and 4 female animals. At least 8 days elapsed between trials. A blood sample was taken before each trial to ensure that there was no oxytetracycline present at the onset.

The animals were fed a standard commercial ration* containing a minimum of 20% crude protein, a maximum of 2% calcium and a minimum of 0,8% phosphate. Water was given *ad libitum*. The dogs were kept indoors in individual pens.

Blood samples were collected from the V. cephalica into vacuum tubes using heparin as anti-coagulant.† The blood was immediately centrifuged and the plasma stored at 4°C until used. It was not kept for longer than 48 hours.

In Trial 1 the purpose was to establish the blood level after doses of 10 mg, 50 mg and 100 mg/kg body mass oxytetracyclines were given as a single dose on an empty stomach, the animals having been starved for 24 hours. Food was made available *ad lib.* 4 hours after the dose was administered.

The purpose of the second trial was to study blood levels after 2 doses of 10 mg and 50 mg/kg body mass respectively had been administered. The second dose was given 12 hours after the initial dose. The first dose was given on an empty stomach and the animals were fed 24 hours later. Water was freely available 4 hours after the initial dose. The oxytetracycline capsules‡ used contained 250 mg active material per capsule and were from the same batch.

Trial 3 was done to compare blood levels attained after the administration of 3 commercial oxytetracycline§ products. These products had labelled claims of

*Prokos-Lobol Feeds
†Venoject-Terumo Jintan Corporation
‡Liquamycin, Pfizer Laboratories
§Liquamycin, Pfizer Laboratories; Oxypam; Propan Pharmaceuticals. Lenocycline, Lennon Laboratories.

250 mg oxytetracycline per capsule but the accuracy of this was not established. They were acquired from a pharmaceutical wholesaler and were within the expiry period stated on the label. The capsules were given per os to the 6 dogs on an empty stomach in a single dose of 100 mg/kg body mass.

RESULTS

The data is presented as the mean and the standard error of the mean of the blood concentration of oxytetracycline in 6 dogs. The Student-t test was applied in the statistical evaluation of the data.

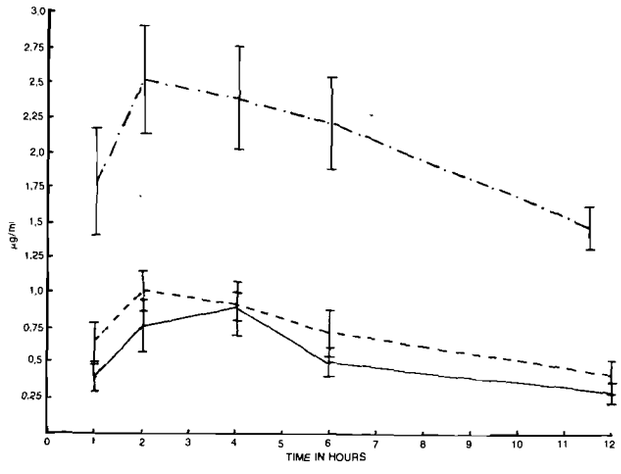

Fig. 1. A comparison of blood levels (Mean values ± standard error of the mean. n= 6) after different amounts of single doses had been given. (——— 10mg/kg; - - - - 50mg/kg; - . - . - . 100mg/kg)

Trial 1

The influence of the 3 different doses given orally to dogs is presented in Fig. 1. At a dosage rate of 10 mg/kg body mass the peak blood level of 0,88 µg/ml was attained after 2 hours and after 12 hours was lowered by 66% to 0,29 µg/ml. With the dose of 50 mgm/kg body mass a maximum blood level of 1,01 µg/ml was attained also after 2 hours. Twelve hours after administration the level had dropped by approximately 60% to 0,41 µg/ml. When a dose of 100 mg/kg body mass was administered the maximum blood level was 2,51 µg/ml after 2 hours. This level was more than double the maximum blood level recorded after the 50 mg dose. Twelve hours after administration the blood level of 1,47 µg/ml was still higher than the maximum level achieved with the other treatments. The difference in blood level after administration of the 50 mg and 100 mg doses, is significant for the first 6 hours ($P<0,05$). After 12 hours the difference is highly significant ($P<0,01$).

Trial 2

In the trial the oral dose of 10 mg and 50 mg/kg body mass were repeated after twelve hours. The results are presented in Fig. 2. During the 24 hour period of observation it was found that the smaller dose gave a lower blood level. After administering the second dose the maximum blood levels in both cases were slightly higher than that attained after the first dose. The decline in blood concentration after the smaller dose was much faster than that recorded after the higher dosage. After 8 hours the concentration had dropped to 0,25 µg/ml; in comparison the high dose still maintained a concentration of 0,88 µg/ml after 12 hours.

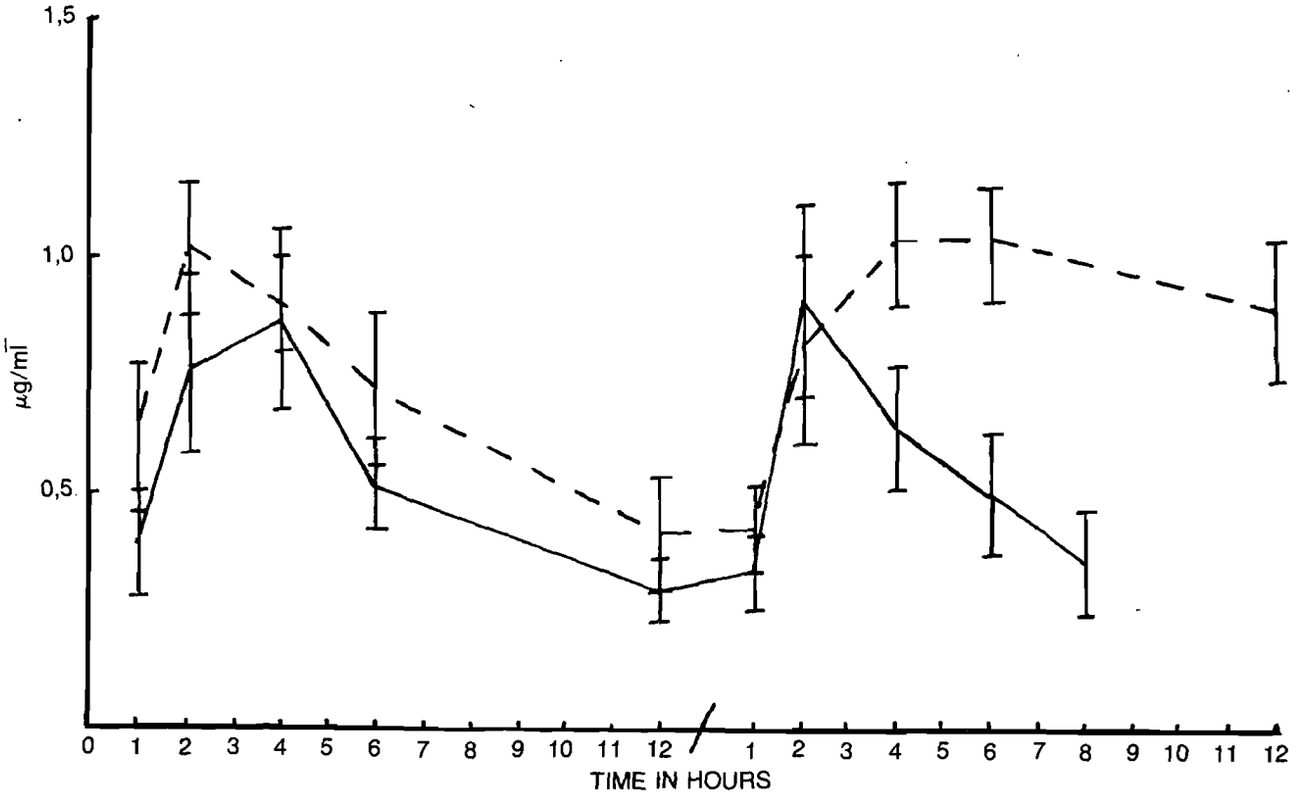

Fig. 2. A comparison of the blood levels (Mean values ± standard error of the mean. n= 6) that were attained after doses of 10mg/kg and 50mg/kg were repeated after 12 hours (——— 10mg/kg; - - - 50mg/kg)

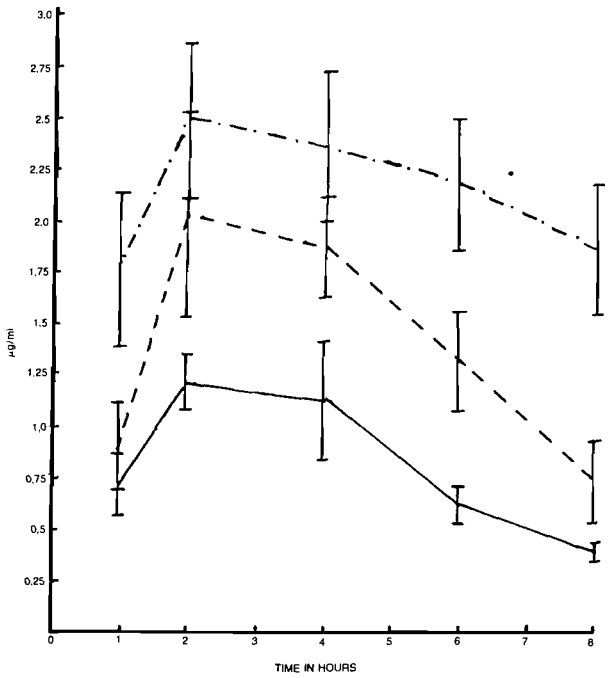

Fig. 3. A comparison of blood levels (Mean values ± standard error of the mean. n = 6) that were reached after 3 commercial products were administered (– . – . – . = Liquamycin; – – – – = Oxypam; ———— = Lenocycline)

Trial 3

A comparison of blood levels between 3 different commercial products is given in Fig. 3. Oxytetracycline in all 3 products reached peak blood levels 2 hours after administration, i.e. Liquamycin 2,51 µg/ml, Oxypam 2,26 µg/ml and Lenocycline 1,22 µg/ml. The trial was concluded after 8 hours at which stage the blood concentrations were as follows: Liquamycin 1,88 µg/ml, Oxypam 0,76 µg/ml and Lenocycline 0,4 µg/ml.

The products were statistically compared, and the results are recorded in Table 1.

Table 1: STATISTICAL ANALYSIS OF BLOOD LEVELS AFTER TREATMENT WITH GENERIC EQUIVALENT OXYTETRACYCLINES

Time in hours after dosing	Liquamycin: Oxypam	Liquamycin: Lenocycline
1	P insignificant	P<0,05
2	P insignificant	P<0,05
4	P insignificant	P<0,05
6	P insignificant	P<0,01
8	P<0,05	P<0,01

DISCUSSION

After oral administration the absorption of oxytetracycline is incomplete. In humans, after a single administration, the absorption varies from 20% to 50% with the absorption between individuals varying by as much as 100%[13]. The large standard error of the mean, as given in the figures, could therefore be explained by this large individual variation in absorption. During the trials it was noted that certain individuals always had a high blood concentration of oxytetracycline while others always had lower blood levels. By using the same individuals in all the trials the results became more significant. If different dogs are used it may become more difficult to draw a conclusion.

One of the routes of excretion for oxytetracycline is via the bile. Part of the excreted drug is reabsorbed from the intestine and the so-called enterohepatic circulation is then established[5]. In dogs the concentration in the bile could be 2 to 3 times that in the blood. An increase in dose leads to an increase in the blood level but not to a parallel increase in bile[5]. This entero-hepatic circulation gives rise to low levels of oxytetracycline in the circulation long after the administration has ceased[5].

The main route of excretion is via the glomerular filtrate of the kidney; in the dog 67% of the administered oxytetracycline is excreted by this route[18]. In dogs suffering from kidney disfunction the excretion pattern could therefore be severely affected. The dogs used in these trials were all normal dogs.

The absorbed oxytetracycline is distributed throughout the body and will accumulate in the tissues in concentrations much higher than the plasma level, *e.g.* lung 150%, liver 310% and kidney 370%[17]. High concentrations are also found in the reticulo-endothelial system[2]. Blood levels are therefore only an indication of the amount of oxytetracycline in the body. A blood level may be lower than an accepted therapeutic level but the concentration in tissue could be sufficient.

The maximum blood levels attained in the study after a single dose of 10 mg and 50 mg/kg body mass were not very different. The only difference was that the higher dose gave a peak value 2 hours after and the lower dose 4 hours after administration. The curves over 12 hours show a similar drop after treatment at both levels, with the higher dose giving a slightly higher blood level. This difference was not statistically significant. These findings are in agreement with those of authors who stated that a single dose of 12,5 mg/kg body mass is of no value in therapy[10]. They recommended that a dose of 25-50 mg/kg body mass should be given 2 or 3 times daily[10]. For the purpose of this study we accepted a therapeutic blood level to be 1 µg/ml and found that by giving 50 mgm/kg body mass twice daily this level can be maintained. Several administrations of a drug per day to a dog may be difficult and it would therefore be advantageous to administer a drug once daily. The study on the effect of a single dose of 100 mg/kg body mass was undertaken to confirm if 1 µg/ml could be maintained over the period. Not only was the maximum blood level significantly higher than in the previous treatment regimes but the blood level after 24 hours was also close to the required blood level. The only prerequisite for this dosage would be that the dog must have normal liver and kidney function, otherwise an accumulation of oxytetracycline in the body could result in hepatotoxicity.

All drugs are chemically formulated within prescribed limits. Despite differences exist between the bio-availability of products[8]. These differences are not only between products but could be also between different batches from the same manufacturer[19]. In humans the generic equivalence of oxytetracycline capsules has been investigated by several workers.

Brice and Hammer (1969) compared sixteen different products of which 7 met their minimum requirements[4]. It is also known that the product with the highest *in vitro* solubility give the highest blood values[13]. During the present trials only 3 products were compared and the formulation as well as the solubility of these products were unknown.

From the results of Trial 3 it is concluded that there is only a statistical difference between Liquamycin and Oxypam after 8 hours. Blood levels attained with Lenocycline are significantly lower than with the other 2 products. From the results obtained under these experimental conditions it can be said that Lenocycline must be given at higher dosage levels, or that the dose be given more frequently. These results serve as a warning to the veterinarian that therapeutic non equivalence of drugs does exist in dogs and that this may be a reason for not getting the expected thereapeutic response from a drug.

ACKNOWLEDGEMENTS

The author wishes to thank the University of Pretoria for financial aid and Miss Dricky Grib for technical assistance.

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BOOK REVIEW

BOEKRESENSIE

GUIDE TO SHELLFISH HYGIENE

P. C. WOOD

WHO OFFSET PUBLICATION NO. 31

World Health Organization, Geneva, 1976 pp 80, Figs 11, Tabs 5, Annexures 4, price not stated.

This booklet augments information on shellfish hygiene which appeared in the report of a WHO Expert Committee on Fish and Shellfish Hygiene (WHO Technical Report Series, No. 550, 1974).

There is extensive evidence of the spread of disease to man following the consumption of polluted shellfish. The shellfish industry of the world is large and in view of the increasing shortage of animal protein it is likely to expand further. Shellfish therefore pose special problems to public health authorities in the areas of production, during handling, processing and transport to the consumer.

The aim of this guide is to summarize information on shellfish hygiene pertinent to the production of shellfish suitable for human consumption, to the prevention of shellfish-borne disease, and to the control of outbreaks of shellfish-borne disease should such outbreaks occur. This guide is intended mainly for the use of officials and professional personnel concerned with the prevention and control of disease transmitted through shellfish.

G.V.S.T.

LANGERHANS CELLS IN THE EPITHELIUM OF THE BOVINE FORESTOMACH: THEIR ROLE IN THE PRIMARY IMMUNE RESPONSE

W. H. GERNEKE

ABSTRACT: Gerneke W. H. **Langerhans cells in the epithelium of the bovine forestomach: their role in the primary immune response.** *Journal of the South African Veterinary Association* (1977) **48** No. 3 187–192 (En) E/M Unit, Dept. of Anatomy, Fac. of Vet. Science, Univ. of Pretoria, Box 12580, 0110 Onderstepoort, Rep. South Africa.

Dendritic, migratory, lymphoid cells identical to the Langerhans cells of the epidermis, have been found in the epithelium of the bovine forestomach. They also possess the characteristic Langerhans cell granules. It can be assumed that these epithelial lymphocytes, (or Langerhans cells) as has been reported for the epidermal Langerhans cells, are antigen detectors and therefore form the first line of defence in the general immunological response of the body. The author suggests that the Langerhans cells of the forestomach be named epithelial lymphocytes. The existence of Langerhans cell granules has not yet been reported in the epithelial lymphocytes of the true stomach, intestines and respiratory epithelium.

INTRODUCTION

With the importance attached to organ transplants in the last decade and especially the role of lymphocytes in cellular as well as humoral immunity[1], it has become more and more obvious that lymphocytes and even certain macrophages, in their search for antigens, must be able to migrate through connective tissue and in between epithelial cells by means of amoeboid movements. This is especially noticeable in the digestive tract and tonsillar regions where lymphocytes are numerous in the lamina propria and between epithelial cells.

In an ultracytological study of the ruminant forestomach, dendritic, migratory cells of a lymphoid nature were encountered between the epithelial cells (Fig. 1) These cells greatly resembled the dendritic Langerhans cells found between the epithelial cells of the epidermis[8]. The origin and significance of these Langerhans cells have been a matter of dispute ever since their discovery in 1868 by Paul Langerhans. He thought them to be ectodermal in origin. Although they resemble melanocytes morphologically they are free of melanin pigment and can be demonstrated by cytological techniques using gold chloride, osmium iodide and ATPase[2] and by lanthanum[4].

The Langerhans cells of the epidermis were regarded by Masson[9] to be worn-out melanocytes which were eventually desquamated with the epithelial cells. Ferreira-Marques[5] considered them to be Schwann cells. Their independence from melanocytes has been shown by the fact that they are already present even before melanocytes become functional, or even in skin deprived of melanocytes through exclusion of neural crest derivatives[3]. Lately, however, most authors favour a mesodermal origin for them[6 12 26]. Ranvier[13] was the first to consider them of lymphatic origin but this suggestion, until recently, has never been followed up.

It is now generally accepted that the Langerhans cells form a relatively constant cell population between epithelial cells of the epidermis, oesophagus and cervix[23 27]. They have also been described in the dermis[28], in lymph nodes[7], in the thymus[11] and in the oral epithelium, gingiva, vagina, lamina propria of the trachea, urinary bladder and pilosebaceous system[10]. They are numerous in the urinary bladder of vitamin A-deficient rats and occur in lesions of histiocytosis X[10].

Their most characteristic feature are the peculiar Langerhans cell granules, visible only in ultramicrographs (Figs. 2 & 3). These granules are seen as straight or slightly curved rods with rounded ends, a central lamella of electron opaque particles and a peripheral membrane of small particles covered externally by a limiting membrane (Fig. 2b). They are usually disc-shaped but may have "racket-like" vesicles at one or both ends (Fig. 4). Their morphology has been fully described by Wolff[24], and by Sagebiel & Reed[15]. It is as yet uncertain whether these Langerhans cell granules are specific markers found only in Langerhans cells or whether the cells found in different locations in which they are present, represent different cell lines[20 26].

The object of this paper is therefore to try and define the nature of the migratory cells, to determine whether they possess Langerhans cell granules and to record any resemblances they may have with the epidermal cells of Langerhans.

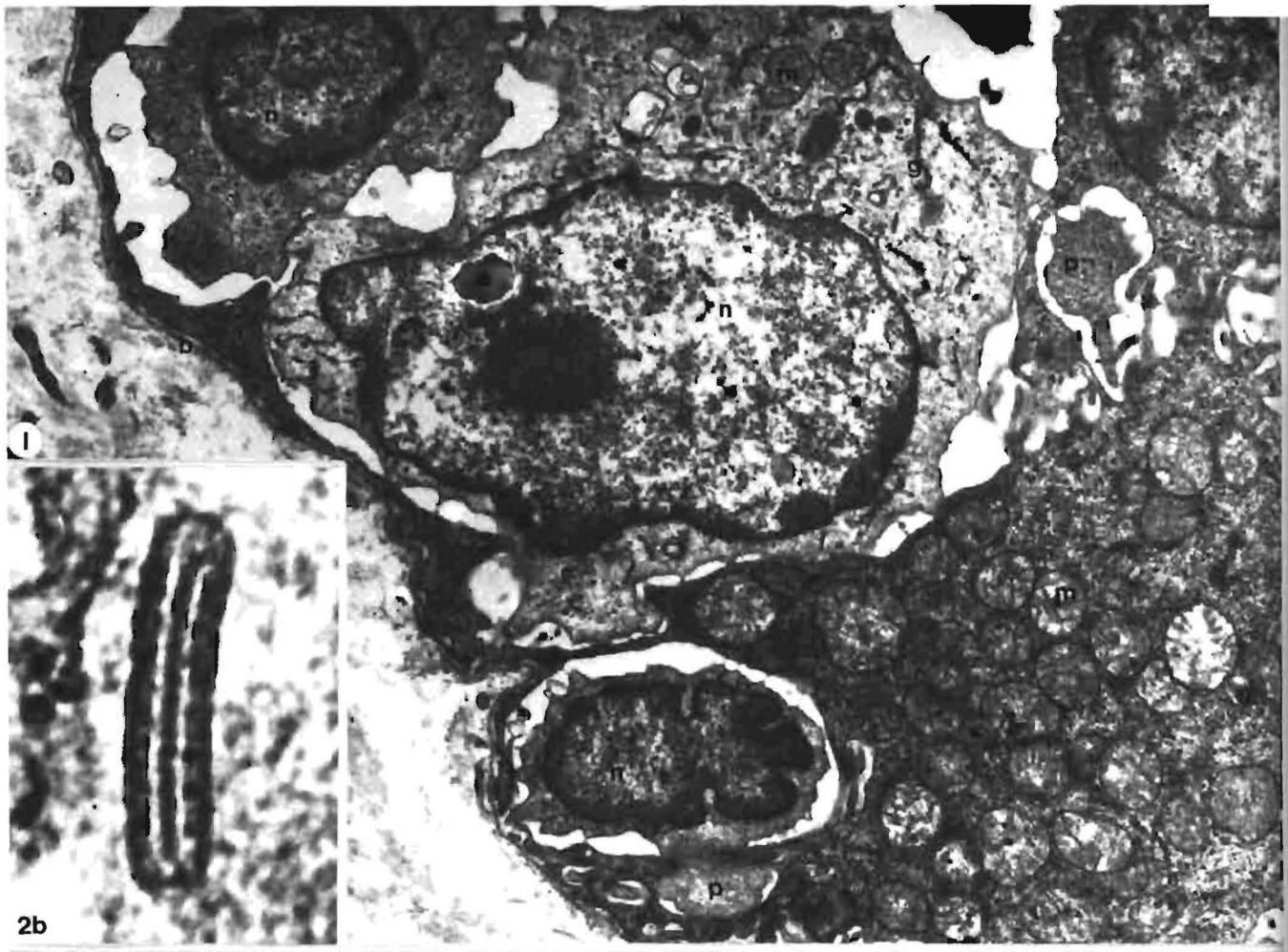
MATERIALS AND METHODS

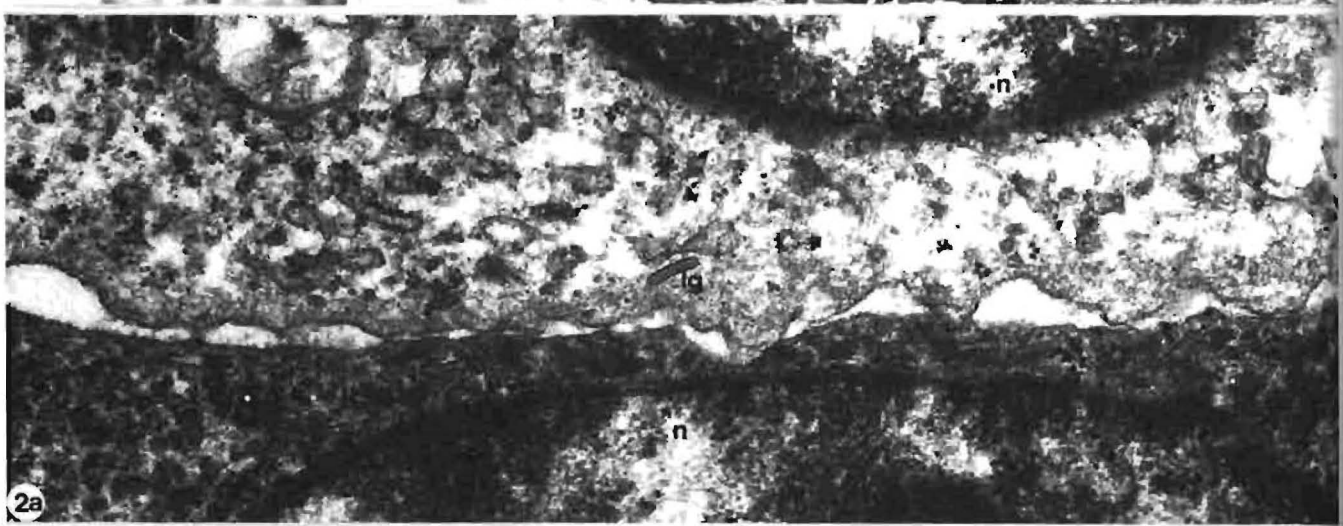
Samples of rumen, reticulum and omasum were collected at the Onderstepoort abattoir from freshly slaughtered cattle of various breeds. These were fixed in 4% glutaraldehyde in Millonig's phosphate buffer (pH 7.3) for 24 hours at 4°C, washed in the same buffer and postfixed in 2% osmium tetroxide also in the same buffer (pH 7.3). Two final buffer washes were given. The samples were dehydrated in ethanol and propylene oxide and embedded in Epon 812 in gelatin capsules for 48 hours at 60°C. Ultrathin sections were cut with glass knives on a Reichert OM U3 ultramicrotome, stained in a saturated solution of uranyl acetate (1 hour) and 0,2% lead citrate (4 minutes) and examined in a Phillips EM 301 electron microscope.

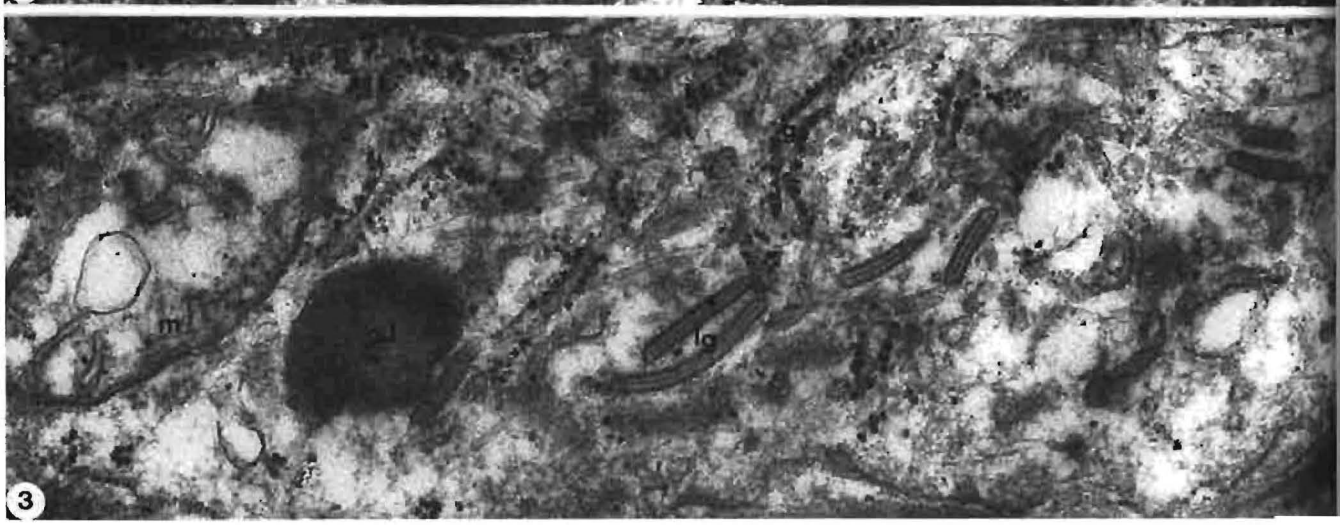
RESULTS

The lymphoid cells encountered in the forestomach epithelium varied in size and shape: there were small globular cells with dark nuclei mostly seen between the keratinocytes of the stratum basale (Fig. 1) whereas the larger cells with stellate cytoplasm and a lobed or indented nucleus were present between the keratinocytes from the stratum basale to the stratum spinosum (Fig. 6). None were ever found above the stratum spinosum. Some were seen passing through the basal lamina and were also encountered in the lamina propria (Figs. 7 & 8). It was impossible to define the direction of migration.

The lymphoid migratory cells in contrast to the keratinocytes had no desmosomes or accompanying protein fibrils. They were provided with dendritic







processes which were always accommodated in the intercellular spaces. The plasmalemma of these processes merely had points of adhesion with the plasmalemma of the keratinocytes (Figs. 2a & 6). In order to pass in between the keratinocytes these processes had to extend the tonofibrils and desmosomes connecting the keratinocytes and also had to compress their microvilli (Figs. 1 & 10).

The keratinocytes were provided with larger and more numerous mitochondria (Fig. 1), a distinct Golgi apparatus and an occasional lysosome. The lymphoid cells in general revealed about a dozen rod-shaped to oval mitochondria always dispersed near the nucleus, a few strands of smooth and granular endoplasmic reticulum (Fig. 6), a small Golgi apparatus (Fig. 11), a diplosome, an occasional fat droplet, few lysosomes and numerous free ribosomes and polyribosomes. Generally the latter two were the only organelles seen in the numerous dendritic processes between the keratinocytes. The ribosomes and polyribosomes appeared to increase in number in the smaller lymphoid cells as soon as they started extending newly formed processes (Fig. 1). Such processes not only could enlarge the intercellular spaces but could actually indent the keratinocytes so that a transverse section through such an indentation gave the impression of an intracellular inclusion (Figs. 1 & 9).

The most significant feature encountered in the lymphoid cells were disc-shaped granules which were always seen in sections as shorter or longer rods with a central lamella formed by close apposition of small electron opaque granules surrounded by an outer double membrane: the inner one also composed of small granules closely apposed to the outer limiting membrane (Fig. 2b). The ends were always rounded or associated with a racket-like vesicle with only an inner fuzzy lining (Fig. 4). This vesicular bulge was only encountered in cytoplasmic strands which had penetrated to the more superficial regions of the stratum spinosum.

These disc-shaped granules were in all respects identical to the Langerhans cell granules described for the epidermis by Wolff[24], and Sagebiel & Reed[15]. However, they did appear to be less numerous in the lymphoid cells of the fore-stomach epithelium than in the Langerhans cells of the epidermis. Many sections through lymphoid cells did not show any Langerhans cell granules probably because they had been missed in sectioning the cells (Fig. 6). No sign of any phagocytosis by these lymphoid cells was ever encountered.

Fig. 1 Three migratory lymphoid cells (nuclei marked n) are present between the keratinocytes of the stratum basale of the rumen epithelium; the larger of these reveals more ribosomes (seen as minute dots), granular endoplasmic reticulum (g) a few lysomes (l) and more mitochondria (m) than the smaller ones. The intercellular processes (p) are filled with ribosomes. The basal lamina (b) and *lamina propria* are well shown. Microvilli (v), numerous large mitochondria (m), ribosomes and polyribosomes (groups of dots) of the keratinocytes are also distinct. X 11 800

Fig. 2.a An epithelial lymphocyte revealing only a single Langerhans cell granule (lg) as well as absence of desmosomes between its plasmalemma and that of the keratinocyte. n = nuclei. X 29 400

Fig. 2.b The Langerhans cell granule of fig. 2a enlarged to reveal its internal structure. X 258 000

Fig. 3 A large number of Langerhans cell granules (lg) seen in an epithelial lymphocyte (or Langerhans cell) of the rumen epithelium. Ribosomes, polyribosomes, granular endoplasmic reticulum (g), a lysosome (l) and a mitochondrion (m) are also visible. X 54 000

DISCUSSION

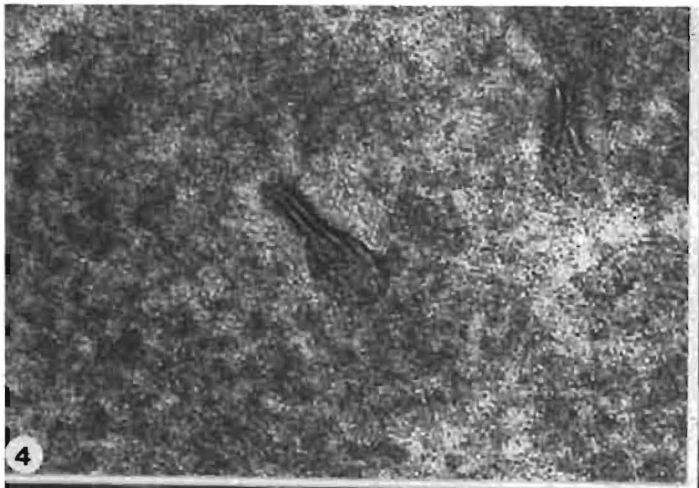
The demonstration of Langerhans cell granules in the dendritic, lymphoid cells of the ruminant forestomach epithelium, and the fact that these cells are morphologically identical to the Langerhans cell of the epidermis, make it reasonable to conclude that the lymphoid cells are in fact Langerhans cells. In the discussion to follow they will therefore be referred to as Langerhans cells of the forestomach epithelium. However, the term epithelial lymphocytes is more appropriate and the author suggests that this term be used in future to name them. Previous authors have referred to them as lymphocytes and neutrophilic granulocytes[17] or as particular monocytes[22].

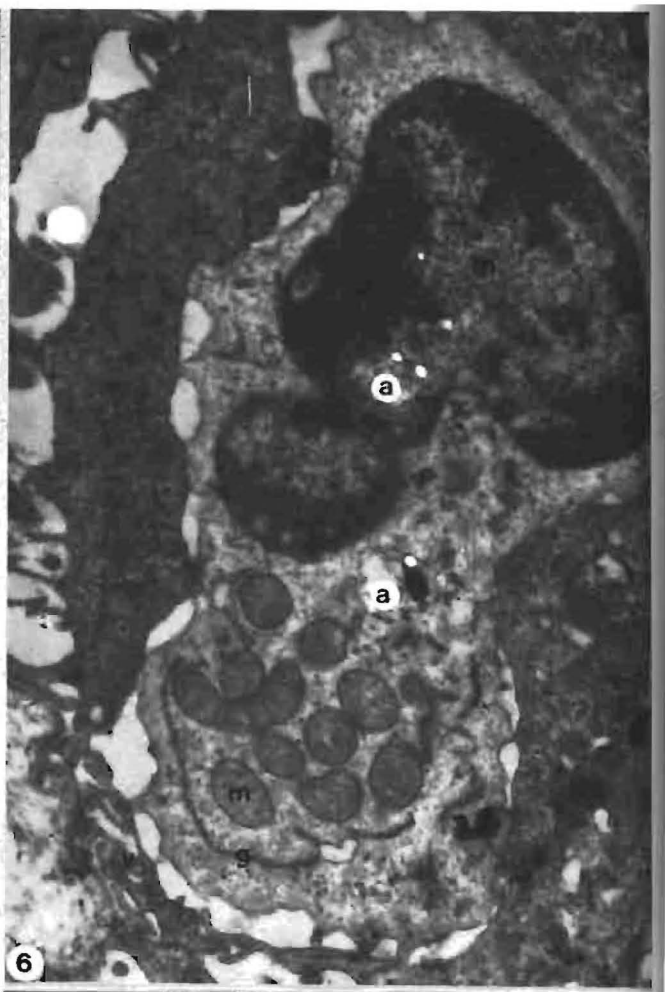
It can be assumed that small lymphoid cells gain entrance through the basal lamina of the forestomach epithelium (Figs. 7 & 8). Here they are probably stimulated to form dendritic processes. To produce the proteins necessary for this cellular hypertrophy there is an increase in ribosomes and polyribosomes before and during the outgrowth of these processes (Figs. 1, 8, 9 & 10). Simultaneously the nucleus assumes a lobed or indented shape (Figs. 1 & 6) possibly as a result of the hypertrophic stimulus *(vide infra)*. It is possible that the hypertrophy of these Langerhans cells is purely a mechanical adaptation to the narrow intercellular spaces: dendritic processes could pass into these narrow spaces and absorb antigens with greater ease than small globular cells.

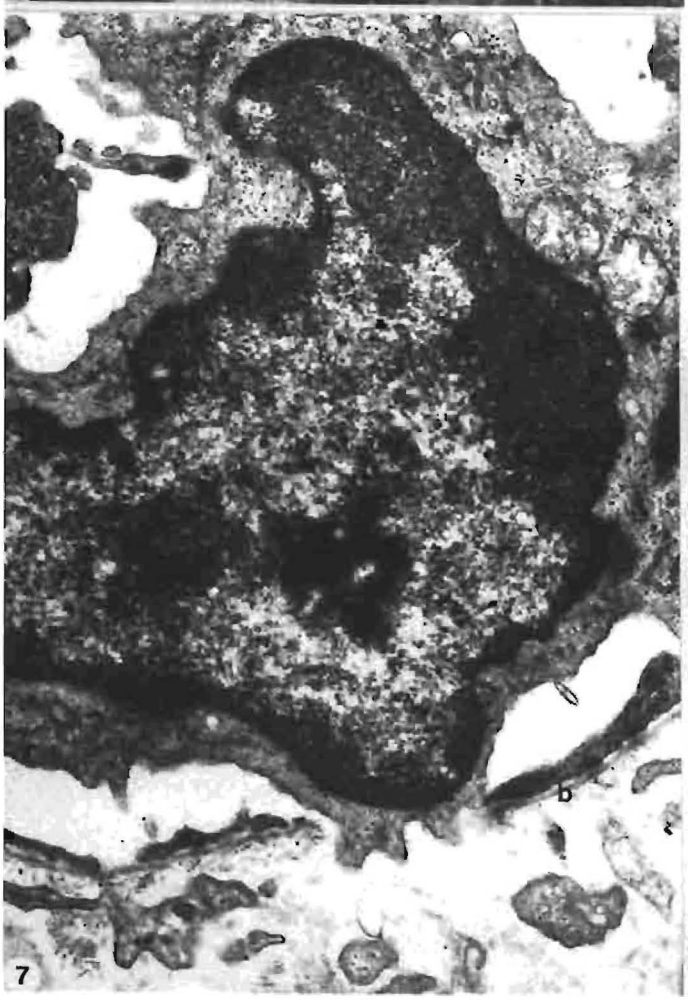
Silberberg *et al.*,[20] using ferritin as an antigen, found it to be located on the surface of Langerhans cells in the epidermis as well as within the local lymph nodes. The Langerhans cell may therefore be able to transport allergens from the initial receptor site to the local lymph nodes where a primary immune response is elicited. Rowden & Lewis[14] suggest that sensitized lymphocytes produced after the primary response, could "home" back to the Langerhans cells where lymphokines could be generated. Thus these target cells could show cytotoxic changes after direct contact or after lymphokine formation. Rowden & Lewis[14] did find a variety of ultrastructural changes in Langerhans cells reminiscent of cytotoxic damage – amongst others bizarre nuclear shapes – another possible explanation for the lobed nuclei of the Langerhans cells.

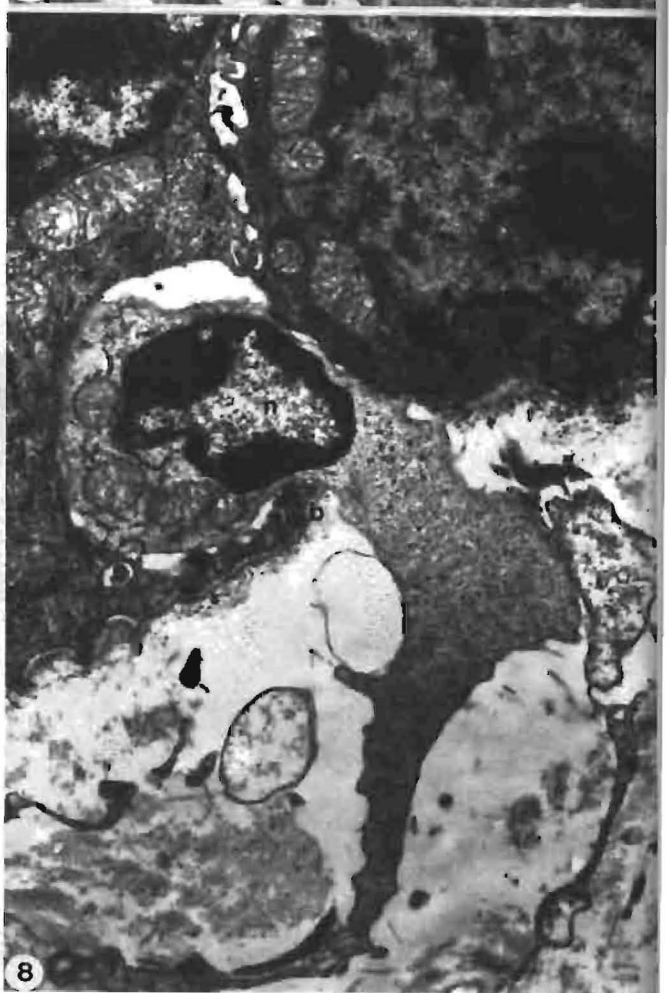
With antigens taken up on the surface of Langerhans cells it is not surprising that Wolff & Schreiner[25] and Sagebiel[16], after conducting experiments with peroxidase and ferritin found Langerhans cells to have no phagocytic activity. Prunieras[12], also found that they do not take up fat or india ink. This indicates that they are not ordinary macrophages, which is not surprising because ordinary macrophages do not contain Langerhans cell granules.

In the past decade sufficient evidence has been gained[12 14 19 20] to completely disprove the remote possibility of Langerhans cells having an ectodermal or neuroectodermal origin. The fact that they have been found in the dermis[28], in lymph nodes[7 20], in the









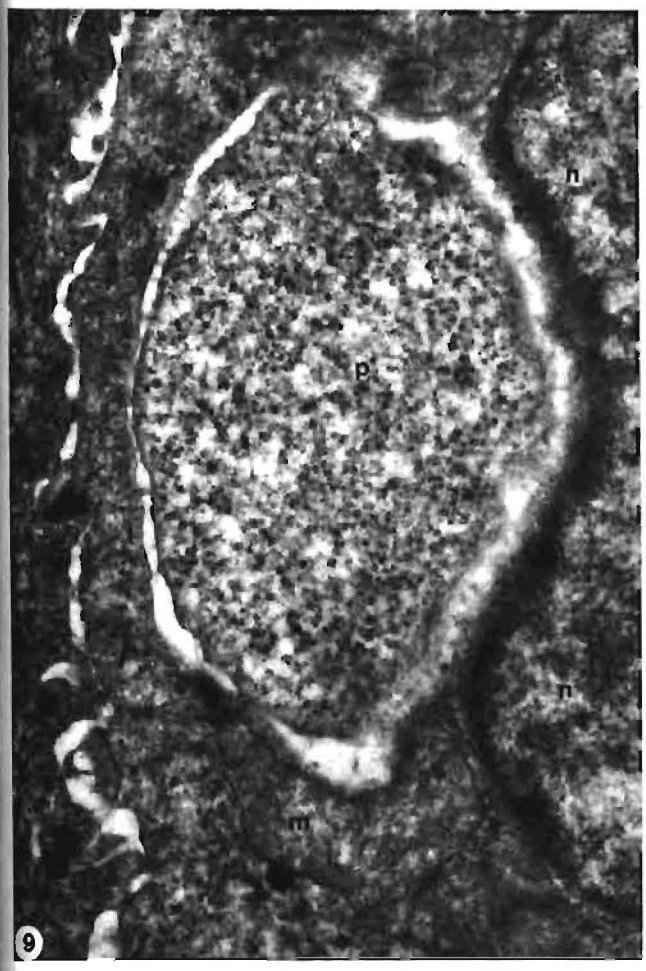


Fig. 9 A ribosome-filled dendritic process (p) of a Langerhans cell adjacent to the nucleus (n) of a keratinocyte and appearing almost as an intracellular inclusion. m = mitochondrion, d = desmosome. X 17 600

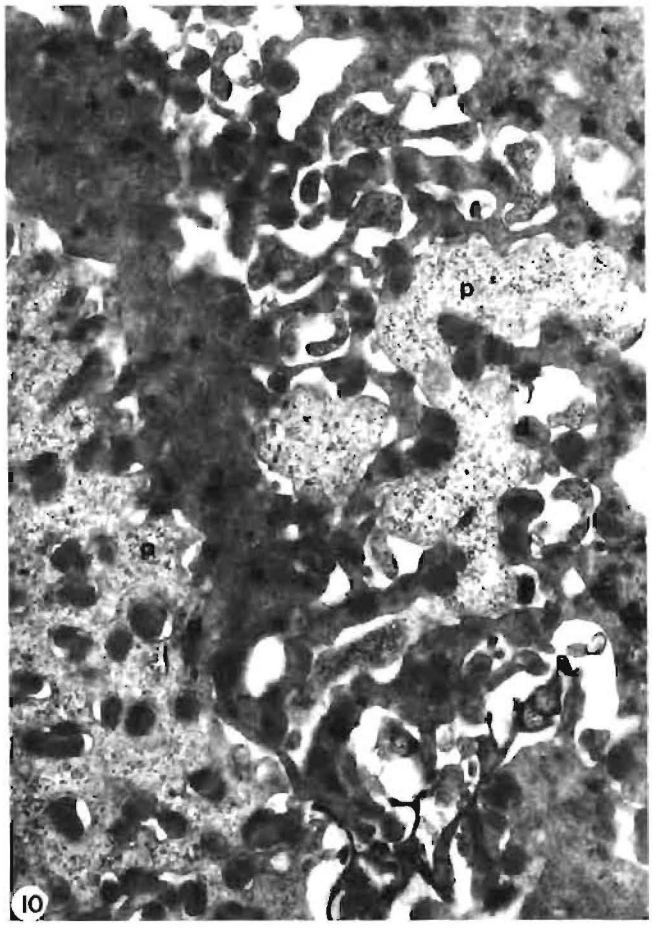


Fig. 10 Numerous ribosome-filled, dendritic processes (p) of Langerhans cells seen between tonofibrils and desmosomes (d) of keratinocytes of the reticulum epithelium. X 14 700

thymus[11] and now in a completely endodermally derived structure, *viz.* the ruminant forestomach, makes it reasonable to conclude that they are mesodermal in origin and of a lymphoid nature. Their migratory nature is further consistent with their recently determined function, *viz.* that of antigen detector[19]. This function is also consistent with their peripheral location in the epidermis as well as superficial location in the forestomach. That antigens applied to the integument, may interact with Langerhans'cells was first suggested by Prunieras[12] and most elegantly substantiated by Silberberg[19] and more recently by Shelly & Juhlin[18]. In general it may be suggested that the Langerhans cells form a very important group of lymphoid cells situated in the protective epithelia of the body, both internally and externally. In this ideal location they play an important role in the primary immune response of the body and thus in its general immunological defence. It is therefore most surprising that the true significance of such an important group of cells has been missed for so many years and thus the greater the credit that has to go to the insight of a cytologist such as Ranvier who, as early as 1875, suggested them to be of a lymphoid nature. Unfortunately his suggestion was never followed up.

Although the significance of the Langerhans cells has now become apparent no satisfactory explanation has yet been given for the presence of the Langerhans cell granules. They apparently either arise from the Golgi apparatus, move peripherally to the cell surface and then open to the surrounding milieu[28] (Fig. 5) or may arise by infoldings of the plasma membrane[16]. To differentiate between these two possibilities is of course very difficult. Wolff and Schreiner[25] using a small molecular weight protein tracer found no evidence that Langerhans cell granules could move from the plas-

Fig. 4 A Langerhans cell granule with its one end blown up into a "racket-like" vesicle. X 266 000

Fig. 5 A Langerhans cell granule in contact with the plasmalemma and opening into the external milieu. n = nucleus, v = microvilli of keratinocyte

Fig. 6 A Langerhans cell with a lobed nucleus (n), numerous mitochondria (m), a few strands of granular endoplasmic reticulum (g) and absence of desmosomes between its plasmalemma and those of the keratinocytes of the reticulum epithelium. The holes (a) are artefacts. X 19 600

Fig. 7 A Langerhans cell partly extending through the basal lamina (b) X 19 600

Fig. 8 A Langerhans cell with a ribosome-filled process passing through the basal lamina (b) and extending deep into the *lamina propria*. X 12 000

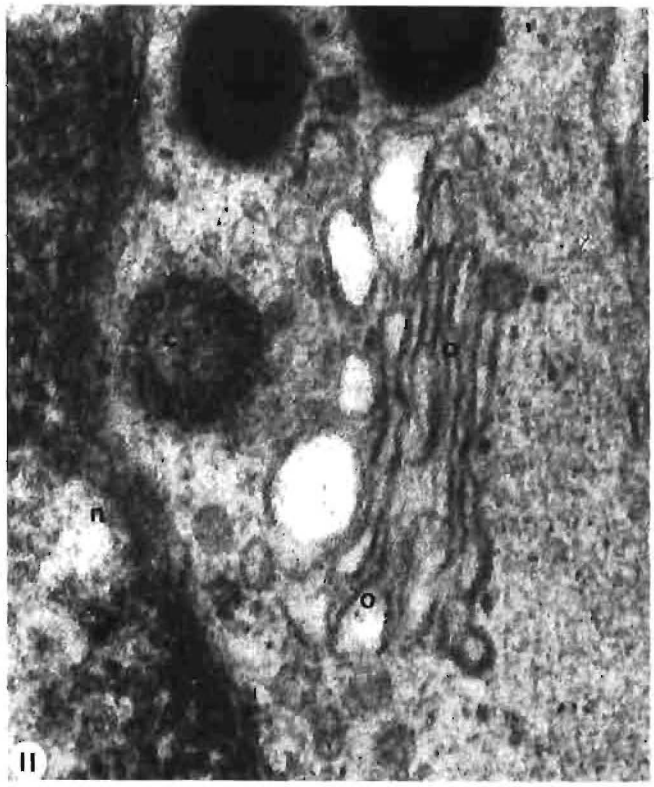


Fig. 11 A Langerhans cell with a Golgi apparatus (o), a centriole (c) and some lysosomes (l) in rumen epithelium. X 93 600

malemma to the interior of the cell. Their importance at the moment lies therein that they act as a more or less specific marker for Langerhans cells. Whether they also occur in other mammalian cell lines is at present not known.

Since the Langerhans cells previously of little more than theoretical interest have now evolved as a cell line of great immunologic importance, it may be concluded that the epidermis is a mixed population of melanocytes, keratinocytes and Langerhans cells, whereas the forestomach epithelium contains only keratinocytes and Langerhans cells. Theoretically these Langerhans cells and their granules should be present not only in stratified squamous epithelium but could also be expected as part of the immunological system in other protective epithelia such as the respiratory and digestive tracts. Although enlarged lymphocytes do occur between the columnar epithelial cells of these epithelia, Langerhans cells granules have not yet been described in them. Further work to substantiate their presence or absence is in progress.

ACKNOWLEDGEMENTS

The author wishes to express sincere appreciation to Mr John Soley for his technical assistance and for developing and printing the photographs; to Mrs Sheila Clarke for preparing the sections for ultramicroscopy and finally to the University of Pretoria for providing an E/M Unit at this Faculty.

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THE USE OF DIMETRIDAZOLE IN THE SOW HERD FOR SWINE DYSENTERY CONTROL: A PRELIMINARY FIELD REPORT

A.C. WELLINGTON* AND H.W. AUCOCK†

ABSTRACT: Wellington A. C. and Aucock H. W. **The use of dimetridazole in the sow herd for swine dysentery control. A preliminary field report.** *Journal of the South African Association* (1977) **48** No. 3 193–194 (En). Maybaker Vet. Res. Station, Box 1130, 6000 Port Elizabeth.

The successful control of swine dysentery in a breeding herd of pigs by the incorporation of dimetridazole into the feed is reported. The role played by the carrier animal, particularly the lactating sow, in the spread of the disease is stressed.

INTRODUCTION

Dimetridazole‡ has been successfully used throughout South Africa in the control of swine dysentery (SD) among fattening pigs.

SD was diagnosed in a commercial piggery situated in the Natal midlands by H.W.A. during October 1974. The owner was advised to improve the hygiene in the premises and to medicate with 0,0225% dimetridazole§ the ration fed to the weaners immediately post weaning.

The improved hygiene and the continued use of dimetridazole in the grower ration prevented any further outbreaks of SD for a period of months.

INVESTIGATION

During May 1975 the farmer reported scouring in weaners believed to be receiving a ration medicated with dimetridazole at the recommended prophylactic level of 0,0225%. A detailed examination was immediately carried out. This included a visit to the piggery by the authors, the taking of faecal smears for laboratory investigation, the prescribing of dimetridazole¶ in the drinking water at the rate of 30 g per 45 litres and the collection of feed samples for the analysis of dimetridazole content. These feed samples were taken from the bulk feed tank and from the feeder bins in the various pens and especially those pens in which loose droppings containing blood spots were seen.

Owing to the fact that the water supply was "on line", the farmer had to construct small cans, each holding about 45ℓ, into which drinking nipples were inserted for the provision of dimetridazole water medication. This medicated water was given for a period of 7 d as the sole water supply to the animals. The scouring in the piglets thus medicated cleared up with the return of normal faecal consistency within 72 h.

The faecal smears were submitted to Allerton Veterinary Investigation Centre, Pietermaritzburg, where a positive diagnosis of SD was made by means of the indirect fluorescent antibody technique for the demonstration of *Treponema hyodysenteriae.*

The feed samples were analysed and it was noted that the inclusion rate of dimetridazole in the feed was substantially lower than the recommended level. Investigation showed that the farmer had, as is customary, used dimetridazole feed medication only in his weaner stock. In the opinion of the authors, the breeding stock probably also acted as carrier animals and intermittent shedders of the causative organisms in this piggery.

It was decided that since the breeding stock might constitute a reservoir of infection, they be given dimetridazole feed medication at the level of 0,03375% for a period of 30 d. Thereafter, all sows on entering the farrowing house were fed a lactation ration containing 0,0225% dimetridazole until their piglets were weaned at 5 weeks of age.

TRIAL

In a single trial carried out in August 1975, 54 piglets, weaned from those sows which had undergone both the above treatment regimens, were divided into two equal groups and were placed in two trial pens which had been thoroughly cleaned, disinfected and rested. The control group received no medication in their feed, while the second group received a ration medicated with tylosin phosphate at 40 g/t. Total body mass of these pigs was noted at intervals up to porker mass and at no stage was there any significant difference in the live mass gain between the two groups. No clinical evidence of SD was noted in either group.

From June 1975 to July 1976, no further clinical cases of SD were diagnosed in this piggery subsequent to the single treatment of the whole breeding herd and thereafter the lactating sows. The medication of lactating sows is being continued. Medicated feed had not been fed to weaners since June 1975.

DISCUSSION

At the time of investigation it was reasoned that the scouring of fattening pigs receiving a medicated ration could have been due to:

(i) an incorrect inclusion rate of medicament
(ii) an increased disease challenge in the piggery
(iii) the smaller pigs within a litter receiving sub-therapeutic quantities of dimetridazole as a result of a lower feed intake, thus becoming more susceptible to infection and possibly acting as carriers.

The disappearance of clinical manifestations of SD following water medication with dimetridazole showed clearly that the outbreak was not due to a dimetridazole-resistant strain of *Treponema.* Analysis

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†Meat Board National Pig Health Scheme, 20 Greenwood Road, 3201 Pietermaritzburg
‡'Emtryl' – Maybaker (S.A.) (Pty) Ltd.
§'Emtryl' premix – containing 22,5% m/m dimetridazole.
¶'Emtryl' soluble – containing 40% m/m dimetridazole.

of the ration which had been fed at the time of the outbreak, showed the percentage of available dimetridazole in the ration to be substantially lower than that which is commercially recommended.

Analysis of the subsequently compounded rations indicated the correct inclusion and even dispersion of dimetridazole throughout the ration.

The cost of medication (1.4.1977) is as follows; the figures being based on the following assumptions:

A 100 sow unit = 5 boars, 23 lactating sows and 72 dry sows; 200 litters per year, or an average of 2,1 litters/sow/annum.

A breeding herd of 100 sows (lactating and dry) requires 300 kg feed per day.

A boar or dry sow requires 2 and a lactating sow 5 kg feed/d.

Each piglet requires 98 kg feed for the period between weaning at 35 d of age and 105 d:

(i) Cost of medicating the total breeding stock ration with 0,0225% m/m dimetridazole for 30 d once per annum = R123,12.

(ii) Cost of medicating lactating sow ration with 0,0225% m/m dimetridazole and fed for the period 5 d prior to farrowing through to weaning of the litter at 35 d of age = R2,74 per sow.

(iii) Cost of medicating ration fed to piglets (ex 100 sow unit) for the period 35 d to 105 d of age = R2 145,02 per annum.

In dealing with outbreaks of SD we believe it is of the utmost importance to:

(a) correctly diagnose the disease. This should be based on the following:
  (i) epidemiology;
  (ii) clinical evidence of the disease;
  (iii) post-mortem examination of one or two pigs in which typical gross lesions of the disease are found;
  (iv) demonstration of numerous organisms resembling *T. hyodysenteriae* in the colonic mucosae by means of phase contrast microscopy or by means of the direct FA test[1]. Ideally, cultural methods[2] should be utilized to confirm the presence of enteropathogenic *T. hyodysenteriae;*

(b) implement immediate therapeutic measures, first using water medication which is followed by feed medication;

(c) monitor the level of the drug in the feed;

(d) improve the level of management and hygiene.

It has been shown that the shedding of *T. hyodysenteriae* by the carrier sow was detectable only during farrowing[3]. This emphasizes the possibility that stress is a factor in the occurrence of shedding by carrier animals and supports our theoretical assumption that the asymptomatic carriers among a breeding herd may break down under the stress of parturition to become shedders of the organism and a hitherto untreated further source of infection in a piggery.

ACKNOWLEDGEMENTS

The authors thank Drs R.K. Loveday, Griffin and Hutchings for their encouragement and support, and for revising the manuscript.

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BOOK REVIEW — BOEKRESENSIE

LE VEAU

P. MORNET AND J. ESPINASSE

Maloine – S.A. Editeur, Paris 1977
pp XIV 607 Figs 138 (15 colour) Tabs 148 Publ. Price 320 F

This book, *Le Veau* (the calf), is the result of the combined effort of not less than 42 authors. In a total of 34 chapters it deals with the following divisions of the subject (the percentage figures in brackets indicating the relative share of the total volume): The general cattle industry (3%), anatomy (10%), physiology (12%), rearing and nutrition (12%), general pathology (-epidemiology, immunology, physiopathology of gastro-enteritic conditions and of respiratory diseases, group pathology) (12%), special pathology (34%), chronology of pathological conditions (3%), prophylaxis and health programmes (1%), nutritional quality and hygiene of veal (6%) and economy of production (3,5%). Most chapters are followed by lists of references.

Obviously a book of such scope cannot exhaustively deal with every detail. The editorial policy, however, to highlight points of particular importance, has been applied very successfully. The illustrations are of a high quality, particularly the colour photographs, and are accompanied by precise descriptions. This is an excellent book and can be highly recommended to all those interested in and working with the subject, who can muster sufficient French to be able to read it.

A translation of this book into English and more books of this standard on other subjects would be highly desirable.

F W H

A SUSPECTED LYSOSOMAL STORAGE DISEASE IN ABYSSINIAN CATS PART I: GENETIC, CLINICAL AND CLINICAL PATHOLOGICAL ASPECTS

P. BLAND VAN DEN BERG*, MAUREEN K. BAKER† AND A. LUCIA LANGE‡

ABSTRACT: Bland van den Berg, P., Baker, Maureen K. and Lange, A. Lucia **A Suspected Lysosomal Storage Disease in Abyssinian Cats. Part I: Genetic, Clinical and Clinical Pathological aspects.** *Journal of the South African Veterinary Association* (1977) **48** No. 3 195–199 (En) Dept. Med., Fac. Vet. Science, Univ. Pretoria, P.O. Box 12580, 0110 Onderstepoort Rep. South Africa.

The genetic, clinical and clinical pathological findings of a neurological syndrome in Abyssinian kittens are described. The findings are compared with similar cases in the literature and a tentative diagnosis of a lysosomal storage disease is proposed.

INTRODUCTION

The term "lysosomal storage disease" has been coined to described the inherited deficiency of lysosomal hydrolases and the subsequent storage of substrate within lysosomes[7]. The criteria for a disease to be classified as an inborn error of lysosomal catabolism were proposed by Hers and are restated by Jolly & Blakemore[7] as follows:

(i) the disease should be a storage disease;
(ii) it should be inherited;
(iii) the storage substance, which need not be homogeneous, should be stored at least initially within lysosomes;
(iv) there should be a partial or absolute deficiency of one of the lysosomal enzymes; and
(v) this enzyme would normally hydrolyse the storage material.

A relatively large number of diseases in man are now considered to be lysosomal storage diseases and include well known syndromes such as Pompe's disease, Tay-Sachs disease (GM_2 gangliosidosis), Niemann-Pick disease (sphingomyelinosis) and Hurler-Scheie syndrome[8]. A number of analogous syndromes have been identified in various animal species[3 7]. In cats GM_1 gangliosidosis[2 4 10], spingomyelinosis[5 11], metachromatic leukodystrophy[1], globoid cell leukodystrophy[6] and glycogenosis[13] have been described. In this report we present a description of a neurological syndrome in 8-12 week old Abyssinian kittens with symptoms strongly suggestive of a lysosomal storage disease.

CASE REPORTS

Genetic History

An imported (from Denmark) inbred (mother-son mating) Abyssinian male, "Sambo" was introduced into a breeding colony in Cape Town in 1974. Following his introduction a number of matings occurred including the following (Fig. 1):

1. "Sambo" and unrelated Female B. Three normal kittens (5, 6, 7) were born on 27.7.1974. Kitten 6 subsequently died of a cause unrelated to the syndrome under discussion.

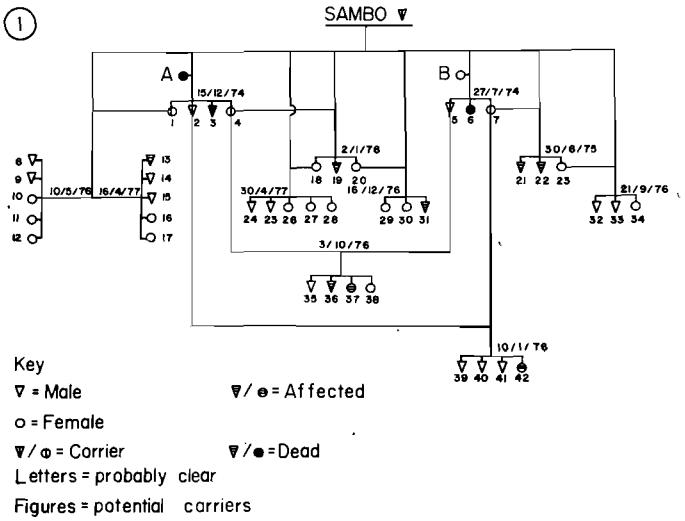

Fig. 1 Genetic diagram showing relevant matings involving the Abyssinian sire "Sambo".

2. "Sambo" and distantly related Female A. Four normal kittens (1, 2, 3, 4) were born on 15.12.1974. Female A and Kitten 3 died of unrelated causes.
3. "Sambo" and Daughter 7. Three kittens were born on 30.8.1975; a normal female (23) and 2 affected males (21,22). Both males were killed when 12 weeks of age. The brain of No. 22 was submitted for examination.
4. "Sambo" and Daughter 4. Three kittens were born on 2.1.1976; 2 were normal females (18, 20) and 1 was an affected male (19) which was submitted live for examination.
5. Half-brother 2 and Half-sister 7. Four kittens were born on 10.1.1976; 3 were normal males (39, 40, 41) and 1 was an affected female (42). The latter was submitted live for examination
6. "Sambo" and Daughter 1. Five normal kittens (8-12) were born on 10.5.1976, and in a subsequent mating 5 kittens were born on 16.4.1977, 4 of which were normal (14-17) and 1, a male, was affected (13). The latter has been submitted but has not yet been fully examined.
7. "Sambo" and Daughter 23. Three normal kittens (32, 33, 34) were born on 21.9.1976.
8. Half-brother 5 and Half-sister 4. Four kittens were born on 3.10.1976; 2 were normal kittens (35, 38), 1 was an affected male (36) and 1 an affected

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female (37). The latter 2 kittens were submitted live for examination.

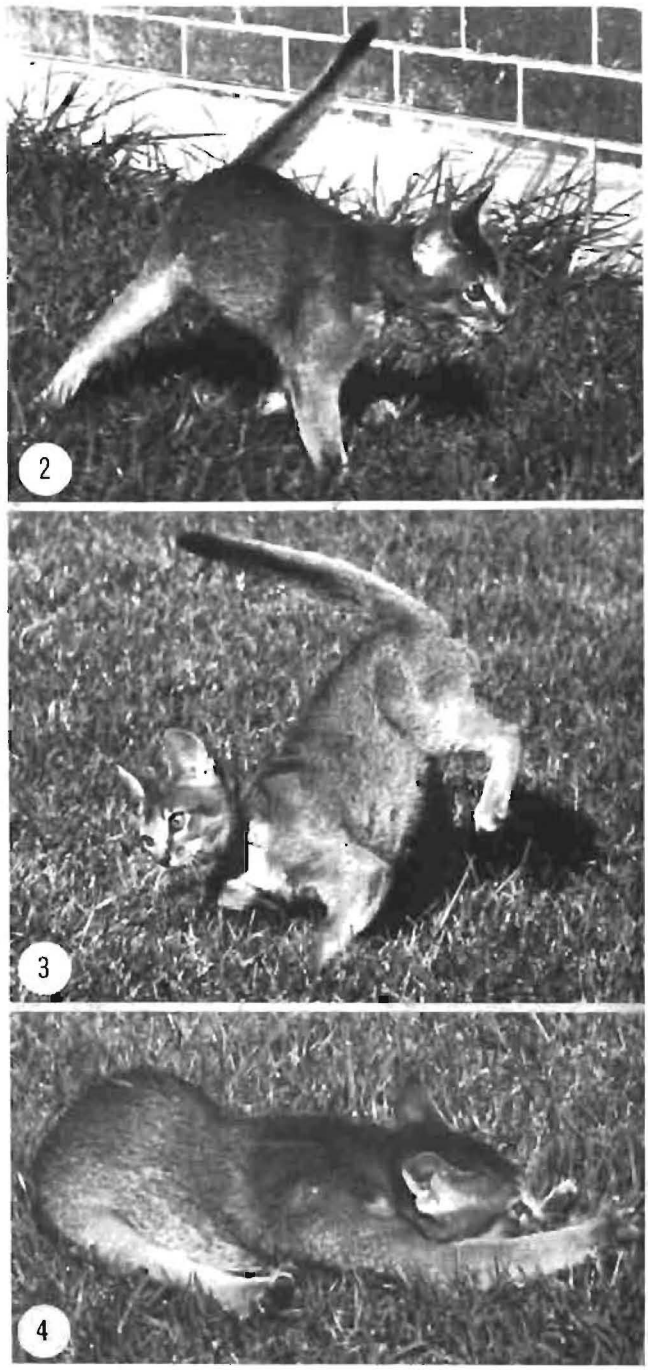
9. "Sambo" and Daughter 20. Three kittens were born on 16.12.1976; 2 were normal females (29, 30) and 1 was an affected male (31). The latter was killed in Cape Town, but was not further examined.
10. "Sambo" and Daughter 18. Five normal kittens (24-28) were born on 30.4.1977.

Clinical History

Information obtained from breeders included the following. All breeding stock was subjected to a strict feline panleukopenia vaccination programme. Dams were healthy during pregnancy and lactation. Affected kittens (21, 22, 19, 42, 36, 37, 31, 13) first showed signs at 8-12 weeks of age, with symptoms becoming severe by 14 weeks. An initial head "quiver" progressed to severe "nodding" of the head, incoordination and loss of balance, generalised tremors, body swaying, rocking movements and falling. Muscle spasms and rigidity with head drawn back and "fits" occurred when the animals were handled. The kittens appeared intelligent, friendly and playful. Their appetites were good although their eating habits were clumsy. They were, for example inclined to blow bubbles in their milk. Treatment was administered in some cases (mainly vitamins B_1, B_6 and B_{12}) but no improvement was noted.

Clinical Findings

Clinical examination of Kittens 19, 42, 36 and 37 confirmed many of the signs reported by their owners. The general condition and habitus were good. When standing, forward and backward, and side to side, rocking movements were marked. Locomotion was generally slow and deliberate with marked ataxia, incoordination, dysmetria (Fig. 2 & 3) and muscle tremors. Directional sense was disturbed. Kittens would approach an object to play but would "angle off". They frequently fell and had difficulty in regaining their feet. Handling and movement appeared to precipitate characteristic seizures, the animal generally assuming a sternal position with head and legs extended forward and strong lumbar flexion (Fig. 4). Seizures were usually of short duration (approximately 30 seconds). Sight was apparently normal, although the pupil and menace reflexes were weak. The opthalmoscope examination was normal. No strabismus was present. Masseter muscle tone was good and normal reactions to pinpricks of the face occurred. The corneal reflex and facial expression was normal. Hearing appeared normal and no head tilt, circling or nystagmus was observed (except No. 42 which had intermittent horizontal nystagmus). The gag reflex, cough reflex and tongue tonus were good. The spinal reflexes (flexor, extensor, patellar, panniculus, anal and visceral) were present although possibly exaggerated in some instances. The postural reflexes were generally normal although a tendency to extensor spasm with lifting of the head in the tonic neck and eye reflex was observed. The righting reactions were present, but were awkward because of reduced coordination. The hanging reflex caused great distress. The placing reflex was present but not accurate, while the extensor postural thrust and hopping reflexes were normal. It was very evident that symptoms were markedly progressive with severe deterioration occurring within weeks.



Figs 2 & 3 Marked ataxia, inco-ordination and dysmetria.
Fig. 4 Seizure in a sternal position with head and legs extended and strong lumbar flexion.

Following the initial period of observation and clinical examination the kittens were anaethetised by the intravenous administration of pentobarbitone*, and blood, urine and cerebrospinal fluid samples were taken for chemical pathological investigation and electro-encephalographs (EEG) and radiographs were made. A bone-marrow sample was taken only from Kitten 19. The haematology and blood chemistry results as well as the urine and cerebrospinal fluid

*Nembutal-Abbott Laboratories S.A. (Pty) Ltd.

Table 1: HAEMATOLOGY AND BLOOD CHEMISTRY

Case No.	19	42	36	37	Normal
Haemoglobin g%	8,1	10,7	5,6	4,4	8–14
Red cell count x 10^6/mm³	4,62	5,96	2,10	1,63	5,5–10,0
Haematocrit (%)	34,5	39,5	26,5	21,1	24–45
Mean cell volume μ^3	64	61	59	56	39–55
Reticulocyte count (%)	—	—	2,6	0,4	0–1,0
White cell count/mm³	16 100	32 200	15 200	7 900	5–19 000
Neutrophiles (%)	77	80	61	62	35–75
Lymphocytes (%)	12	12	10	15	20–55
Monocytes (%)	3	5	8	2	1–4
Eosinophiles (%)	8	3	20	21	2–12
Basophiles (%)	0	0	1	0	rare
SGPT i.u./ℓ	30	16	19	23	6–25
SAP i.u./ℓ	36	9	152	41	50–122
LDH i.u./ℓ	288	248	224	328	48–94
CPK i.u./ℓ	—	—	63	39	10–60
Glucose mg%	108	183	118	76	60–118
Pyruvate mg%	1,49	0,16	1,03	1,05	<1,5
Cholesterol mg%	160	190	228	74	95–130
Blood urea nitrogen mg%	17,4	6,0	37	39	20–30
Total serum protein g%	6,8	6,1	5,8	5,0	5,4–7,2
Albumin g%	3,09	3,2	0,64	0,79	3,2
Alpha-1-globulin g%	0,50	0,41	1,61	1,06	0,3
Alpha-2-globulin g%	0,50	0,31	0,64	0,53	0,4
Alpha-3-globulin g%	0,74	0,73	1,29	0,53	0,7
Beta-1-globulin g%	}	0,2	}	0,53	0,4
Beta-2-globulin g%	1,12	0,41	0,32	0,53	0,4
Beta-3-globulin g%	}	0,20	}	—	0,3
Gamma-globulin g%	0,85	0,62	1,29	1,06	0,8
A:G ratio	0,83	1,10	0,12	0,19	1,0

Table 2: URINE ANALYSIS

Case No.	19	42	36	37	Normal
Specific gravity	1,070	1,050	1,040	1,055	1,018–1,040
pH	8,0	6,0	5,0	6,5	5,0–7,0
Protein	++	—	—	+	—
Glucose	—	—	—	—	—
Ketones	—	—	—	—	—
Bilirubin	—	—	—	—	trace
White blood cells	—	—	+	—	occasional
Red blood cells	—	+	—	—	nil
Epithelial cells	—	—	+	—	occasional
Casts	—	—	+	—	occasional
Crystals	—	+	—	+	occasional

Table 3: CEREBRO-SPINAL FLUID ANALYSIS

Case No.	19	42	36	37	Normal
Appearance	clear	clear	clear	clear	clear
Specific gravity	—	1,006	1,006	1,006	1,006
Protein mg%	—	400	0	100	10–30
Glucose mg%	61,5	113	66	60	40–90
White cell count/mm³	1	70	1	1480	10–25
Red cell count/mm³	—	—	—	—	—
LDH i.u./ℓ	—	128	64	56	40–120
CPK i.u./ℓ	—	56	23	47	10–60
Bacterial and fungal culture	—	—	—	—	—

analyses are given in Tables 1, 2 and 3. A Sabin-Feldman test for toxoplasmosis done on serum from Kittens 19 and 42 was negative. Radiographs of these same kittens showed no alteration in the size of the cerebellar fossa and no enlargement of parenchymatous organs. Cells in the bone-marrow preparation from Kitten 19 revealed no gross chromosomal abnormality. Electro-encephalographs were made using the Siemens Mingograf Junior EEG 8 channel recorder. A simple programme utilising 2 occipital, 2 frontal and a central needle electrode was employed as described by Redding[12]. As controls EEG's were recorded from 3

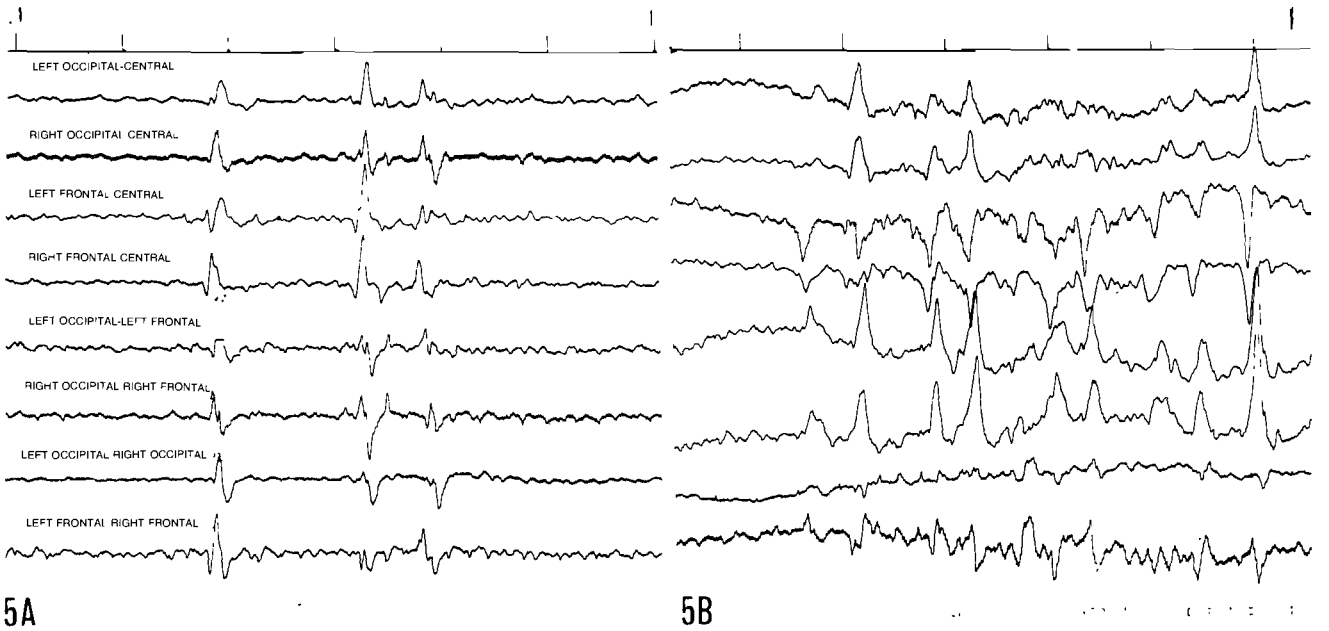


Fig. 5 Electro-encephalographs recorded from (A) normal control kittens and (B) affected kittens. The latter show marked high voltage slow wave activity especially in the frontal leads.

normal anaethetised kittens. In these normal animals an average frequency of 4-8 cycles per second was noted with amplitudes ranging from 6-65 microvolts, together with intermittent spike activity with amplitudes of 50-240 microvolts (Fig. 5A). Alterations from these normal patterns were observed in the affected kittens. There was a tendency to alternate periods of low activity (6-8 cycles per second, amplitude 15-40 microvolts) and high voltage, slow wave and spike activity (1-4 cycles per second, amplitude 50-200 microvolts), especially in the frontal leads (Fig. 5B).

Following the above observations and procedures the kittens were killed, Kitten 19 at 18 weeks of age, Kitten 42 at 21 weeks, and Kittens 36 and 37 at 11 weeks. Specimens from 19, 42, 36 and 37 were taken immediately after death. The pathological findings are recorded in the second part of this paper[9].

DISCUSSION

Lysosomal storage diseases, being inborn errors of metabolism, manifest themselves at an early age[1 2 8]. The kittens in this report began to show symptoms at 8-12 weeks of age, which complies well with this. A greater incidence of these syndromes is likely to be found in certain breeds especially where inbreeding occurs[7]. Again this was the case here. It is very apparent on examining the breeding programme that the observed cases can be related to the introduction of the inbred sire "Sambo". It is also apparent that the parents of affected kittens are phenotypically normal, that they are consanguinous, that male and female siblings are affected and that the ratio of diseased to phenotypically normal kittens is consistent with that of an autosomal recessive trait. It is therefore assumed that the condition is being transmitted as such. Based on this assumption "Sambo" and Kittens 7, 4 and 2 are considered heterozygotes which produced affected homozygous kittens Nos. 21, 22, 19 and 42. To further verify this "autosomal recessive theory" test matings were carried out using heterozygotes "Sambo" and Kitten 4 on Abyssinian siblings of unknown genotype. These matings produced 4 clinical cases 36, 37, 31 and 13 which appeared to substantiate the theory, as well as exposing Nos. 5, 20 and 1 as carriers. One of Hers' criteria, namely that lysosomal storage diseases are inherited, thus appears to have been fulfilled.

The symptoms of a storage disease are progressive since the storage of material, and subsequent compromised cell function, continues inexorably[1 8]. The kittens in this report illustrated this point well. The initial head quiver progressed to a severe ataxia, incoordination and inability to walk within weeks. The symptoms of ataxia, dysmetria and muscle tremors, together with a normal mental status and cranial nerve examination, and slightly exaggerated spinal, and at times awkward postural, reflexes, are strongly suggestive of a cerebellar disorder. This was substantiated during the post-mortem examination, with the most severe lesions being present in the cerebellum[9]. Little reference is made in the literature to clinical pathological changes associated with lysosomal diseases. In the condition described here the disease process is chiefly confined to the central nervous system[9]. The clinical pathological changes are therefore unlikely to be striking and this was borne out by the results obtained. The only major changes are the anaemia, eosinophilia and hypo-albuminaemia shown by Kittens 36 and 37, which are strongly indicative of internal parasitism. Parasites were not demonstrated at autopsy however, although treatment just before referral could explain this discrepancy. Other changes, such as the elevation of lactic dehydrogenase and blood urea nitrogen, are considered to be indicative of tissue damage without in any way being specific for the syndrome. The sig-

nificance of the rise in cholesterol shown by 3 of the kittens is at this stage unknown. Analysis of cerebrospinal fluid also gave inconclusive results as only 2 of the kittens showed an increase in the protein concentration and leukocyte count. These findings cannot furthermore be related to a greater severity in clinical signs or histological lesions in the 2 kittens. The Sabin-Feldman test for toxoplasmosis and the radiographs in Kittens 19 and 42 yielded negative results, and were therefore not repeated in Nos. 36 and 37. Similarly the bone-marrow examination performed on Kitten 19 was not repeated in the other animals. Electro-encephalograms were more informative. Marked differences from the normal patterns were observed. Although the patterns of the 4 kittens were not entirely consistent, high voltage slow wave activity, generally considered indicative of neuronal damage[12], was present in all of them. Degeneration of cortical neurones was confirmed on histopathological examination[9]. Electro-encephalography may thus be of diagnostic value in differentiating lysosomal storage disease of the central nervous system from its main differential diagnosis, namely, cerebellar hypoplasia.

CONCLUSIONS

From the evidence presented here there can be no doubt that the neurological syndrome described in this report is an inherited progressive disorder involving especially the cerebellum. Important differential diagnoses (e.g., cerebellar hypoplasia, toxoplasmosis and thiamine deficiency) have been eliminated, and together with the pathological examinations[9] it would appear that this syndrome qualifies for the description of a "suspected lysosomal storage disease". The chemical nature of the storage material and the specific enzyme deficiency have yet to be idenfified. We wish to stress the importance of the recognition of this type of syndrome in order to curtail the spread of animal genetic diseases and to provide animal models for research into analogous human conditions.

ACKNOWLEDGEMENTS

Grateful thanks are extended to the Abyssinian cat breeders for their cooperation in the investigation of this syndrome, and to the technical and nursing staff of the Department of Medicine, Faculty of Veterinary Science, University of Pretoria.

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BOOK REVIEW RESENSIE

STRONGYLUS VULGARIS IN THE HORSE: ITS BIOLOGY AND VETERINARY IMPORTANCE

C. P. OGBOURNE AND J. L. DUNCAN
Commonwealth Agricultural Bureaux, Farnham Royal 1977
pp 40, Figs 21 (1 colour), Tabs 2. Price not stated

This is a comprehensive review of the current state of knowledge of all aspects of the biology of this important parasite of equines. It includes sections on the free-living and parasitic stages of the life cycle, the pathogenesis of the larval and adult stages, epidemiology, diagnosis, treatment and prophylaxis.

The parasitic life cycle of this helminth, which for a long time has been a subject of controversy, is clearly described and pictorially illustrated. The marked pathogenicity of the larval stages, even when only small numbers are present, is discussed and many of the macro- and microscopic pathological changes are illustrated. The clinical signs of infestation are correlated with the parasitic development and pathogenicity of the nematode. In addition the epidemiology of infestation, as determined in numerous studies, is utilized in the rational formulation of control measures. An interesting preview of possible future developments is also given.

The review is well-written and reflects the extensive practical and research experience of both its authors in the field of equine strongylosis. It will be enjoyed by helminthologists, pathologists and students and should be a valuable addition to the libraries of all equine practitioners.

I G H

A SUSPECTED LYSOSOMAL STORAGE DISEASE IN ABYSSINIAN CATS PART II: HISTOPATHOLOGICAL AND ULTRASTRUCTURAL ASPECTS

A. LUCIA LANGE*, P. BLAND VAN DEN BERG† AND MAUREEN K. BAKER‡

ABSTRACT: Lange, A. Lucia, Bland van den Berg, P. and Baker, Maureen K. **A suspected lysosomal storage disease in Abyssinian cats. Part II: Histopathological and ultrastructural aspects.** *Journal of the South African Veterinary Association* (1977) **48** No. 3 201–209 (En) Dept. Path. Fac. Vet. Science, Univ. Pretoria, P.O. Box 12580, 0110 Onderstepoort Rep. South Africa.

The histopathological and ultrastructural findings in the central nervous system and lymphoid tissue of Abyssinian kittens suffering from a disease which was clinically characterised by neurological disturbances, are described. The lesions were vacuolisation of neurones and macrophages with light microscopy and lamellated membranous cytoplasmic bodies, initially in lysosomes with electron microscopy. Irregularly shaped membrane-bound bodies with an amorphous substance were eventually formed in the cytoplasm of affected cells. It is considered that this is a lysosomal storage disease.

INTRODUCTION

The concept of inborn errors of lysosomal storage defects is a relatively recent finding[6]. Lysosomal storage diseases have been well documented in humans[6] and it is only in the last decade that related conditions have been reported in cats[2 4 15] and other animals[7 8].

The historical, genetic, clinical and clinical pathological findings of the syndrome encountered in Abyssinian kittens, under discussion here, are recorded in a separate report[3]. Clinically these kittens exhibited ataxia, incoordination and siezures. Five of the affected kittens were killed for post mortem examination.

MATERIALS AND METHODS

Two male kittens, Nos. 21 and 22 (Diagram), which had developed neurological disturbances at 8 weeks of age, were killed at 12 weeks of age. The brain of Kitten 22 was preserved in formalin for histopathological examination. In the course of the next 2 years several related kittens showed similar neurological deviations on clinical examination and were submitted live to the Faculty of Veterinary Science, Pretoria. On completion of clinical tests Kittens 19, 42, 36 and 37 were killed by an intravenous injection of an overdosage of pentobarbital sodium and autopsied. Kitten 19 was 18 weeks old, Kitten 42 was 21 weeks old and Kittens 36 and 37 were 11 weeks old. Unfortunately no material was available from Kittens 21 and 31, and sections from Kitten 13 were not available at the time of writing (see Diagram).

The following specimens were collected from the killed kittens:

(1) Portions of the brain, spinal cord, liver, spleen, lymph nodes, kidney, adrenals, lung, pancreas, heart muscle, eyes, gut and thymus were fixed in 10% buffered formalin for light microscopy. Sections were stained routinely with haematoxylin and eosin (HE). In addition, thick plastic embedded sections were stained with toluidine blue and examined with the light microscope. Holzer's[16] and Luxol fast blue-Holmes silver nitrate[13] stains were done on sections of the brain.

(2) Selected portions of the cerebrum, cerebellum, thalamus and midbrain; and portions of the spleen,

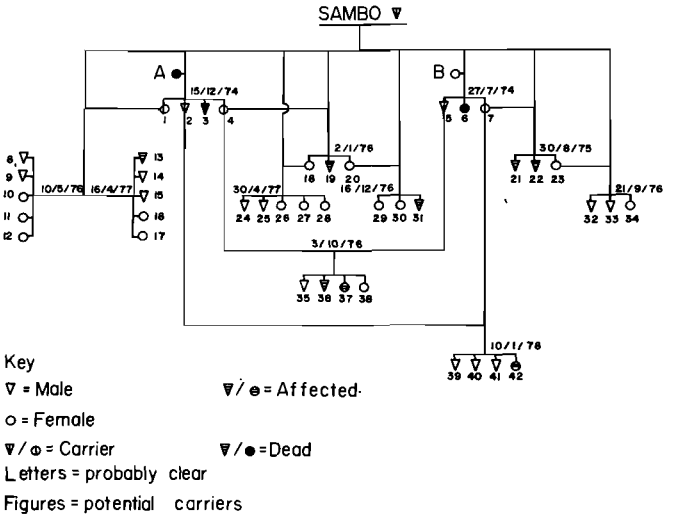

Fig. 1 Genealogical tree indicating normal, carrier and affected cats.

mesenteric lymph nodes, liver, kidney and lung were taken for electron microscopy. Tissue blocks, cut to approximately 1 x 1 x 1 mm in size were fixed in 4% glutaraldehyde in Millonig's phosphate buffer (pH 7,2-7,4) at 4°C for 24 hours. Blocks were then washed in the same buffer and post-fixed for 1 hour in 2% osmium tetroxide. Following 2 more buffer washes, the blocks were dehydrated in ethanol and propylene oxide and embedded in Epon 812 in gelatin capsules at 60°C for 48 hours. Ultra-thin sections were cut with glass or diamond knives with a Reichert AMU 3 ultramicrotome, stained in 1% uranyl acetate for 10 minutes, and 0,2% lead citrate for 30 seconds and examined in a Philips EM 301 electron microscope.

(3) Portions of the brain, spleen, lymph nodes and liver were fixed in calcium formol (1% Ca Cl_2 and 10% formalin) for histochemistry. Osmium tetroxide alpha naphthylamine (OTAN)[1], NaOH-OTAN[1] stains were done.

(4) Frozen sections of the brain, spleen, lymph nodes, liver and lungs were stained with periodic acid Schiff (PAS)[12], Sudan black[12] and oil-red-O[12].

RESULTS

Macroscopic

Macroscopically very few significant lesions were seen. The central nervous system did not show any lesions.

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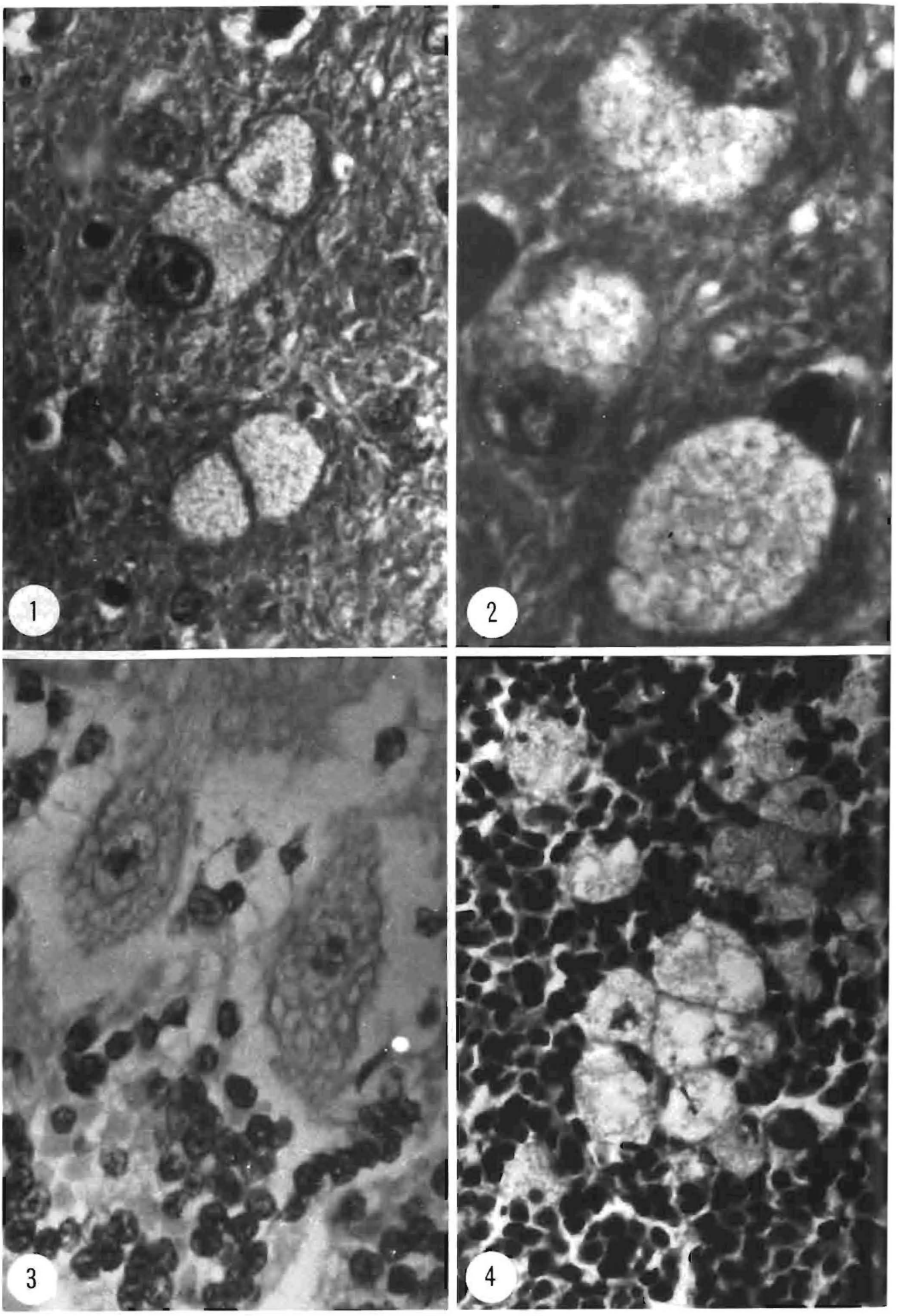
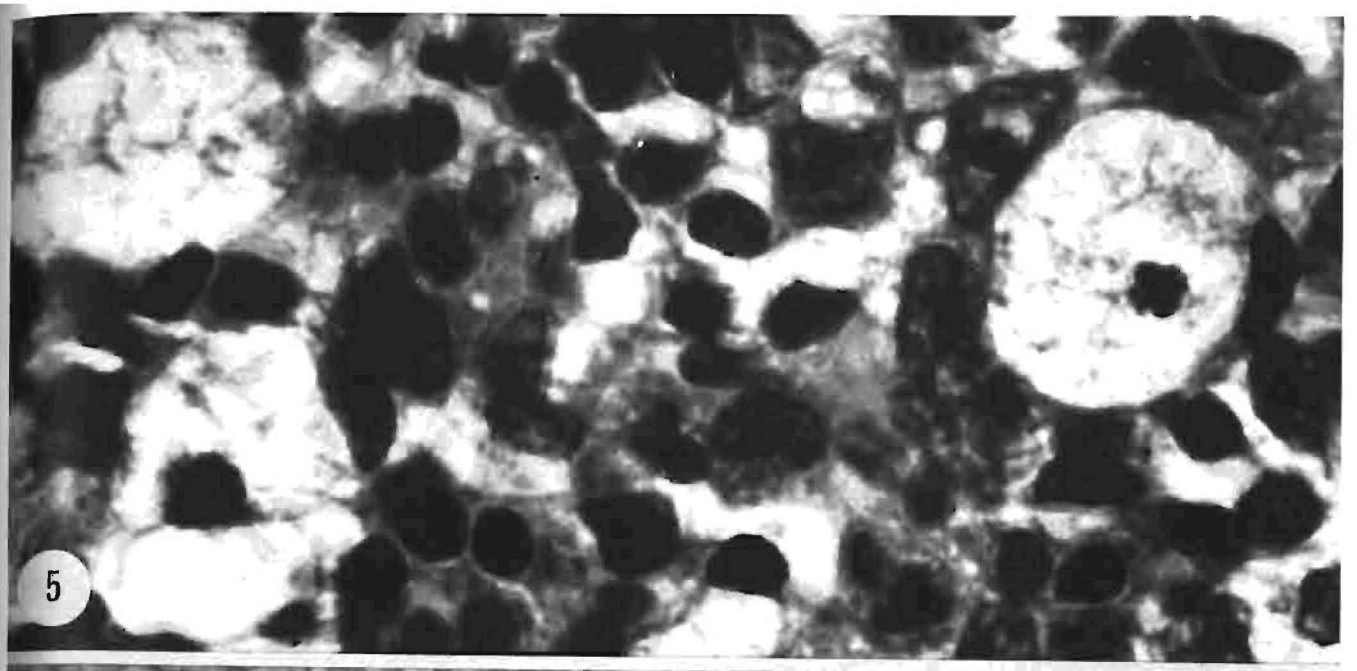
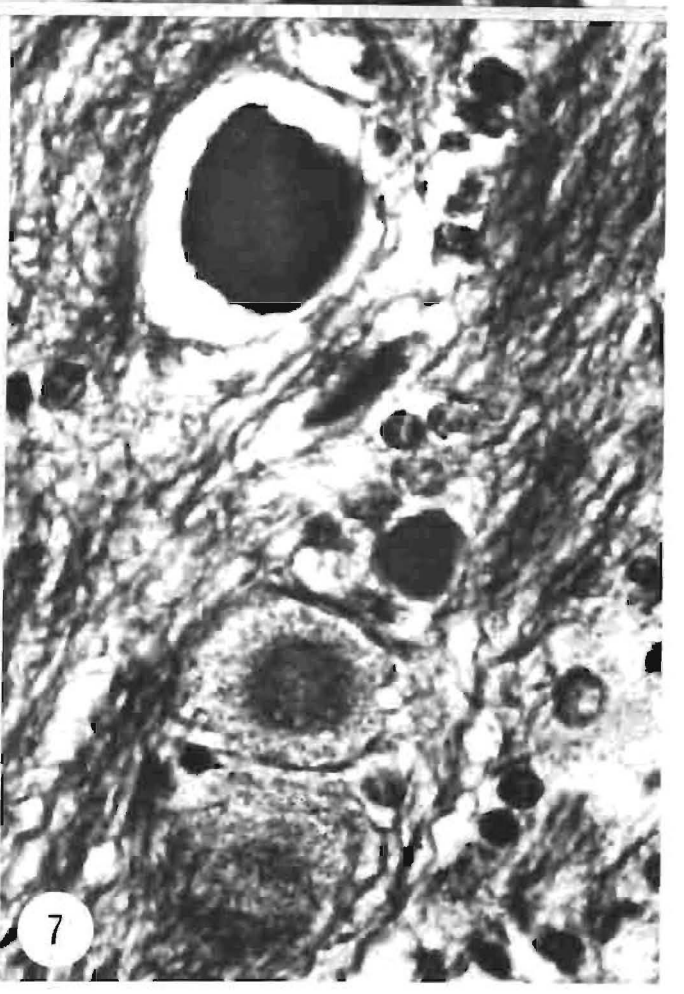






Figs. 1 & 2 Vacuolated neurones in the frontal cortex. H.E. X 1280 & X 2800

Fig. 3 Vacuolated Purkinje cells in the cerebellum. H.E. X 1280

Fig. 4 Vacuolated macrophages in a germinal centre of a mesenteric lymph node. H.E. X 960

Fig. 5 Vacuolated macrophages in a germinal centre with vacuoles of varying sizes in the cytoplasm. H.E. X 2000

Fig. 6 Different sized spheriods in the cerebellar white matter. H.E. X 1000

Fig. 7 Two types of spheroids. One with a homogenous inner structure surrounded by a swollen myelin sheath. The other with a granular appearance and a darker central structure. Toluidine blue X 1400

The mesenteric lymph nodes in all the kittens examined were enlarged, and their germinal centres were prominent and varied in size from 0,5-1,0 mm diameter. The spleen did not show obvious involvement of the germinal centres. The liver and kidneys in the kittens were paler in colour and more friable than normal. One kitten had an acute purulent bronchopneumonia along the edges of one cranial lobe.

Light Microscopy

Serial sections of the brains of 5 kittens were examined. Pathological changes of a similar nature were encountered in the brains of all 5 animals. They did, however, vary in severity; the older kittens (Nos. 19 and 42) had more advanced lesions than the younger ones (Nos. 22, 36 and 37).

Neuronal lesions occurred throughout the brain, being more obvious in certain areas than in others. The most severely affected neurones were those in the inner molecular layer of the frontal cortex, the medial geniculate body, the superior colliculi, the caudate, dentate, gracile, olivary, cuneate and ambiguus nuclei and the cerebellum. Lesions in the Purkinje cells of the cerebellum were the most prominent ones. Neurones in the dorsal horn of the cervical spinal cord were also affected, but to a lesser degree than the above.

Affected neurones were enlarged due to the presence of membrane-bound vacuoles of varying size in the cytoplasm (Fig. 1-3). Their nuclei were pushed to one side of the cell and some showed prominent chromatin changes. Many of the neurones containing these vacuoles exhibited degenerative or necrotic changes and several of these were being replaced by proliferating glial cells. The identity of the latter was confirmed in sections stained by Holzer's method for glial cells.

The most striking lesion in the white matter was the presence of numerous "spheroids". These were not apparent in the frontal cortex, but were very prominent in the corpus callosum, brain stem and cerebellar white matter. The spheroids, presumed to be swollen cell processes, appeared as round to oval eosinophilic bodies with HE (Fig. 6). They varied in appearance and size being from 2,75-20 mm in diameter. Some were granular, others had a definite internal structure (Fig. 7) while several had a homogenous dense appearance and were surrounded by a dilated myelin sheath (Fig. 7). That these were indeed swollen myelin sheaths was confirmed with sections stained by the Luxol fast blue-Holmes silver nitrate method. The spheroids had a brown-black homogenous or granular appearance with this stain. In addition the internal structure of many of them stained slightly positive with both PAS and Sudan black methods. Numerous swollen myelin sheaths in the cerebella of all 5 cases gave the white matter here a vacuolated appearance. Only 1 suspected spheroid was seen in the spinal cord of 1 case.

The germinal centres of the lymph nodes and spleen were very prominent due to the presence of numerous large vacuolated macrophages. Identical macrophages were also present in the medullary cords of the lymph nodes, in the red-pulp of the spleen and in the peri-bronchiolar lymphoid tissue of the lungs. Most of these cells had a small excentric pyknotic nucleus and the cytoplasm was filled with numerous membrane-bound vacuoles of varying size (Fig. 4 and 5).

The vacuoles in affected neurones and macrophages did not stain with PAS, oil-red-O, OTAN and NaOH-OTAN (technical difficulties were, however, experienced with the OTAN and NaOH-OTAN stains. Using Sudan black stain, the walls of the vacuoles stained black but the content remained unstained. An acute purulent bronchopneumonia was found in the lung of one kitten. Alveolar macrophages in the alveoli of the other kittens were slightly increased in number but no significant lesions were found in these cells. Changes in the liver and kidneys varied from diffuse cloudy swelling to hydropic degeneration. No significant lesions were noted in the other organs examined.

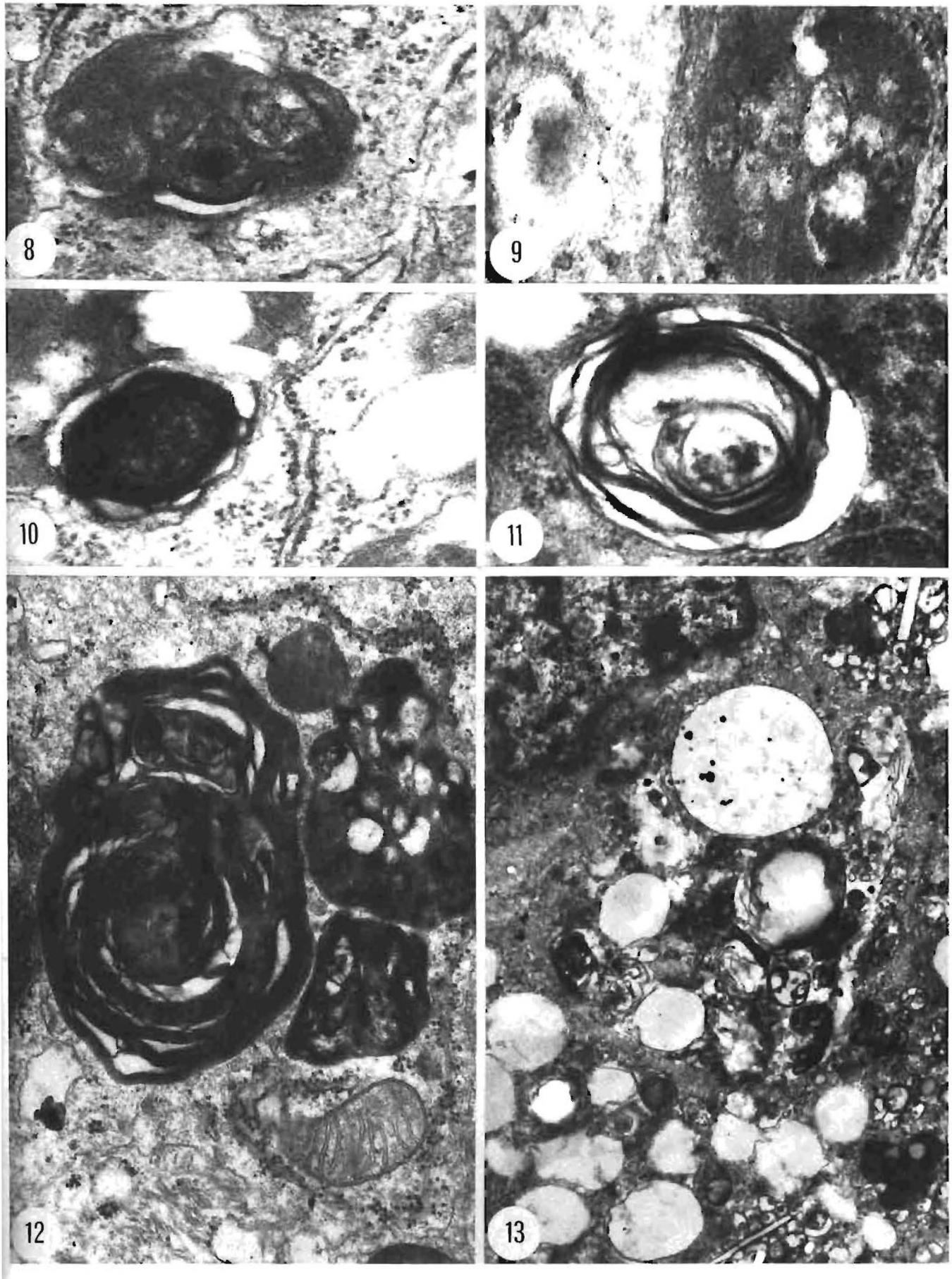
Electron Microscopy

Many neurones of the cerebrum, thalamus and cerebellum of the 4 kittens which were investigated by electron microscopy, showed variable numbers of irregularly shaped membrane-bound lamellated bodies in the cytoplasm. These structures are generally referred to as membranous cytoplasmic bodies or MCB's[2]. All these bodies contained a grey granular substance interspersed with lamellated patterns and electron-lucent areas, and lamellar remnants. Areas of an amorphous grey ground substance or clear spaces were also present (Fig. 8, 9 and 11). In some of the MCB's were tightly lamellated structures surrounding a central core of granular amorphous moderately electron-dense material (Fig. 10).

Some glial cells also contained similar, but not identical MCB's in their cytoplasm. These were grey granular structures surrounded by a membrane, or regularly lamellated electron-dense structures (Fig. 12). Several other glial cells contained membrane-bound vacuoles which varied in size and contained small amounts of slightly electron-dense amorphous material (Fig. 13). A few of these vacuoles still had peripherally-situated lamellar remnants present. Cleft-like spaces also occurred in some glial cells (Fig. 13).

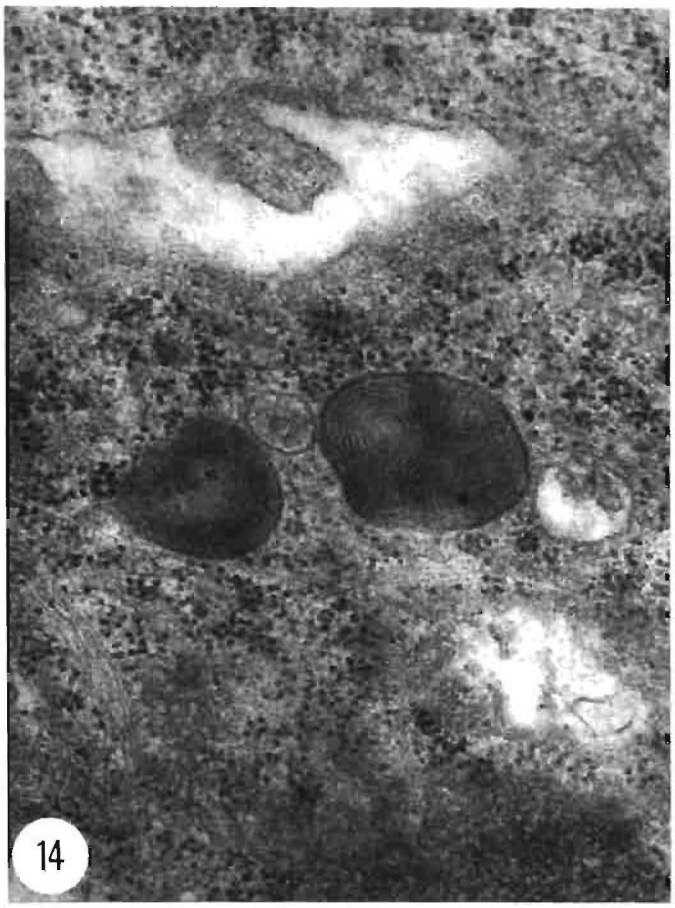
Spheroids of varying size and appearance were seen in the cerebrum, thalamus, brain stem and cerebellum. The spheroids were distorted and varied in appearance. The spheroids were basically of 3 types. Some were comprised of a relatively homogenous electron-dense structure in which were a few small vacuoles (Fig. 18), while in others remnants of normal neurofibrils were present, as well as degenerating mitochondria and round lamellated structures of varying size could be discerned (Fig. 19). The other type of spheroid was mainly composed of rounded lamellated structures which varied in size. Some of these contained a moderately electron-dense amorphous material (Fig. 20 and 21). All the spheroids were surrounded by a thin myelin sheath or membrane.

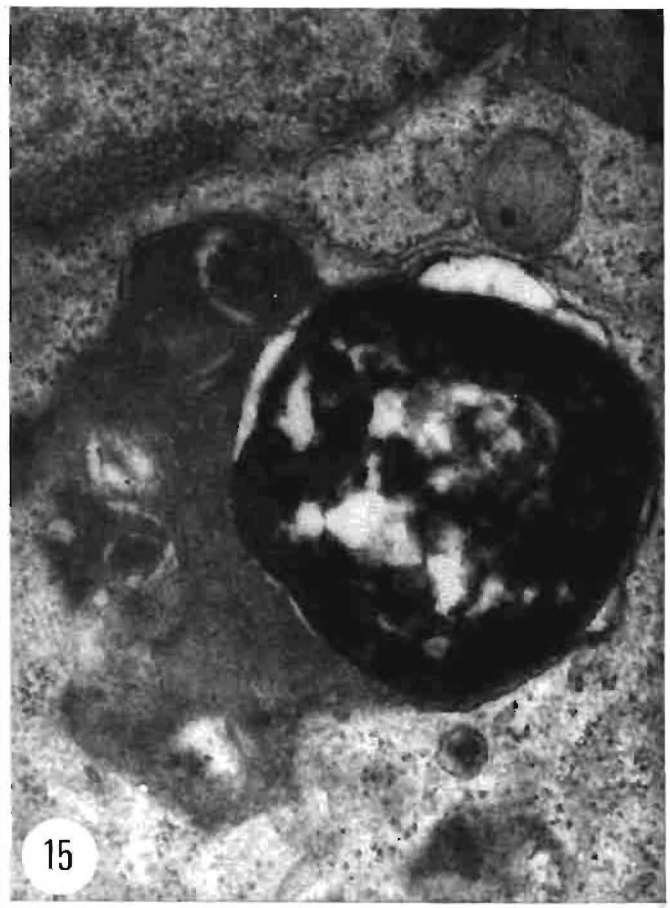
Affected macrophages in the lymph nodes and spleen also contained single or multiple MCB's in their cytoplasm. These were basically of 4 types. The bodies were initially surrounded by a trilaminar membrane, had a lamellated internal structure and varied in size from 0,28-0,64 microns (Fig. 14). Similar larger and more irregular lamellated bodies were seen in other macrophages. The staining density of the lamellations in these structures varied from intensely to moderately electron-dense. The more electron-dense lamellations surrounded areas of lamellar remnants and granular material (Fig. 15). A third type of MCB was seen in

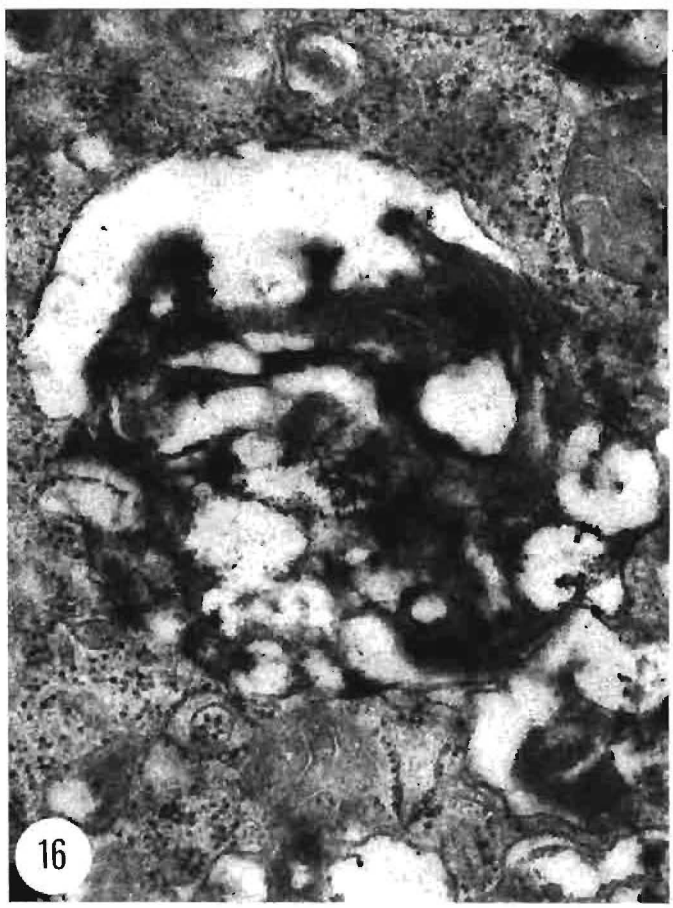


Figs. 8, 9, 10 & 11 Membranous cytoplasmic bodies in the cytoplasm of neurones. Lamellations clearly visible as well as different stages of disintegration of the lamellations. X 72000

Figs. 12 & 13 Different stages of lamellated membranous cytoplasmic bodies in glial cells. X 38500 & X 11800







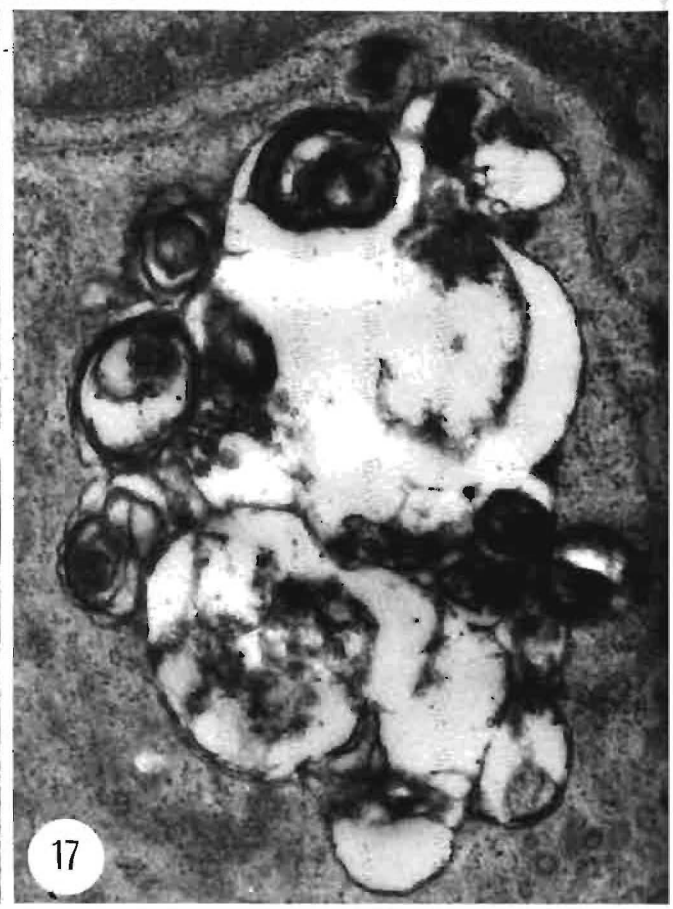


Fig. 14 Small membranous cytoplasmic bodies surrounded by a trilaminar unit membrane in the cytoplasm of a macrophage. X 48000

Fig. 15 More electron-dense lamellations developing in an irregular membranous cytoplasmic body in the cytoplasm of a macrophage X 48000

Fig. 16 A membranous cytoplasmic body in the cytoplasm of a macrophage with fragmentation of lamellations. X 44000

Fig. 17 An irregular membranous cytoplasmic body with remnants of lamellations peripherally and an electron-lucent amorphous content X 42000

other macrophages. It appeared as if the lamellations of these structures had "ruptured", leaving fragmented lamellated remnants surrounded by a trilaminar membrane (Fig. 16). In the cytoplasm of other macrophages very irregularly shaped MCB's were found. These structures were surrounded by a membrane and the internal content was mainly composed of a homogenous slightly electron-dense material with only a few lamellated remnants present at the periphery (Fig. 17). The lungs, liver and kidneys did not reveal any significant lesions.

DISCUSSION

Hers, as cited by Jolly[7], has proposed the 5 criteria which are required for a condition to be classified as a lysosomal storage disease. These are:

(i) the disease should be a storage disease;
(ii) it should be inherited;
(iii) the stored substance, which need not be homogenous, should be stored, at least initially, within lysosomes;
(iv) there should be a partial or absolute deficiency of one of the lysosomal enzymes; and
(v) the enzyme in question would normally be expected to hydrolyze the stored material.

Several of the findings encountered in the study of this neurologic syndrome in Abyssinian cats concur with the above criteria. That the condition is inherited has been proved beyond doubt[3]. The presence of storage material in affected neurones and macrophages was revealed by both light and electron microscopy. The latter confirmed that initially the storage material is present in lysosomes (Fig. 14 and 15) and that this material then progressively accumulates in them (Fig. 15, 16 and 17). Thus, in all, 3 of Hers' criteria have been met. A definite pattern of accumulation of this storage product was evident. Initially small lamellated bodies, surrounded by a trilaminar unit membrane were present (Fig. 14). It is thought that these were primary lysosomes according to the description by Rhodin[17]. Different stages of disintergration of the lamellations then occur and eventually irregular bodies containing lamellar remnants and an amorphous substance are found (Fig. 16 and 17). The parallel situation of these electron microscopic structures encountered by light microscopy is probably the accumulation of cytoplasmic vacuoles of varying sizes in the neurones and macrophages. These findings compare well with other lysosomal storage diseases described by Blakemore[2], Chrisp, Ringler, Abrams, Radin and Brenkert[4] and Percy & Jortner[15] in cats, Jolly[7] and Jolly & Hartley[8] in other animals. Blakemore[2], in his description of GM_1 gangliosidosis in cats, found an accumulation of PAS and Sudan black positive substance in neurones and reticulo-endothelial cells in the brain and other organs respectively. Percy & Jortner[15] found vacuolated neurones and macrophages in their cases of feline lipidosis. In both of the above cases lamellated membranous cytoplasmic bodies were found in affected cells, with electron microscopy. Jolly[7] described mannosidosis in Angus cattle. With light microscopy vacuolated neurones and pericytes were found in the brain and other organs, e.g. liver and spleen had vacuolated reticulo-endothelial cells. Percy & Jortner[15] and Jolly[7], however, found that these vacuoles in affected cells did not have any specific staining reactions.

In an attempt to determine the nature of the stored material, different histochemical methods were used. Negative staining results were found with PAS, oil-red-O, OTAN and NaOH-OTAN, although the results obtained with the latter 2 stains cannot be accepted as conclusive due to difficulties experienced with the staining methods. Only the walls of the vacuoles of affected neurones and macrophages stained positive with Sudan black, thus indicating that they contained lipids.

Spheroids are considered to be degenerating cell processes, and evidence of this was found by the staining reaction of these structures with the Luxol fast blue-Holmes silver nitrate method. Spheroids have been described in the central nervous system of apparently normal animals[11 14]. Percy & Jortner[15], Blakemore[2] and Jolly[7] also refer to the presence of spheroids. However, in none of the cases described by these authors, or in those under discussion here, have these spheroids been present in such large quantities as were encountered in the cats with feline hereditary neuroaxonal dystrophy described by Woodard, Collins & Hessler[19], or in the human condition, infantile neuroaxonal dystrophy, described by Haberland, Brunngraber & Witting[5], Kamoshita, Neustein & Landing[9], Kohn, Mundel & Wallis[10] and Takei[18].

The light microscopical and electron microscopical appearance of the spheroids in our cases correspond well with those described by Woodard *et al.*[19], Haberland *et al.*[5], Kamoshita *et al.*[9], Kohn *et al.*[10] and Takei[18]. In these cases, however, no specific lesions were found in neurones or in cells in other organs. The appearance of the ultrastructural lamellated round structures in the spheroids is very similar to the process occurring in the nerve cells and macrophages, and it is postulated that these may be an extension of the changes seen in the cytoplasm of the neurones.

Although histochemical and ultrastructural techniques have failed to identify the substance stored in these cells, there is sufficient evidence to support the claim that this is a lysosomal storage defect.

The cause of the acute purulent broncho-pneumonia in Kitten 36 could be attributed to inhalation pneumonia due to the inability of these kittens to maintain their balance while feeding.

Different lysosomal storage diseases, such as GM_1-gangliosidosis, GM_2-gangliosidosis (Tay-Sachs disease), mannosidosis, Niemann-Pick's disease and others, have been described in humans[6]. Similar diseases have been reported in animals[2 4 7 15]. It is thus felt that where animal models for these diseases exist, as in the defect described in this report, that these should be utilised to provide methods for determining carriers, and to make early diagnoses in affected animals and humans possible.

CONCLUSION

We are satisfied that the condition under discussion is a suspected lysosomal storage disease, and that 3 of Hers' criteria have been met *viz.* it is a hereditary condition[3], and there is a progressive accumulation of a storage material which is stored in lysosomes.

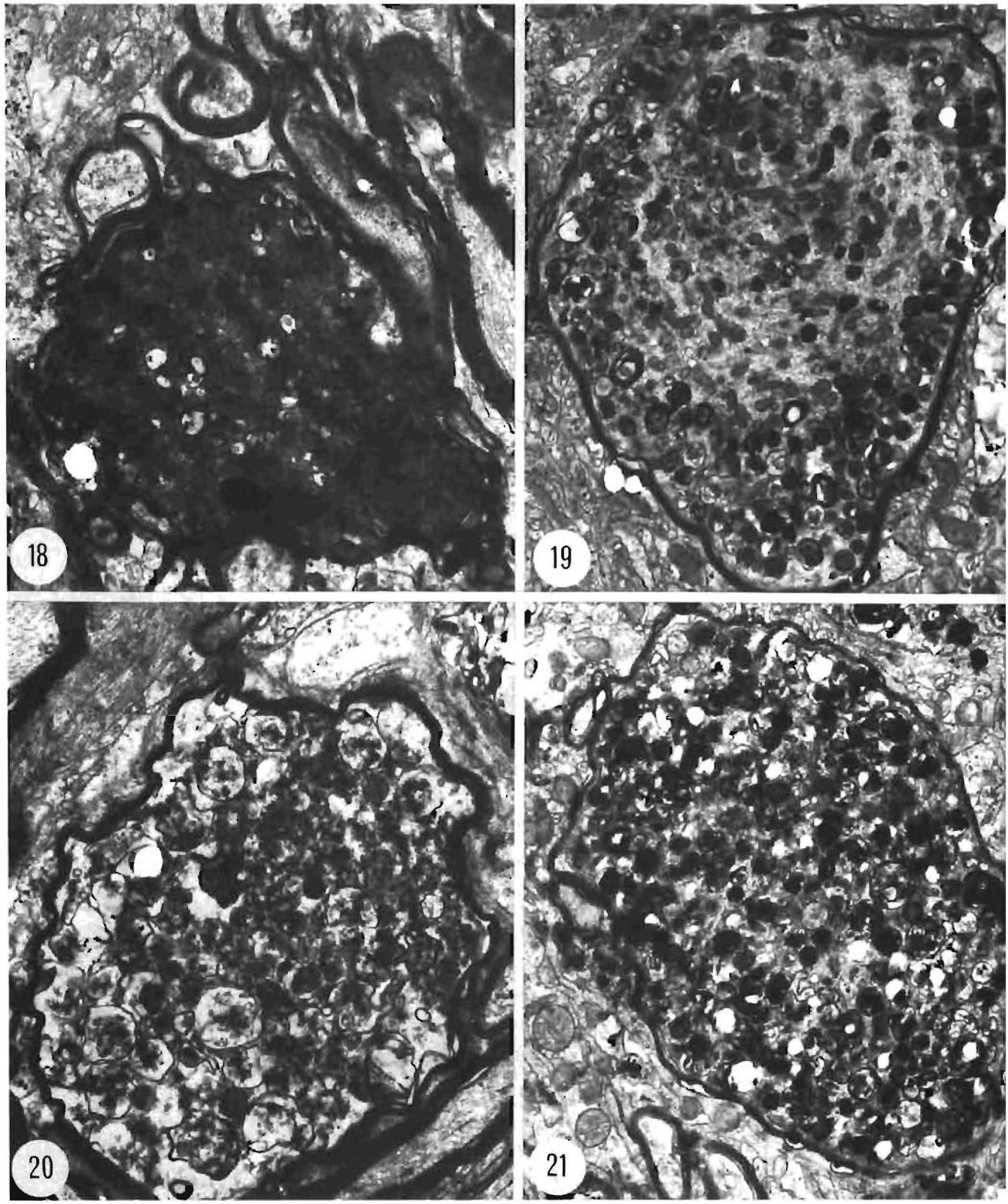


Fig. 18 An electron-dense spheroid interspersed with small empty vacuoles. X 19180

Fig. 19 A spheroid containing neurofibrils, mitochondria and round lamellated bodies. X 10750

Figs. 20 & 21 Spheroids with lamellated structures in different stages of disintegration. X 15000 & X 11520

ACKNOWLEDGEMENTS

We wish to thank the Abyssinian cat breeders for the cooperation extended to us, the staff of the Department of Pathology and of the Electron Microscopy Unit of the Faculty of Veterinary Science, University of Pretoria, for skillfull technical assistance, and Mrs E. Fouché for typing of the manuscript. The assistance of Messrs. J. Soley and R. Watermeyer, Dr K. Solomon and Miss. N. Oosthuizen is particularly appreciated.

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BOOK REVIEW

BOEKRESENSIE

VETERINARY PHARMACOLOGY AND THERAPEUTICS

ED. L. M. JONES, N. H. BOOTH AND L. E. MCDONALD

4th Ed., The Iowa State University Press, Ames. 1977 pp xii+1380, Figs 332, Tabs 137, Price $60

This is the new edition of the book which was previously edited only by L. M. Jones and now has been published 12 years after the 3rd edition. Needless to say much has happened in the field of veterinary pharmacology during this time period and the 12 contributors have attempted to cover the most important developments.

The text has been divided into 16 sections, namely: an introduction, pharmacodynamics, drugs acting on the autonomic and somatic nervous systems, drugs acting on the central nervous system, local anaesthetics, drugs acting on the cardiovascular system, fluid and electrolyte balance, endocrine pharmacology, drugs acting on the digestive tract, nutritional pharmacology, locally acting agents, gases of therapeutic value, chemotherapy of microbial, fungal and viral diseases, chemotherapy of parasitic diseases, veterinary toxicology, and finally a chapter on the toxicology of drug and chemical residues.

This edition covers topics such as toxicology, the parasiticides, analgesic and anaesthetic agents, molecular pharmacology, and pharmacokinetics more extensively than the previous edition. A new chapter also has been added which discusses the toxicological and public health implications of the presence of drug residues in edible tissues of animal origin. Moreover, information is provided regarding withdrawal times for a substantial number of therapeutic agents. The material on the use of many drugs in laboratory animals, exotic species and in captive as well as free-ranging wild animals has been considerably expanded in the new edition.

Comprehensive information on a very large number of veterinary drugs, most of which have been approved for use in animals in the United States, has been included. Unfortunately several important agents available to veterinarians in South Africa are either not discussed at all or are only briefly mentioned but this is an understandable feature. The omission of a section covering the antineoplastic agents is a pity.

Many of the sections are excellently presented and if anything excessive detail may almost be a problem in some cases. Overall the standard of the text is very high indeed.

Veterinary Pharmacology and Therapeutics is a book which may be of considerable value to veterinary students as well as to practising veterinarians. Moreover, it should prove to be of benefit to many scientists working in related fields, or in biomedical research areas. This new edition may be highly recommended as a reference text.

W.L.J.

CASE REPORT **GEVALVERSLAG**

GANSKWEEK (*LASIOSPERMUM BIPINNATUM*) POISONING IN CATTLE

D. J. THORNTON

ABSTRACT: Thornton D.J. **Ganskweek** *(Lasiospermum bipinnatum)* **poisoning in cattle.** *Journal of the South African Veterinary Association* (1977) **48** No. 3, 210–211 (En). Box 219, 6280 Graaff-Reinet, Rep. South Africa.

An outbreak of ganskweek poisoning in a herd of 93 cattle on a farm in the Graaff-Reinet district of the Cape Province is described. Five animals died and at least 16 others were affected. Clinical signs included nervous symptoms (intractability wildness, aggressiveness), icterus, melaena, abdominal pain and photosensitisation. The most prominent lesions present in the one animal autopsied were a severe hepatopathy and haemorrhagic tendencies.

HISTORY

During May 1974 a herd of cattle consisting of 93 pregnant cows and young calves was transferred from one camp to a smaller one on a farm in the Graaff-Reinet district of the Cape Province. This camp contains a small wheat land which was bordered on one side by a flowing stream lined chiefly by rushes, Scotch thistle and ganskweek *(Lasiosperum bipinnatum)*. The latter plant occurs throughout the farm. *Senecio* spp. are also present in parts. Three days later one cow was found dead and 2 sick animals were encountered next to the stream. On closer investigation by the owner it was noticed that many of the cattle had become very wild and aggressive – in fact several had become so aggressive that the farmer was unable thoroughly to examine the herd to determine precisely how many were affected. Some charged the farm hands if they were approached too closely. The following day 3 more animals died and at least 14 were ill.

Clinical signs in affected animals were described by the farmer: wildness, shaking of the head, kicking at the abdomen, swelling around the eyes, haematuria, epistaxis, slight salivation and a dry muzzle which eventually became cracked.

I investigated the outbreak on the 6th day after the animals had been placed in the camp. On this day the 5th mortality had occurred and 16 other cattle were ill.

CLINICAL SIGNS

In addition to many of the clinical signs mentioned above, the following were manifested by some of the affected animals on the day of the investigation: Walking backwards (2 animals); persistence in standing on hindlimbs with forelimbs raised in an attempt to scale a 1,85 m high stone wall (1 animal); subcutaneous oedema of the lower mandibular region (1 animal); dirty yellowish-brown pigmentation and petechiation of the sclera (majority of affected cattle); faeces in rectum hard and surrounded by black blood (majority); many of them showed tenesmus but no faeces were passed. One cow which was lying in a position of lateral recumbency had a rectal temperature of 41°C and tachycardia.

Lesions which developed subsequently were a drying, cracking and sloughing of the superficial layers of the skin of the udders and, in some cases, of the unpigmented skin in other parts of the body. One cow aborted.

POST MORTEM EXAMINATION

The fifth animal to die was autopsied. The following lesions were observed: Presence of a copious quantity of uncoagulated blood in the subcutaneous tissues which had oozed from the blood vessels after skinning; generalized icterus; haemorrhages (from petechiae to suggilations in size) scattered throughout the peritoneum; hepatomegaly and hepatopathy which comprised multiple foci of apparent coagulative necrosis up to about 0,5 mm in diameter disseminated more-or-less evenly throughout the liver parenchyme; the gall bladder was distended and its wall was haemorrhagic and thickened by oedema; a yellow oedematous, jelly-like material was present in the abdomasal wall; haemorrhages of varying sizes were present in the mucosa of the abomasum; epi- and endocardial haemorrhages were present particularly in the auricles, left ventricle and along the course of the coronary vessels; pulmonary haemorrhage.

Specimens of the liver and several other organs were collected for histopathological examination.

DIAGNOSIS

A diagnosis of suspected ganskweek poisoning was made on the basis of the liver pathology and the fact that examination of the camp revealed evidence that the plant had been eaten by the cattle. This diagnosis was later confirmed following the examination of the specimens by the Regional Veterinary Laboratory, Middelburg, Cape.

As differential diagnosis, seneciosis, Rift Valley fever, fungus and dicoumarin poisoning were considered.

TREATMENT

The herd was immediately removed from the camp and affected animals were treated as follows: Liquid

paraffin and molasses were administered per os; 'Tioctan'* (a liver protectant), Vitamin B12, vitamin B complex and 'Haemomin'† (a blood coagulant) were administered parenterally, and recumbent animals received intramuscular injections of 'Carditone' ‡ (a heart stimulant).

All the treated animals recovered.

*Fujisawa Pharmaceutical Co., Ltd.
†Vetmed Laboratories (Pty) Ltd.
‡Panvet.

DISCUSSION

It is my opinion that ganskweek poisoning is one of the most important forms of intoxication of sheep and cattle in the Graaff-Reinet district of the Karoo. It occurs commonly during the winter months and frequently results in photosensitisation. The plant is widely distributed in this part of South Africa.

ACKNOWLEDGEMENTS

The Regional Veterinary Laboratory, Middelburg, Cape is thanked for examining the specimens and Professor R. C. Tustin for assistance with the drafting of the report.

CASE REPORT **GEVALVERSLAG**

A CONGENITAL OESOPHAGOTRACHEAL FISTULA IN A TWO-YEAR-OLD DOG

LEA STOGDALE*, D.G. STEYN* AND B.C. THOMPSON†

ABSTRACT: Stogdale Lea; Steyn D.G.; Thompson B.C. **A congenital oesophagotracheal fistula in a two-year-old dog.** *Journal of the South African Veterinary Association* (1977) **48** No. 3, 212–214 (En) Dept. Med., Fac. Vet. Science, Univ. Pretoria, Box 12580, 0110 Onderstepoort, Rep. South Africa.

A congenital oesophagotracheal fistula in a two-year-old dog is reported. An account is given of the clinical symptoms, radiographic appearance, the supportive therapy, surgical correction and the post mortem findings.

INTRODUCTION

Congenital oesophagotracheal fistulas are very rare in both humans[2] and animals[1,4]. Van der Gaag, Kuiper and Kroneman[5] reviewed the literature and could locate descriptions of congenital oesophagotracheal fistulas in a calf, 3 dogs and 1 cat. In addition they described a case in a calf. These authors were able to find 3 reports of oesophagobronchial fistulas, 1 in a cat and 2 in dogs. Van der Gaag *et al.*[5] discussed the embryological development of the oesophagus and the pulmonary airways, relating this to the variations of congenital malformations affecting the oesophagus. This case report describes the clinical symptoms, radiographic appearance, surgical correction and post mortem findings of a congenital oesophagotracheal fistula in a two-year-old Yorkshire Terrier.

CAS HISTORY

A two-year-old male Yorkshire Terrier, weighing 2 kg, was referred to the Department of Medicine with a history of coughing, dysphagia and vomiting. Before the onset of these symptoms the dog had been lively, in good condition and had suffered no previous illnesses. Two weeks prior to admission, it had suddenly commenced coughing persistently, eating and drinking with difficulty and frequently vomited food or water during and after ingestion. The animal was treated by the referring veterinarian with antibiotics and supportive therapy. As no response was obtained it was referred to the Faculty of Veterinary Science.

At the initial clinical examination (Day 1) the dog was found to be in poor condition; he was very depressed, refused to eat and was unwilling to walk. The mucous membranes were slightly pale and the animal was considered to be 5% dehydrated as judged by skin elasticity. The respiratory rate was 40/ min with a moist productive cough occurring approximately every 5 min. Respiration was forced and was mainly diaphragmatic with little movement of the ribs. Each inspiration was preceded by grunting noises and the alveolar and bronchial sounds were markedly increased. Moist rales and clear gurgling noises were audible during the initial part of each expiration. The cervical oesophagus was palpably distended with gas and the abdomen was enlarged due to the presence of excess gas in the stomach. The dog eructated periodically with a gurgling noise. No abnormal mass in the abdomen could be palpated. Haematological examinations showed a macrocytic anaemia and a neutrophilic leukocytosis.

RADIOGRAPHIC FINDINGS

Plain radiographs were taken of the thorax and abdomen. On both the lateral and dorso-ventral radiographs the stomach and small intestines were seen to be markedly distended with gas. Foci of increased density were distributed throughout the lung field.

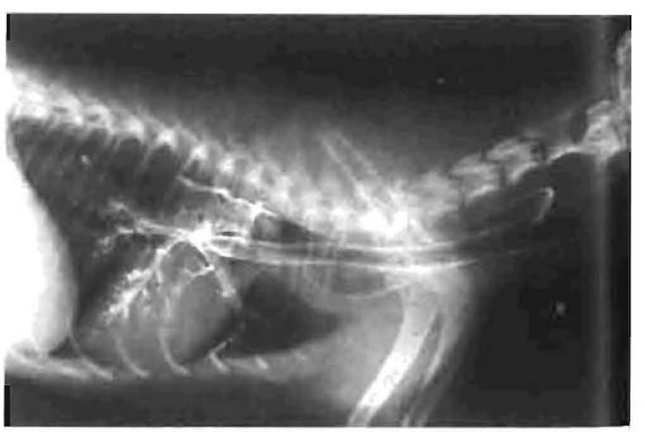

Fig. 1 Lateral radiograph of the neck and thorax 10 minutes after a barium swallow. The inflated oesophagus is outlined by the barium, which has adhered to the wall from the level of the 3rd to 6th thoracic vertebrae. Barium has passed into the lungs delineating the trachea, bronchi and bronchioles.

A barium swallow was given to the dog and its passage along the gastro-intestinal tract was observed with a fluoroscope and recorded on radiographs taken 10 min, 30 min, 3 h and 24 h after the barium was administered. The barium passed rapidly along the cervical oesophagus and then remained in the thoracic oesophagus for 1 to 2 min before peristaltic movements propelled it into the stomach. During the time that the barium remained in the thoracic oesophagus some of

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†Box 90, Gwelo, Rhodesia.

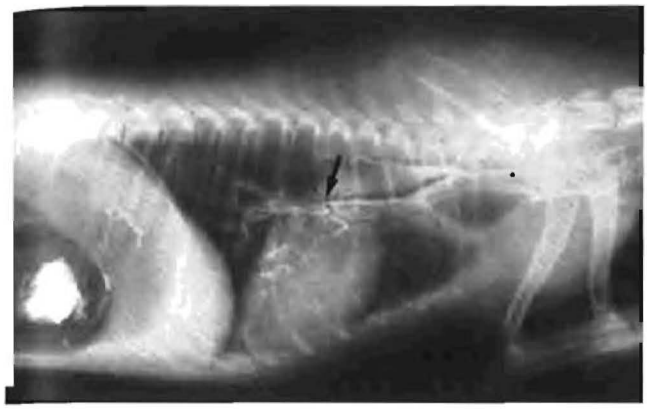

Fig. 2 Lateral radiograph of the thorax 30 minutes after a barium swallow. There is a suggestion of a fistula (arrow) running from the dilated oesophagus to the trachea at the level of the 5th rib, just caudal to the cranial bronchus.

the contrast medium was seen to pass into the lungs. The trachea, bronchi and bronchioles were clearly outlined by the barium (Fig. 1). Barium adhered to the oesophagus from the level of the 3rd to 6th thoracic vertebrae indicating an oesophagitis. The oesophagotracheal fistula was not obvious on any of the radiographs but is suggested by a small barium shadow running ventrally from the oesophagus to the trachea at the level of the 5th rib just caudally to the cranial bronchus branch (Fig. 2).

Three hours after the barium was given, radiographs (Fig. 3) showed that the barium was passing through the gastro-intestinal tract rapidly and clearly outlined the gas-filled intestines. Radiographs taken 24 h after the barium was given showed that some of the contrast medium had reached the rectum but that some had remained in the area of the duodenum, suggesting a partial obstruction or a porous foreign body.

Based on clinical, laboratory and radiographic findings, the provisional diagnosis made was an upper intestinal tract obstruction (such as a sponge) and, in addition, a defect in the swallowing mechanism or in oesophageal function.

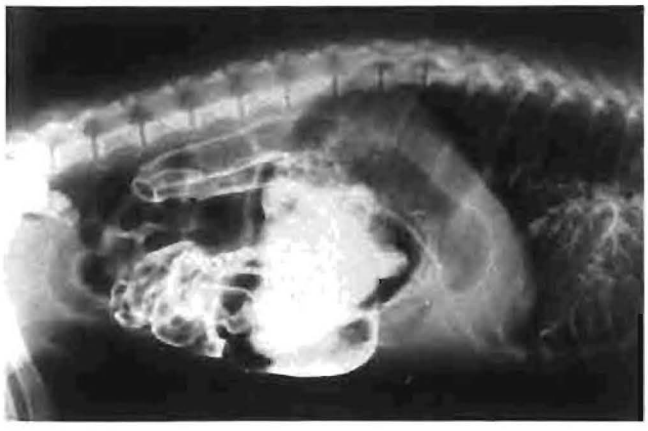

Fig. 3 Lateral radiograph of the abdomen 3 hours after barium was given. The barium had passed rapidly along the gastro-intestinal tract, clearly outlining the gas filled intestines. The barium in the lungs has spread throughout the pulmonary field.

TREATMENT

Supportive therapy was commenced as soon as the dog arrived in the hospital and was continued daily. Each day, 100 ml of dextrose-saline solution* and 50 ml of balanced electrolyte solution† were administered intravenously. Eighty mg theophylline ethyleneamine‡ and 20 mg ampicillin§ were given intramuscularly 4 times each day. On the first day 0,2 ml of glucocorticoid mixture¶ and 1 ml of vitamin B complex** were injected intramuscularly. Since a haematological examination on Day 3 showed a decrease in the haematocrit reading, 20 ml of packed red blood cells were administered intravenously.

Surgical intervention was considered essential to diagnose the aetiology of the pneumonia and the gastro-intestinal dilatation, and to remove the cause. Despite reasonably intensive care and supportive therapy the little dog was a very poor surgical risk. On Day 3, general anaesthesia was induced with 0,5 ml of a 5% thiopentone sodium solution*† intravenously. The dog was intubated and anaesthesia was maintained with 1% halothane*‡ in oxygen using a closed circuit anaesthetic machine*§. A continuous intravenous infusion of Ringer-lactate solution*¶ was given throughout the surgery. A laparotomy was performed via a mid-ventral incision. The abdominal cavity was explored and all the abdominal contents were thoroughly checked for abnormalities. None were found, thus ruling out intestinal obstruction. However, when the rebreathing bag was compressed the stomach dilated. This led the surgeon to suspect an oeseophagotracheal fistula. The abdomen was closed using a standard technique.

In order to confirm the suspected diagnosis of oeseophagotracheal fistula, an oesophagoscopy and a tracheoscopy were carried out immediately using a human pediatric gastroscope. Oesophageal examination revealed a slit-like aperture about 3 mm long in the ventral oesophageal wall, dorsally to the heart. Bubbles of air were seen coming from this opening when the rebreathing bag was compressed, causing forced inspiration. Tracheoscopic examination also revealed a small opening, of about 3 mm diameter, in the dorsal wall of the trachea, situated above the heart and just caudal to the aperture of the cranial bronchus.

Thus, the presence of an oesophagotracheal fistula was diagnosed and a thoracotomy was performed to correct the defect. Manual positive pressure ventilation was commenced as the right side of the thorax was opened by a dorso-ventral incision in the 6th intercostal space. The oesophagotracheal fistula was isolated directly above the heart at the level of the 5th rib. It was about 4 mm long and extended ventrally from the oesophagus to the trachea. The fistula was ligated at both ends with 2 sutures of No 1 silk. The thoracic

*"Sodium Chloride and Dextrose Injection B.P. 0,45% (m/v); 2,5% (m/v)". Baxter
†"Plasmalyte B". Baxter
‡"Aminophyllin", Searle
§"Penbritin", Beecham Research Lab.
¶"Opticortenol-S", Ciba Geigy
**"Vitamin B Complex injection", Centaur Labs (Pty.) Ltd.
*†"Pentothal", Abbolts Labs.
*‡"Fluothane", I.C.I.
*§"Fluotec, type FRM", Cyprane Ltd.
*¶"Ringer-Lactate solution B.P.", Baxter.

musculature was then closed routinely. At this stage spontaneous respiration had not started and the heart beat was fast and weak. The cardiac stimulant, heptaminol hydrochloride† and the respiratory stimulant doxapram hydrochloride‡ were injected intravenously. The dog failed to recover from the anaesthetic and died 15 minutes after the completion of the surgery.

AUTOPSY FINDINGS

At post mortem, the oesophagotracheal fistula was carefully examined. It was 4 mm long, running ventrally from the oesophagus to the trachea. When the 2 silk sutures were removed, the fistula was seen to have parallel sides and a patent lumen. There was no fibrous tissue around it. The diameter of the fistula was 2 mm. There was a 3 mm slit-like opening in the oesophagus and an oval opening of similar size in the trachea. It was concluded that this was a congenital fistula. There was a subacute, diffuse foreign-body pneumonia with focal areas of emphysema. The oesophagus was inflamed throughout much of its length. The gastro-intestinal tract was gas-filled and devoid of contents apart from a small amount of barium in the caecum. The pathological aetiological diagnosis was foreign body pneumonia as a result of a congenital oesophagotracheal fistula.

†"Cortensor", Wander
‡"Doxapram", Robins Co.

DISCUSSION

Oesophagotracheal fistulas may be congenital or acquired as a result of trauma, infection or neoplasia[3]. Congenital fistulas are usually detected during the first few days of life as choking and cyanosis recur with each attempt at nursing, and there may be an excessive amount of gas in the gastro-intestinal tract[2]. In the case described here, clinical symptoms relating to the oesophageal fistula only started when the dog was 2 years of age. The fistula had a slit-like opening into the oesophagus and this must have remained closed (perhaps filled with mucoid material) during the asymptomatic 2 years.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. A. Fourie for referring the case, Miss M. A. Groenland for translating one of the references, Dr. L. Bomzon for revising the original paper and Mrs. J. Oberholzer for typing the manuscript.

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INFORMATION

INLIGTING

APLASTIC ANAEMIA FROM VETERINARY PHENYLBUTAZONE

Recently a 20-year-old professional jockey died of aplastic anaemia after taking phenylbutazone prepared for veterinary use. The drug, an anti-inflammatory agent, is widely used to treat both animals and humans; however, the dose is *much* greater for horses than for humans (for horses 2-4 g a day per 1 000 pounds of body weight, for humans 300-600 mg a day). The patient was hospitalized on December 16, 1975, with a 2-week history of spontaneous bruising and listlessness. He admitted having taken phenylbutazone in the form of crumbled 1-gram horse tablets about 20 times in the previous 3 years. One month before he was admitted to the hospital, he took 2 g a day of the veterinary product for more than 3 days for mild but painful injuries sustained in a fall. He was also taking furosemide, 40 mg per day, and cathartics occasionally.

Studies of multiple bone-marrow biopsy specimens demonstrated fatty marrow with almost complete aplasia. Bone marrow was transplanted, but the patient died 40 days post-transplant of disseminated candidiasis without evidence that the graft had taken.

It is a well-known fact among race track personnel that for minor aches and pains jockeys, grooms, and trainers often take phenylbutazone that is manufactured for horses. The patient confirmed the widespread use of "bute" at the race track and only after specific questioning admitted using it himself. He was not aware of any adverse effects of the drug.

Only chloramphenicol causes more cases of drug-induced aplastic anaemia than phenylbutazone. Although the mechanism of phenylbutazone-induced haematologic toxicity is not known, there is evidence that it is dose related. Phenylbutazone and aminopyrine have been reported to cause a granulocytosis when taken in certain Chinese herbal preparations.

The use of phenylbutazone by persons working around stables and race tracks is not surprising when one considers its availability and effectiveness. Physicians and veterinarians should be aware of this practice and counsel against it since veterinary phenylbutazone (greater strength than that manufactured for human use) can be fatal to man.

Souce: *Journal American Medical Association* 236(9): 1049, 1976

BOVINE FLUID THERAPY

P.C. ARDINGTON

ABSTRACT: Ardington P.C. **Bovine Fluid Therapy.** *Journal of the South African Veterinary Association* (1977) **48** No. 3 215–218 (En) Box 23, 4490 Mandini, Rep. South Africa.

The paper emphasizes that fluids are generally given to cattle in insufficient quantities. Estimation of the state of hydration and calculation of requirements for replacement and maintenance for 24h is essential. Administration routes of choice are discussed. Acid-base balance, the relative importance of bicarbonate, K, Na, Ca, glucose and blood and precautions regarding typical South African conditions are discussed. Several examples of cases are presented, as are tables and formulae for calculation and replacement of fluid. The paper is essentially a practical guide for clinicians.

I. REHYDRATION

In general we tend to give fluids in insignificant quantities to cattle. One should estimate the state of hydration, the replacement needs and maintenance requirements the following 24h, and find practical methods of administration.

Estimations may be made as follows:

1. State of hydration

Dehydration	Calf	Adult
5%	Mild depression. Skin usually normal. Animal standing	Acute infectious disease. High fever (40–42°C.). Skin usually normal.
10%	Very depressed and weak. May be unable to stand. Skin inelastic. Eyes seriously sunken.	Depressed. Weak. Skin inelastic. Eyes obviously sunken.
15%	Moribund	Terminal

2. Replacement needs

Percentage dehydration x body weight (kg) = litres fluid required; e.g., 10% x 50 kg = 5ℓ fluid required.

3. Maintenance for 24 hours

Maintenance for 24h= Volume required for body weight (kg) x 80 mℓ.

4. Administration

(a) Calves with 5% dehydration: 2–2,5ℓ by stomach tube followed by electrolyte solution suckled from a bottle.

(b) Calves with 10% dehydration: Rehydrate by intravenous route, maintain orally.

(c) Adult Cattle: It is rarely practical or economic to rehydrate them by the intravenous route. In general one should use this route only for small volumes of specific electrolytes such as calcium and potassium or glucose in concentrated form.

Except for bicarbonate solutions (see II), choose the oral route via stomach tube or make available in bucket. One can safely give 10–15ℓ via stomach tube to adult cattle in one dose unless the beast has a primary digestive problem. *Do not* give this large volume to a cow with abdominal distension, traumatic reticulitis, overeating, suspected intestinal obstruction, bloat, etc. For obvious reasons these exceptions are extremely important. Using a stomach tube in cases such as acute mastitis or metritis is extremely beneficial.

Follow this by making water freely available and also make use of the salt hunger that many ill and convalescing animals have. Some animals will drink large volumes of water to which common salt or salt plus potassium chloride has been added. This is a valuable method of inducing some animals to drink their requirements. Offer 2 containers, one with water and the other containing water (10ℓ) plus salt (80g) and potassium chloride (20g). The approximate consumption should be determined so that the animal's status will be known 24h later.

II. ACID-BASE BALANCE

The vast majority of bovine cases requiring fluid therapy in South Africa involve primary metabolic acidosis. As can be seen from Table I, the diseases causing metabolic alkalosis/acidosis are relatively rare:

Table 1: TYPES AND CAUSES OF DISTURBED ACID-BASE BALANCE

Primary Metabolic Acidosis:	
(a) Infectious disease	– Acute enteritis with diarrhoea.
	– Babesiosis.
	– Acute peritonitis.
	– Septicaemia.
	– Acute mastitis and metritis.
	– Emphysematous foetus.
	– Anaplasmosis.
(b) Non-infectious	– Haemorrhage.
	– Anaemia.
	– Grain overload, acid fermentation.
	– Exhaustion, stress, transport.
	– Shock.
	– Laparotomy.

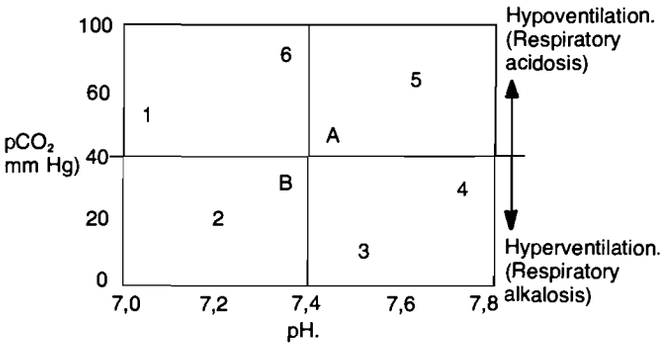
Paper presented at the Congress of the Natal Branch, SAVA, June, 1977.

Primary Metabolic Alkalosis:
- –Abomasal displacement and torsion.
- Rostral intestinal obstruction.
- Prolonged stasis of forestomachs.
- Urea poisoning.

Primary Respiratory Acidosis:
- Pneumonia.
- Airway obstruction.
- Bloat.

Respiratory Alkalosis:
- Almost invariably secondary (to compensate for metabolic acidosis).

The respiratory component usually compensates the metabolic component by tending towards the opposite direction. As an example, a calf with acute diarrhoea may be at the hypothetical point B in Fig. 1 and be in a state of metabolic acidosis with compensatory respiratory alkalosis.



A. – Normal pH = 7,4 and pCO_2 = 40.

1. 2. 3. } – Metabolic acidosis.

4. 5. 6. } – Metabolic alkalosis.

B. – Metabolic acidosis with compensatory respiratory alkalosis.

Fig. 1 Acid-base balance (Diagrammatic)

It is important to appreciate the relationship between the levels of pCO_2 and pH in Fig. 1, because this enables one to evaluate a clinical case in the field without laboratory values and to estimate replacements. In the example of a calf with diarrhoea, one knows that there is bicarbonate loss in the faeces and that dehydration and poor circulation tend to further the acidosis. It needs bicarbonate intravenously, as does a cow with babesiosis or which is ill and recumbent in a truck after a long journey.

The requirements should be based on the extracellular fluid volume (ECF) as follows:
ECF = (Live mass in kg x 0,3) litres.
Milliequivalents bicarbonate deficit per litre x ECF = Total bicarbonate required (m Eq)

Table 2 gives a clinical approximation for calves with acute diarrhoea. The calculations appear below the table.

Table 2: BICARBONATE REQUIREMENT OF 50kg CALF WITH ACUTE DIARRHOEA

Dehydration	Fluid requirement (litres)	Bicarbonate requirements per litre in mEq/ℓ	Total bicarbonate needs in mEq
10%	5	20	300
15%	7	30	545

Calculations for 10% dehydration:
Live Mass (50kg) x 10% = 5ℓ fluid required.
ECF = Live Mass (50kg) x 0,3 = 15ℓ.
Bicarbonate needs = ECF (15ℓ) x bicarbonate requirement (20mEq/ℓ) = 300 mEq bicarbonate (as $NaHCO_3$)

In other cases, one should adopt the following rule for metabolic acidosis:

It is safe to give 4mEq bicarbonate per kg live mass immediately by rapid intravenous infusion (5 min.).

e.g. (1) 50 kg calf with diarrhoea. Give 50 kg x 4 = 200 mEq bicarbonate rapidly (5 min.).
e.g. (2) 500 kg cow with acute babesiosis and haemoglobinuria. Give 500 kg x 4 =2000 mEq of bicarbonate rapidly.

In the field this system gives a rapid, safe and simple method of making a significant change to the acid-base status. More may be given slowly in isotonic solutions (e.g. "Plasmalyte B") depending on the clinical signs and economic considerations.

It is important to use the oral route in ruminants because bicarbonate will upset rumen pH and will not reach the circulation in adequate quantities.

In summary it is advisable to approach acid-base correction as follows:
(1) Using the history and clinical signs as guides, determine the animal's metabolic state (usually either normal or metabolic acidosis).
(2) If necessary, correct by rapid intravenous administration of sodium bicarbonate solution to the safety limit.

III. ELECTROLYTES, BLOOD, GLUCOSE

Electrolytes

1. Potassium

The normal value in bovine plasma is 3,9–5,8 mEq/ℓ. This electrolyte usually receives too little attention in cattle.

Cattle normally consume and excrete large quantities of potassium. They are inefficient at conserving it.

Potassium is important in renal regulation of acid-base balance. Low plasma levels impair renal regulation.

Anorexic animals suffer from potassium depletion because there is no intake to augment losses due to continued excretion.

Large amounts of potassium are lost in cases of haemolysis and haemoglobinuria, severe tissue destruction, septic processes like acute mastitis or metritis (pus is rich in potassium), diarrhoea and upper digestive tract obstructions and stasis.

Animals with depleted potassium are depressed, off their feed and show muscular weakness. Although these symptoms are common, possible potassium depletion as a cause should not be forgotten.

It is dangerous to administer intravenously large amounts of potassium in hypertonic solutions since this may raise plasma levels rapidly and arrest the heart. It should, therefore, be administered intravenously in concentrations similar to normal blood or preferably given by mouth.

It is difficult to estimate potassium requirements so one should supply adequate quantities by a safe route (orally).

Dalton's formula for diarrhoea in calves recognises the severe depletion of potassium in such cases. It is made up as follows:

Sodium chloride	– 117 g
Potassium chloride	– 130 g
Sodium bicarbonate	– 168g
Potassium phosphate (dibasic salt K_2HPO_4)	– 135 g

Add 28,5 g (1 ounce) of this powdered mixture to 5ℓ of water; add 250 g of glucose. Feed in place of milk for 24–48 h. Add the antibiotic of choice to the solution.

In adult cows the following solution may be used:

Water	10ℓ
Sodium chloride	80g
Potassium chloride	20g

Offer the cow a free choice between this solution and fresh water. Five to 10ℓ of this electrolyte solution may initially be administered by stomach tube.

2. Sodium and chlorine

These electrolytes are not as neglected as potassium is; their importance is realised. They should be made available to ill animals or given in isotonic solutions orally or intravenously. The same formulae for calves and cattle as for potassium may be used. Salt in water is very useful in making animals drink to rehydrate themselves. Cows have been observed to drink approximately 32ℓ of water containing over 200 g of salt during a 24 h post operative period (over 7000 mEq of sodium and chlorine).

Exudates and pus also contain sodium and chlorine. Thus salt should be available for cases in which much pus is produced and drained. Losses in cases of diarrhoea are considerable.

3. Calcium and other electrolytes and minerals

These will not be discussed because they are involved in specific syndromes and need not be considered under general fluid therapy.

Blood

A 500 kg cow has a blood volume of about 35ℓ. For a blood transfusion to be meaningful at least 5ℓ are required. When the haematocrit approaches 10% a blood transfusion is often necessary. Clinically, in cases of babesiosis or anaplasmosis, signs of muscular tremors and weakness or recumbency usually indicate a hopeless prognosis unless a blood transfusion is performed.

The collection of blood can be time consuming unless a large bore (10 gauge or less) needle is used. The skin over the jugular vein should be anaesthetized and incised (1–2 cm) before inserting such a large needle. Sodium citrate solution (0,25g/100 mℓ blood) is needed as an anticoagulant if vacuum collection bottles are used a tight fitting adapter to the bleeding needle must be on hand.

Administer the blood to the recipient as fast as it will flow under gravity through a 14 to 16 gauge needle or catheter.

Glucose

This is necessary in calves with diarrhoea because it:

(a) provides energy if the calf will not drink milk;
(b) assists the absorption of electrolytes, particularly potassium, from the intestine; and
(c) aids the cellular sodium pump mechanism and removal of hydrogen ions from cells.

Glucose may be given orally in the form of Dalton's solution or intravenously.

IV. PRECAUTIONS

Animals that are very anaemic and also wild or aggressive may excessively exert themselves and suddenly drop dead. Care in treatment, passing of stomach tubes, etc., is essential. It may be advisable to sedate such animals with low doses of tranquillizers before intravenous therapy or stomach tubing. Oral administration of fluids by gravity flow is time consuming and increases the period during which the animal is under stress. A simple hand pump, which is adapted to the stomach tube, enables one to administer large volumes of fluid rapidly and efficiently.

In-dwelling catheters are very useful in calves and even adults when a litre or more of fluid is required. To ensure a successful placement, always incise the skin over the jugular vein, suture the catheter to the skin and tape it around the neck if it must remain there for several hours.

Calves with diarrhoea should receive antibiotics parenterally as well as orally. Meningitis and septicaemia are more common if only oral antibiotics are used. Scour tablets are poorly absorbed in calves with diarrhoea and a well dispersed powder or solution in the electrolyte solution is far better.

V. CONCLUSIONS

A simple systematic approach to each case should be made as follows:

(1) Estimate the immediate fluid requirements and those for the next 24h.
(2) Evaluate acid-base status, decide if correction is necessary and calculate bicarbonate required for acidosis.
(3) Estimate electrolyte losses and requirements.
(4) Combine all requirements and decide what route or routes of administration to use, considering prognosis, size of animal and economic factors.

Examples of several cases follow:

CASE A: 3 week old calf with approximately 5% dehydration, acute diarrhoea for 24h, weight 50kg, mildly depressed.

(i) Fluid requirements immediately =

$$\frac{5}{100} \times 50 = 2.5\ell$$

Fluid requirements 24h = 50 x 80 = 40,00 mℓ
= 4,0 ℓ
Total = 6,5 ℓ

(ii) On clinical signs the calf is not severely acidotic and does not need intravenous bicarbonate. Could give 200 mEq (50kg x 4) bicarbonate safely. Dalton's formula supplies bicarbonate per os.

(iii) K^+, Na^+, Cl^- and bicarbonate losses have been considerable. Electrolyte solution required.

Treatment:

- Remove milk or replacer.
- Administer antibiotic intramuscularly.
- Administer 2–2,5ℓ of Dalton's formula per os with soluble antibiotic powder.
- Instruct to feed 2ℓ of Dalton's formula 12 and 24h later, continuing antibiotic therapy.

CASE B: 3 week old calf, acute diarrhoea 24h, weak but just standing, and with 10% dehydration, depressed, 50kg live mass.

(i) Fluid required immediately =

$$50 \times \frac{10}{100} = 5\ell$$

Fluid required 24h = 50 x 80 = 4000 mℓ = 4 ℓ
Total = 9 ℓ

(ii) Acid-base balance (Refer Fig. 1): Estimated base deficit per litre of extracellular fluid = 20 mEq per litre.
ECF = (50 x 0,3) = 15ℓ
Bicarbonate required = 15 x 20 = 300 mEq

(iii) Losses of HCO_3^-, K^+, Na^+, Cl^- and bicarbonate severe and continuing.

(iv) Remove milk replacer.
- Place in-dwelling catheter and secure.
- Administer antibiotic intravenously.
- Administer 6ℓ of isotonic fluid containing Na^+, Cl^-, K^+ and add a total of 300 mEq sodium bicarbonate to the fluid. Give 1ℓ rapidly; then 1ℓ per hour.
- Try oral route after 6h.
- If calf is still too weak to suckle give full amount intravenously, then maintain orally.

CASE C: Cow with acute babesiosis, T = 41°C, haemoglobinuria mild or absent. Assessed as follows:

(i) Fluid required immediately. The cow is not severely dehydrated. 24h maintenance = 500 x 80 = 40ℓ.

(ii) Acid-base balance not likely to be severely affected.

(iii) Electrolyte losses mild. Some potassium loss will occur.

(iv) Treatment:
- Administer drugs of choice.
- Offer electrolyte solution – bucket free choice.
- Observe for any deterioration in metabolic state.

CASE D: Cow with acute babesiosis. T = 41°C, pulse 100/min., clinically anaemic, frank haemoglobinuria, weak and depressed, estimated 5% dehydration. Live mass 500kg.

(i) Fluid requirement immediately:

$$500\text{kg} \times \frac{5}{100} = 25\ell$$

Fluid required 24h: 500 x 80 = 40 000 mℓ = 40ℓ
Total = 65ℓ.

(ii) Acid-base balance: Metabolic acidosis expected in febrile disease with anemia and tissue hypoxia. Bicarbonate required immediately at 2–4 mEq per kg live mass. Requirements = 500 x 4 = 2000 mEq bicarbonate intravenously.

(iii) Electrolyte losses: Potassium losses in urine combined with reduced intake due to anorexia will be significant.

(iv) Treatment:
- Administer drugs of choice for treatment and support.
- Administer 2000 mEq bicarbonate as Sodium bicarbonate intravenously.
- Administer 15ℓ water plus 80 g sodium chloride plus 20 g potassium chloride by stomach tube.
- Offer water and electrolyte solution free choice.
- Observe closely. If water is not drunk give 10–15ℓ 12 hours later by stomach tube.

Repeat bicarbonate treatment 6–12h later. Consider a blood transfusion if the cow becomes very weak, is unable to rise or develops severe muscular tremors. Adjust the cost of therapy to the value of the cow.

In conclusion I would like to say that there are economic, practical and rational methods of administering fluids to cattle. Even severely ill animals of low value can be economically assisted to recovery.

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HERBERT WATKINS-PITCHFORD*

1865–1951

Herbert Watkins-Pitchford was born on 3 June 1865 in Tatten Hall, Cheshire, England. He was the third son of Rev. J. Watkins-Pitchford, vicar of St. Jude's, London and married Emily May, the daughter of Dr Henry Wilson. They had 3 sons and 1 daughter. He died on 25.6.1951 at Illovo Beach.

In 1889 the government of Natal appointed a commission to investigate the best means of improving the quality of cattle and horse breeds. The presence of redwater in the warmer regions of the colony had, since its introduction in 1870, been a great handicap to stock improvement. The commission recommended *inter alia* that a board of agriculture be established and that posts for at least 4 veterinarians be advertised with the proviso that "each of these gentlemen should moreover be microscopists". The recommendations, however, were not put into effect until rinderpest threatened in 1896 – one of the applicants was Herbert Watkins-Pitchford.

Watkins-Pitchford studied at the Royal Veterinary College in London and qualified as M.R.C.V.S. on 16.5.1889. He became a fellow on 14.12.1894, the title of his treatise being Epilepsy of the Dog. He practiced for a short while at Sandhurst, but on being offered the post of Principle Veterinary Surgeon of the Colony of Natal, he sailed for Durban during May 1896 where he succeeded Samuel Wiltshire who had entered the Natal Service in 1874. As staff he had several stock inspectors. He was given temporary offices in the Pietermaritzburg Town Hall and when this was burnt down on 12.7.1898 he was requested to choose a site for and design and build a bacteriological centre which was to include a laboratory, accommodation for himself and staff, sheds, stabling and a crematorium. He chose a stand of 17 acres in Town Bush Valley near Pietermaritzburg. This became known as Allerton Laboratory and the complete set up cost initially £3 500; a sum of £1 800 being provided annually to meet salaries and maintenance costs. In 1898 he was appointed Director of the Natal Veterinary Department, a position he held until his retirement in 1912, when following Union in 1910, the 4 territorial veterinary services were placed under national control with Field Services' headquarters in Pretoria and Research Services at Onderstepoort; one gathers that he was disappointed that Allerton was not chosen.

Herbert Watkins-Pitchford
(From the H.H. Curson collection)

Allerton Laboratory, Pietermaritzburg in the early days
(From the H.H. Curson collection)

Rinderpest

In April 1896 rinderpest reached the Mafeking district in the Cape Colony, and crossed the Limpopo River and entered the Zuid Afrikaansche Republiek (Trans-

*This review of the life of one of South Africa's most prominent veterinarians was composed at the request of the Editor by Dr. Gertrud Theiler

vaal). It spread rapidly southwards despite all attempts to contain it, such as miles of guarded fences, a "shoot and compensate" policy and restriction of movements of cattle and humans. The Z.A.R. and Natal governments agreed to establish a combined operation to investigate the possibility of checking the disease by prophylactic measures and on 10.10.1896 Theiler from the Z.A.R. and Watkins-Pitchford set up camp under very primitive conditions on the farm Witfontijn in the Marico district.

Handicapped by want of adequate laboratory apparatus they concentrated on the production of an immunity against the disease. Initially a passive immunity in susceptible animals was induced with the use of serum obtained from recovered animals. Later experiments were undertaken to produce an active immunity in animals protected by a passive immunity by the inoculation of virulent blood 8 days after the administration of protective serum. The success of this line of investigation led to the idea of producing a mild form of the disease by the simultaneous injection of immune serum and virus – the eventual outcome was the recommendation that 50 ml of serum and 1 ml of virulent blood be administered. This resulted in but a mild attack of the disease. The serum of goats, sheep, swine, dogs, guinea-pigs and horses was also tried, with varying results. When Theiler was recalled from Marico to set up the Waterval laboratory with Danysz and Bordet, H.W.P. and his assistant F. Verney moved camp to Rustenburg in January 1887. For want of clean cattle they had to close down their laboratory in March.

Meanwhile Robert Koch, who at the invitation of the Cape Government, had commenced his investigations in Kimberley 8 weeks after the Marico laboratory came into operation. On 5.12.1896 his findings on the bile method were published and stole the show as it were. When rinderpest broke out in Natal in July 1897, H.W.P. as Principal Veterinary Officer organised the prophylactic campaign. According to circumstances and availability of material from sick or immune cattle, he made use of the serum method, Kock's bile method or Hutcheon's glycerinated-bile method, with varying success.

By the end of 1898 rinderpest was well under control throughout South Africa. The last report came from the Transvaal-Bechuanaland border in August 1899, until a fresh outbreak occurred in Basutoland and the O.F.S. which crossed over into Natal, where its spread was so irregular and unpredictable that H.W.P. was convinced that it was the work of enemies who deliberately introduced and disseminated it. For want of fresh serum from infected cattle Natal resorted to the glycerinated-bile method with excellent results, despite the wartime military- and stock movements.

At the Bloemfontein conference in 1903 the 4 (now) colonial governments agreed on the adoption of concerted measures and agreed to the use of the serum method only.

Theiler and H.W.P. had independently published their rinderpest findings before Danysz and Bordet, H.W.P.was aggrieved that the local papers, and the press generally, credited the foreigners with the serum method. He took up the matter with the Natal government (as did Theiler with the Transvaal Volksraad), and as a result his work was acknowledged and his name vindicated. It was recorded: "In our opinion the greatest credit is due to H.W.P. for the careful and assiduous research ably conducted, often under adverse circumstances into the question of rinderpest".

Pre-war activities

Upon his return from the rinderpest investigations in the Rustenburg district H.W.P., like all other South African veterinarians, found that, as Principal Veterinary Officer, he had to be a man of many parts, under bewilderingly novel and primitive conditions. It was not, however, until he moved into his Allerton laboratories that he could settle into a planned routine of work. At first much of his time was spent in grappling with the rinderpest outbreak. Whereas his predecessor, Samuel Wiltshire, had fought singlehanded, with little or no machinery, either legal or executive, in existence beyond some stock inspectors, by now about a dozen Government Field Veterinarians had been appointed. To assist in the guard work along the fences, H.W.P. could call on the services of the Natal Mounted Police, of which he was official veterinarian, with head quarters in Pietermaritzburg. (In the Transvaal *after* the Anglo-Boer War, Stewart Stockman, the P.V.O., called on the S.A. Constabulary to assist in disease control work.)

Even before moving into the new laboratories at Allerton as Veterinary Research Officer he had to cope with an outbreak of *glanders* amongst the police horses. Then in 1899 he was called upon to eradicate *anthrax*, first recorded by Wiltshire in 1896. He advised prompt inoculation with vaccines, distributed by Allerton, and the careful burial of carcasses. Though not of direct veterinary importance, Allerton was interested in the production of a *fungus* to be used as a spray control for *locusts*. By 1898 he had prepared a local vaccine for *quarter-evil* or blackleg (sponssiekte), a disease which he estimated as probably destroying the lives of more animals throughout a year, than the other stock diseases combined. This vaccine needed only 1 vaccination instead of the 2 necessary for the European and the Grahamstown vaccines which had been in use in Natal till then. Thousand of doses were sent out annually, much to the satisfaction of the farmers.

Anglo-Boer War

The outbreak of the War not only put a stop to work in the laboratory, but army movements also negated all disease control measures. Allerton Laboratories were in charge of the layman, P.J.X. Kearney who later qualified as a MRCVS in 1904 and was appointed Government Veterinary Officer, Umtata in November 1906, whilst H.W.P. and some of his staff were being besieged in Ladysmith, in charge of 4 000 horses. Horses eventually became the main source of proteins for the beleagured city. Weakened by severe illness contracted during the siege, he was granted 6 months leave in the latter half of 1900. Conditions in Ladysmith at the time were graphically depicted by him in a letter to his wife which was later published by the Natal Witness, Pietermaritzburg in 1964 under the title, "Besieged in Ladysmith".

Post War activities

Shortly after his return from sick leave he relinquished the post of Principal Veterinary Officer of Natal, when

G.B. Woollatt succeeded him. Freed from routine veterinary administrative duties, and from being plagued by D-day for articles for the Natal Agricultural Journal, of whose pages he made full use, and despite the easing off of administrative routine, he yet complained that, as Government bacteriologist, undivided work on any one research project was still impossible. His annual report for the year ending 31 December 1903 mentions work being done on horse-sickness, bubonic plague, quarter-evil and bluetongue and the production of snake antevenin. Routine work included: reports on morbid tissues; fluids for the Health and Veterinary Departments and for private practitioners; reports for the C.I.D.; examinations for diagnoses of enteric fever, diptheria and malaria, etc.; as also analyses of water samples. In 1905 he tested copper sulphate as a water cleanser. Five preparations were being produced: vaccines for quarter-evil, mallein, tuberculin, locust fungus and antivenomous serum. Allerton also served as distributor for diptheria vaccine, anthrax vaccine, tetanus serum and rinderpest serum.

At this time besides outbuildings and camps for stock, a crematorium and a small-animal room, his laboratory was equipped, *inter alia*, with an up-to-date camera, centrifuge run by an oil engine, copper retort for distilled water, a pressure sterilizer and meterological apparatus. By 1904 he had acquired an electrically controlled incubator.

Bubonic Plague

As a professional assistant E. Haydon, who had worked on plague in Bombay was sent to Durban, where bubonic plague had broken out in December 1902 till August 1903. He served for 10 months, when Wilfred Watkins-Pitchford, also from Bombay, took over. Much work was done on plague-isolates, their vitality in and out of cadavers, infectivity and transmissibility, their extreme polymorphism and their possible carriers.

Zebra Hybrids

Though complaining of overwork and lack of assistance he yet found time to publish on zebra-ass hybrids. This research was possibly stimulated by Zeederberg's efforts at training zebras for his mailcoaches in the Transvaal and also by Prof. Ewart's hybridization experiments in Edinburgh. In so far as the zebra is resistant to horsesickness he felt it could be utilized for transport purposes.

Horsesickness

As in other parts of South Africa, Natal was plagued with HS, a disease recorded by South African travellers as being associated with wet malarious areas. It was absent in the hills and prevalent after rains, absent after first frosts and stabled horses were less susceptible to attack than free ranging ones. Watkins-Pitchford spent much time proving or disproving various theories as to its origin and cause e.g., dew, wet-grazing, inhalation of spores or germs from nosebag, ingestion of infected material. Like his Cape and Transvaal contemporaries before him he concluded it was being spread by nocturnal flying insects. In Natal in 1898 the field experience had been 2% loss in stabled horses, 53% in the open air. He suspected *Anopheles funestes* as being the transmitter. He could, however, not incriminate it as he was unable to rear it in the laboratory. (He kept away the disease by burning horse-dung in the stables as recommended by S.T.A. Amos.) In the early stages of his investigations he secured the services of David Bruce released by the Army to study horsesickness and human dysentery, at the Army Headquarters at Fort Napier. Bruce had been called in by the Natal Government in 1894 to study nagana in Zululand. Bruce, however, after but a short while, from 9.12.98 to 12.2.99, was recalled to military duty. Before he left it was established that the HS agent could pass through a fine porcelain filter. It was not until after the Anglo-Boer War that Allerton could resume HS investigations when Wilfred Watkins-Pitchford was appointed in 1903. In 1908 H. W. P. postulated a long incubation period, "... for the last year or two I have been endeavouring to establish a system of treating HS by means of a vaccine which, while producing a mild and controllable form of the disease, will not endanger the safety of the animal,... I now experience no difficulty in producing this in the majority, i.e. 80% of horses inoculated". By 1904 inoculation of HS was already in practice in the Transvaal. Mules were being inoculated with a polyvalent serum.

East Coast Fever (ECF)

Introduced into the Transvaal by cattle sent to restock the herds depleted by rinderpest and the Anglo-Boer War, ECF made its appearance in Natal in 1904 possibly via Swaziland into Zululand. Stringent measures to restrict traffic in cattle and the movement of cattle to clean veld through a series of temperature camps, temporarily stopped the disease from spreading. Later outbreaks were mainly due to retrenchment of staff, army remount movements and the Zulu Rebellion of 1907.

At the first Pan African Interstate conference in Bloemfontein in November 1903, Lounsbury had implicated *R. appendiculatus*, the brown ear-tick, as the vector of ECF and in that he reported "an effective remedy for the tick is now known to be at hand in arsenical dips . . . every 14 days . . . no harmful effects (on cattle)... carried out for 9 months". It was resolved to recommend the eradication of the tick by dipping or spraying, associated with restriction of cattle movement and quarantining. Dipping and spraying of sheep and goats were both well known operations from the early day against scab and mange. Dipping had been applied somewhat randomly against cattle disease in the Eastern Cape: reported by Hellier for Chumies farm 1891; Douglas at Heatherton Towers 1896, 1899; Roberts at Cottisbrook 1899; Lounsbury and Dixon, Cape Vet. Dept. in 1900. Civil Veterinary surgeon J. Buck dipped horses in Kimberley in the 1901 post war campaign to eradicate mange, and a photograph of this is the earliest that the writer has seen of an elongate dipping tank in South Africa. In 1902 Baynes of Nelsrust Dairies, Natal, constructed a tank according to the then prevalent Australian model. This tank was conveniently near to Allerton to enable frequent visits.

Watkins-Pitchford set out "to show the efficacy of the various tick destroying preparations in general use as well as to ascertain whether such washes were capable of application at short intervals and at such a

strength that, while all ticks were effectively destroyed, the beast itself would not suffer in the cleansing process". He eventually came up with his laboratory dip, with recommended strengths for 3 day, 5 day and 14 day intervals. As Lounsbury had recommended in 1903, he reared *R. appendiculatus* to obtain its life cycle and above all its feeding periods. In so far as the shortest feeding period for both the larva and the nymph is 3 days he recommended that dipping be carried out every 3 days. His recommendations were followed with conspicuous success regardless of whether the washes were applied by dipping or in his powered spray-pump race.

He showed that at the 3 day dipping interval, the beast became habituated to arsenic, which was deposited in the deeper layers of the skin (where the ticks suck) where it was maintained at a fairly consistent saturation level, the excess being excreted in the urine; the period of maximum excretion being during the 6th to 10th hour after dipping. At lesser strengths and longer dipping intervals there was no retention of the arsenic – the beasts merely acting as vehicles for carrying the ticks to the dips. He was also able to show the distinct influence of dipping on lengthening the period of incubation of ECF according to how long before or after infection the beast was dipped – the incubation period was extended from extending it from 9 to at least 16 days – another factor in favour of the short interval habituated beasts.

Being a practical man, he not only advised on the making and the size of tanks or sprays but also went into their cost-structure and ensured a government subsidy for the farmer needing assistance. Despite the farmers' keen efforts and the advice and encouragement (and enactments) of the provincial/Union governments, it was obvious that the ticks were not being controlled. Whereas Watkins-Pitchford's short interval pilot-test had given good results, it has not stood the test of extensive field experience and in the long run there was a breakdown, drawing attention to the necessity not only of knowing the wash's chemical composition and strength, but also a studying the introduced extraneous matter with its arsenic resistant bacterial flora – 35 years later the arsenic resistant tick itself – calling for dipwashes other than arsenic.

The complete breakdown of control measures in the 1920's led to a restudy of the disease in the ox itself. Finally Neitz was able to show that the recrudescence on farms supposedly cleared of ECF was due to the fact that ECF-recovered cattle were not sterile, when he showed the presence of endoglobular parasites. This parasitism, however, was extremely low. So low that the chances of ticks becoming infected were extremely poor, but did happen at times sufficiently so as to allow for the recrudescence after intervals varying from 2-15 years. Since the fault lay in the cattle and not in the tick the slaughter-out policy was called for and this finally eliminated ECF as late as May 1955, i.e. half a century after its appearance in South Africa.

Redwater

Watkins-Pitchford's short-interval dipping schedule for Natal not only reduced the incidence of ECF but also that of *redwater,* which was already present in Natal in 1870 and which had shown a high mortality in Chaka's time. Due to the risks attendant upon applying Edington's Grahamstown inoculation, Natal had not done much in this line. Watkins-Pitchford's own experiments showed a loss of 20%. Strict control of cattle movements, as also dipping, had been recommended by the Intercolonial Veterinary Conference in Cape Town May 25 1904, measures such as had been adopted by Stewart Stockman in the Transvaal after the Anglo-Boer War and in the same year in the Eastern Province.

Bluetongue in sheep

In his report to the Under-secretary for Agriculture in 1908, H. W. P. gives an account of work done in Natal during the previous 5 years. He drew attention to the fact that bluetongue and horsesickness often occurred in the same areas, inferring the agency of flying insects. Shedding and kraaling at night reduced its incidence. Differences in susceptibility of sheep of different ages and of various breeds were apparent. Of particular note is his finding that it seemed highly probable that different types of the disease are to be met, which varied greatly in their virulence. This conjecture was supported with some force by the curious and erratic reactions given by, presumably, the same sample of vaccine in various parts of Natal during the previous 2 years (whether the vaccine was from the Cape, Transvaal or Natal). The Cape vaccine was a serum-virus preparation; the Transvaal used a strain attenuated by passages for several generations. Watkins-Pitchford obtained his vaccine by producing a mild attack through sheep, by submitting aseptic defribinated blood from a sick sheep in a specially arranged incubator to a temperature varying from 112°–117°F (44°–47°C) for a length of time depending upon the degree of its original virulence. It was found that, by adjusting the length of this exposure, the degree of virulence could be controlled almost to the point of extinction. He based this method on that of Leclainche and Vallée at Alfort in 1900 in attenuating by heat *Clostridium chauvoei,* the causative agent of quarter-evil of cattle. He also drew attention to the fact that the insect, whichever it may be, is killed by the effluvium of kralled sheep and to the protection offered by shedding.

Glanders

An outbreak of glanders in army horses in 1897, and again during and after the Anglo-Boer War, led to the preparation of Mallein at Allerton, as was done in France. In 1898 he repealed Law 14 of 1887 and enacted the Glanders Act 27. The chief advantage of the measure being the legalising of the Mallein test.

Snake Anti-Venines

Natal was, and still is, riddled with poisonous snakes. Soon after his return from the rinderpest experiments at Marico we find H. W. P. advertising in the Agric. J. for snakes to be sent to him, especially mambas; 5-10 shillings being offered for a sound live snake. Again in 1904 there was an urgent appeal: "as the horse supplying the serum died some days ago and I have to commence the immunization of another animal at once". It would seem that he was aiming at a polyvalent ante-venine. This anti-snakebite work was eventually

taken over by de Lignèris at the S.A.I.M.R. in Johannesburg.

Scab

Whereas in the Cape Colony the eradication of scab was long the subject of political rather than purely economical consideration, politicians fell or succeeded according to whether they supported or opposed legislation requiring all farmers to dip their sheep against scab. The matter was placed beyond the complete control of veterinary authorities. F. Verney in Basutoland, not having politicians to contend with, was the first to clear his country of this otherwise, theoretically, easily controllable complaint. In Natal the first scab act was passed in 1865. The annual report for 1901 states "Although the Scab Act is defective in many ways... this colony is passably clean; nearly all the outbreaks of the disease can be traced to sheep introduced from the 3 surrounding colonies... It is very disturbing to see the quantities of sheep introduced into this country under martial law." Yet, in the same year no less than 68 farms in 11 districts are listed as under licence for disease of stock-scab, and the authorities lamented the lack of staff to implement the act.

As in H. Watkins-Pitchford's days scab is still (1974) appearing sporadically in Natal, in certain confined regions in the sheep areas of the Drakensberg foothills, for the same reasons as at the turn of the century. Today matters are somewhat aggravated not by army requirements but by a change in currency of lobola (bride-price), which is now being paid in sheep and not in cattle as heretofore – leading to irregular and surreptitious movements of sheep, even between the 8 to 10 day dipping intervals.

VETERINARY MATTERS

Legal

In 1897-98 he repealed Law 14 of 1887. Act No. 27 was enacted to legalise the use of the Mallein test for glanders.

As a result of representation by H. W. P., and the practical sympathy of the Home Ministery, the Natal Act 21/1899 was passed making the registration of veterinarians compulsory with a registered Veterinary Board, thus protecting the public from unqualified practitioners. Natal was well ahead of the other territories in this aspect. A Natal Vet. Med. Ass. was only formed at the end of 1909 with H. W. P. as its first president. In 1907 he became a member of the Board of Health.

Constabulary and Militia

As Principal Veterinary Surgeon to Natal in 1896 and later as Government Veterinary Bacteriologist and Director of the Veterinary Department as from November 1901, H. W. P. found himself involved, probably more willy than nilly, in matters, outside his official duties. Thus upon C. Wiltshire's retiral he undertook the veterinary duties of the Natal Mounted Police with headquarters at Pietermaritzburg. The Imperial Army had its chief cavalry centre at Pinetown, mounted infantry, artillery and transport at Ford Napier, adjoining Pietermaritzburg and at the outbreak of the Anglo-Boer War a remount depot at Mooi River. With war impending in 1899 the Imperial authorities asked him to form a Civil Veterinary Corps; thus the Natal Veterinary and Remount Corps was formed with H. W. P. in charge as Major. Upon the outbreak of war he was appointed to Col. Royston's staff and was besieged in Ladysmith. After the war this Corps, which had helped the Army Vet. Dept. of the Imperial war office throughout the campaign, became part of the Militia Defence Force of the Colony. It saw service in the 1906 Zulu Rebellion. Upon his retiral from Government service H. W. P. relinquished his association with the Corps as from 19.4.1912. Officially this Corps ceased to exist on 30.6.1913.

It was at this period that he perfected a new veterinary pannier for horses. He also studied the effect of the "Mark VI" 303 bullet shot from different ranges at different organs or tissues of a horse. Undoubtedly spurred on by the extraordinary waste of military horses during the Anglo-Boer War he drew up a very detailed "Field Service Manual". It was, however, only printed in 1907 under the signature of the then Commandant of the Natal Militia. H. W. P. questions whether this Manual was of any use in the 1914-18 War, but expects not.

Major General Francis Smith, in his veterinary history of the 1899-1902 War in South Africa, places on record an appreciation of the services rendered by the small but well organised Natal Army Veterinary Services. To his name may also be credited: a patent pack saddle, water-carrier, filter and water purifier, and a device for the rapid distribution of ammunition.

1914-1918 War

The next mention we have of war activities is that Lt. Col. H. W. P. ex Natal permanent staff being gazetted as temporary Lt. Col. on 6.7.1915. During the period, June 1916 to February 1917, he was in charge of the Swaythling Remount Depot and veterinary hospital when, inter alia, he was sent to South America to buy horses for the army. Later he was Commandant of the Army Veterinary School at Aldershot. In 1917 he published an "Inquiry into the horse disease known as septic or contagious pneumonia" (also referred to as specific pneumonia), a debilitating disease prevalent amongst consignments of horses to England from overseas countries. His final conclusion was that septic pneumonia and its generally associated primary catarrhal condition are not infectious. The chief and probably sole factor determining the establishment of the disease would be a condition of lowered vitality of the mucous membrane of the respiratory tract, however brought about, thereby rendering possible the invasion of a prevalent micro-organism, Bacillus X being present in each instance. Time did not permit a full scale experiment to establish preventive measures – apart from recommending fresh air, and temperaturing and a long rest at port after landing. He also recommended that any cases occurring en route were to be destroyed and thrown overboard. H. W. P. also made many observations and recommendations on the routine feeding of military horses. Other complaints were seasonal, e.g., winter mange, and periodic blindness in young horses due to ophthalmia. Because of the availability of the mallein test glanders could be controlled. The final figures for the War showed mortality of army horses to be less than 15% per

annum. These were much lower than in any previous war, and only 2% higher than in peace time.

With the establishment of the Veterinary Sanitary Service the Veterinary Corps became a huge salvage corps dealing with thousands of pounds of debilitated – almost waste – material and restoring it back to utility and value.

The King's Birthday Honours dated 3.6.1918 include the bestowal on Temporary Lt. Col. H. W. P. of the "Companion of the most distinguished order of St. Michael and St. George" for services rendered in connection with the war.

Final Retirement

In so far as his experiences during 2 wars had impressed on him the value not only of the management and hygiene of both man and beast but also the value of correct feeding, he settled down to dietetic studies a subject which had been simmering in his mind since Ladysmith. He applied himself especially to the preparation of a form of artificially digested proteid matter and a rapid cure for Bacon and Beef. His protein extract, according to the 1921 Vet. Journal "promises to come before the public prominently at no distant date... medical and analytical authorities and the press generally, have endorsed the unusual dietetic claims, while clinical evidence as to its practical utility grows daily". Apparently H. W. P. was ahead of his time. There are no further reports on his preparations in the veterinary press – his daughter tells me that H. W. P. was never able to market them. He eventually donated both his meat conservation process and his Nutresco Foods to the Red Cross who started manufacturing – until it was pointed out that it was illegal for the Red Cross to manufacture and sell.

It is at this period that he found time to occupy himself with one of his hobbies – writing a novel, "In God's Good Time" and to pay occasional visits to S.A. where he had retained some business interests. In 1935 he finally settled on the South Coast to be near part of his family. He died at Illovo in 1951 at the age of 86, happy in the knowledge that the farming community had always appreciated and valued his services and that the Natal Provincial Council and Government had complimented him upon his work during his difficult early years as also for his work on the prevention of East Coast Fever, and had appreciated his inordinate sense of duty to his fellow men by appointing him a Justice of Peace.

LIST OF HONOURS AND MEDALS AWARDED TO HERBERT WATKINS-PITCHFORD

Commander of St. Michel and St. George. Silver gilt and enamel collar badge (gazetted 3.6.1918).
Queen's South African Badge with Bars. Defence of Ladysmith and Orange Free State. Edge Major H. Watkins-Pitchford V.V.D.
Natal Rebellion with Bar 1906. Edge Lt. Col. H. Watkins-Pitchford. Natal Militia Staff.
Union of South Africa 1910.
(These medals are now in the Africana Museum, Johannesburg).
Considered lost: 1914-1918 War Medal.

AAN DIE REDAKSIE

LETTER TO THE EDITOR

EMBRIO-OORPLASING

Waarde Heer,

Noem dié nuwe tegniek op sy regte naam!

In die laaste tyd hoor en lees 'n mens al hoe meer oor die nuwe tegniek van embrio-oorplasings – en dit is noodsaaklik dat die regte terminologie tog uit die staanspoor gebruik moet word. Daar is al gepraat van "ovatransplantasies, eiseltransplantasies, ovum-implantasies, enbrio-transplantasies, embrio-oorplantings, ovum-oordrag, enovulasies en embrio-oordraging" – almal verkeerde benaminge.

Ten eerste pas die woord "ovum" (meervoud ova) glad nie, want dit gaan oor bevrugte ova en 'n ovum is reeds van die oomblik van bevrugting 'n embrio. Oor hierdie terminologie word daar selfs in die nuwe veeteelt-wetgewing gestruikel.

Ten tweede word in hierdie werk geen oorplanting, transplantasies of implantasies van embrio's gedoen nie. Daarvoor sou liggaamsweefsels en bloedvate met mekaar verbind moet word. Die proses behels bloot die oorplasing van embrio's van die skenker-diere na die ontvangers. Dit is dus 'n uitspoel en 'n insit van lewende materiaal wat net met een woord korrek aangedui kan word: met "OORPLASING".

As 'n mens die twee prosesse – die uitspoel en dit insit – spesifiek wil beskryf kan 'n mens die woorde "Uitspoel" en "Inplasing" gebruik maar die regte Afrikaanse benaming van die hele proses is dus EMBRIO-OORPLASING (in Engels EMBRYO-TRANSFER)

Hoogagtend, die uwe
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BOOK REVIEW **BOEKRESENSIE**

FIRST STEPS IN VETERINARY SCIENCE

KENNETH ASPINALL

ISBN 0 7020 0635 1 Bailliére Tindall, London. 1976 p VII+207

The idea for this book originated from the experience of the author while working with technical assistant over many years in practical conditions of disease control, animal management, animal treatment and animal production.

Few opportunities exist for formal training of veterinary technicians and in the majority of situations veterinarians have to provide in job training for these people.

This very commendable book enables the technician in training to grasp the essentials of the craft he is acquiring while relying on his teacher to expand on matters discussed.

This publication will also be of value to agricultural students, veterinary nurses, farmers, zoo keepers and in fact any person considering a career among animals.

The introductory chapter deals with man and animals – their inter-relationship and this is followed by chapters on anatomy and physiology, animal behaviour, animal production, the relationship between health and disease, methods used in treating animals and emergency treatment and handling of animals. An extremely useful glossary and information tables are appended at the end.

The experience of the author is evident throughout the lucid text. The great difficulty with a publication for lay persons is the decision of which information to include and what to leave out at the particular level it should be presented. I feel that the writer has been most successful in this respect and am confident that this publication will form the basis for many further editions of First Steps in Veterinary Science.

K.v.d.W.

BOOK REVIEW **BOEKRESENSIE**

MICROBIOLOGICAL ASPECTS OF FOOD HYGIENE

TECHNICAL REPORT SERIES 598

Report of a who expert committee with the participation of FAO

World Health Organization, Geneva, 1976 pp 103, Tabs 3, Annexures 3, price not stated.

This booklet contains the report of the meeting of a WHO expert Committee on Microbiological Aspects of Food Hygiene with the participation of FAO held in Geneva from 16 to 22 March 1976. It supercedes the previous booklet on Microbiological Aspects of Food Hygiene, WHO Technical Report Series 399, published in 1968.

Awareness of microbiological health hazards arising from the consumption of contaminated food has grown in recent years and has resulted in national and international intensification of food hygiene programmes.

This report is divided into two parts. Part One deals with the microbiological agents of food-borne disease and Part Two deals with the microbiological hazards in relation to foods. References to literature and additional reading on specific aspects of food hygiene and food-borne diseases are listed after the appropriate sections or chapters.

The Committee gives special attention to the relative public health importance of the various food-borne disease agents with regard to the severity and incidence of the diseases. It considers further the epidemiological aspects of these diseases, taking into account browth, survival and, where applicable, toxin production under various conditions of production, processing and storage. The report also concerns itself with prevention and control of microbiological hazards including those related to population movement, tourism and local food habits.

Although this booklet does not deal with the broad field of food microbiology in detail, the review of recent developments in the field of food microbiology and the accompanying expert recommendations make this booklet invaluable for the food hygienist.

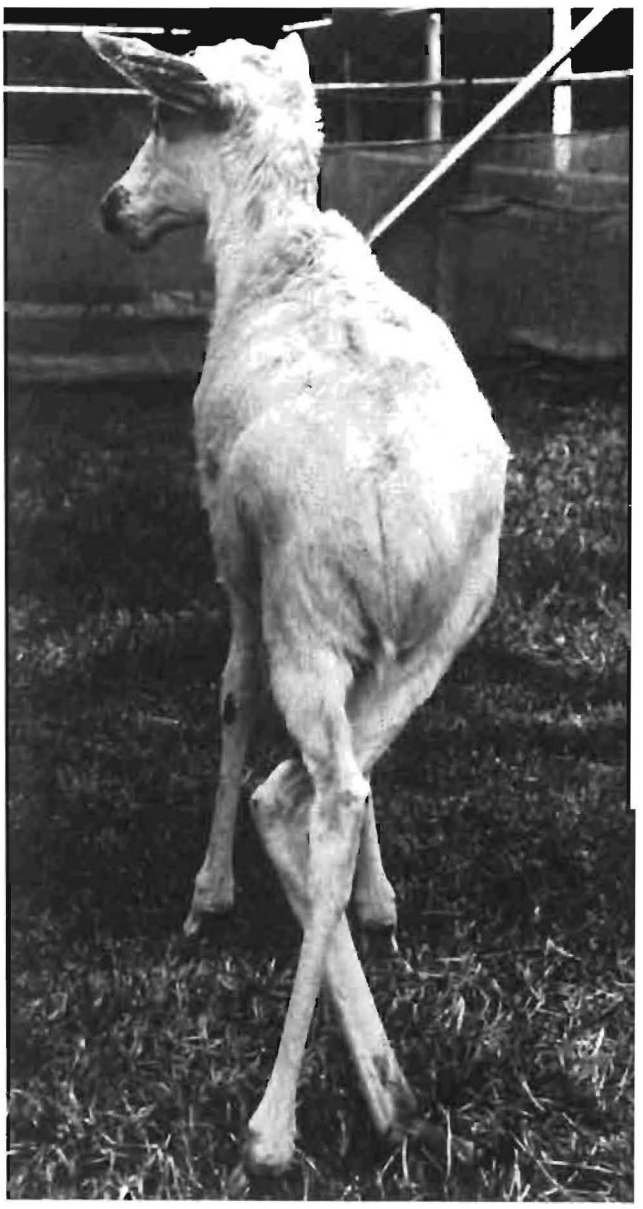
G.V.S.T.

POSTERIOR PARESIS IN A BLESBOK *DAMALISCUS DORCAS PHILLIPSI**

A white blesbok *Damaliscus dorcas phillipsi* approximately 4 months old, born to a white female, was first observed showing signs of posterior paresis at the age of 2 months.

On closer examination "crossing over" of the hind legs was seen. The cranio-medial aspect of the left tarsus and the caudolateral aspect of the right tarsus were denuded of all hair. Although the buck could stand on all 4 legs, there was a weight shift towards the front legs. The muscles of the hind legs were partially atrophied. It propelled itself forwards with the hindlegs in the "crossed over" position. In comparison to free-living normal blesbok its movements were greatly impaired.

Tranquilization was performed with 2 mg xylazine intramuscularly. Radiographic examination revealed bilateral fractures of the proximal femoral epiphyses at the epiphyseal lines. The *trochanter major* and *caput femori* were bilaterally separated from the shafts. Inadequate mineralization of both acetabular cortices suggested that the condition was of long standing, and may even have been present at birth or happened very soon thereafter. The absolutely symmetrical nature of the four "fractures" could indicate congenital epiphyseal separation.



*Submitted by Dr J. van Heerden, Department of Medicine, Faculty of Veterinary Science, University of Pretoria, P.O. Box 12580, 0110 Onderstepoort. The Editor welcomes short communications and/or photographs of interesting or unusual observations.