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Devoted to the cause of the
Veterinary Profession

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General Articles

STUDIES ON A NEW MADRAS STRAIN OF LAPINIZED RINDERPEST VIRUS SUITABLE FOR USE IN VACCINE PRODUCTION

By

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Introduction

Rinderpest among cattle in India is an important day to day problem, and the success of all the plans for livestock improvement and increase of agricultural wealth will depend to a great extent, upon the ease with which we are able to control and eradicate this disease from the country. The disease is endemic to the land and the Government of India and the Provincial Governments are endeavouring to evolve suitable methods for the successful control of the disease. The methods adopted by the Western and some of the Eastern countries to eradicate this disease, viz., mass slaughter of cattle, adoption of stringent quarantine measures, and the use of killed or inactivated vaccines are not equally applicable to India. The killed or inactivated vaccines, due to their short or uncertain immunity and high cost, have little utility in this country. The most practical method then seems to be the use of live attenuated vaccines which will be cheaper and at the same time confer a lasting and durable active immunity on the inoculated cattle, and thus raising the level of the herd immunity.

The S. S. method of inoculation using a suitable dose of Anti-Rinderpest Serum and Rinderpest Bull Virus was found very useful in the early stages in controlling outbreaks of Rinderpest, but this is a very expensive method for a vast country like India with a large population of over 200 million cattle and buffaloes, and this method was not free from the dangers of spread of infection and other complications either.

The introduction of the goat adapted virus by Edwards (1927) has provided us a very cheap and efficient product for the immunization of cattle and buffaloes against this disease and made possible the rapid immunization of whole cattle populations, during the last two decades. This goat-adapted virus, in spite of its great promise, has produced some disappointment in the early stages, by its imperfect attenuation and by causing severe reactions resulting in some mortality; but of late, the Mukteswar 'W' and 'Y' line of Goat Virus has by its prolonged and continued passage in goats, become highly attenuated and safe for use on the indigenous cattle and buffaloes of India without in any way losing its antigenicity or invasiveness. The processing of this virus in a freeze-dried form with the help of the personnel and equipment supplied in recent years by the Food and Agriculture Organization of the United Nations in some of the laboratories, has greatly improved its viability and keeping qualities, and its availability at all times for the protection of the valuable livestock of this country from this most dreaded scourge. But yet, this goat virus is found unsafe for use on the highly susceptible cattle and buffaloes, animals with traces of foreign blood, imported cattle, sheep, and goats, without the simultaneous administration of some hyperimmune serum. This has necessitated further search for a cheap and efficient new product milder than the goat-adapted virus, which could be used for protecting these highly susceptible cattle, animals in advanced stages of pregnancy, sheep and goats.

During the past 7 or 8 years, a considerable amount of information has been published about a strain of Lapinized Rinderpest Virus, evolved by Nakamura, Wagatuma, Fukusho (1938), which could be used as a cheap, safe and efficient immunizing agent for protecting the highly susceptible cattle in different parts of the world, and the attempts of several workers to adapt the Rinderpest virus to rabbits.

Attempts were made by Haddow and Idnani (1947) and later by Datta, Seetharaman and Rajagopalan (1951) at the Indian Veterinary Research Institute, Mukteswar, to evolve an Indian strain of rabbit-adapted and fixed virus for general use of a vaccine in India. At the Veterinary Biological and Research Institute, Ranipet also, some work was undertaken from 1949 onwards to adapt the local strain of Rinderpest bovine virus to rabbits with the hope of producing a strain of lapinized virus which could be used as a cheap and efficient immunizing agent for protecting the highly susceptible cattle and buffaloes, sheep and goats in the Madras State, against Rinderpest without the expensive Anti-Rinderpest Serum. A great measure of success was achieved in this attempt, and so far the lapinized virus has shown great promise for use as a good and safe immunizing agent againt Rinderpest.

Historical

Edwards (1924) was the first to demonstrate that Rinderpest virus could be successfully propagated in rabbits. Later, Inoue (1934), Nakamura *et. al.* (1938) Baker (1946), and Haddow and Idnani (1947) succeeded in adapting the bovine virus to rabbits, and studied its attenuation in this species of animals. Inoue (1934) could passage a laboratory strain of bovine rinderpest virus in the rabbits up to the 50th generation. Nakamura *et. al.* (1938), working in Korea, made extensive and systematic studies on the effect of serial passage ofrinderpest virus in rabbits and concluded that the virus was reduced in virulence for cattle after the 100th passage, when the inoculated cattle survived after showing only a mild thermal reaction. They also observed definite lesions in the Peyer's patches and mesenteric lymph glands of rabbits infected with lapinized virus. Some of these workers have remarked that it may not be possible to adapt all strains of Rinderpest virus easily and successfully to rabbits. Baker (1946), at Gross Isle, found that to adapt the bovine virus to rabbits successfully and to increase its pathogenicity in them, it was necessary to alternately passage the virus in rabbits and susceptible calves. Haddow and Idnani (1947) found that a freshly isolated epizootic strain of high virulence was necessary for infecting rabbits, and this strain became safe for use in cattle after the 50th passage in rabbits. Further attempts were reported to have been made at the Indian Veterinary Research Institute, Mukteswar, to evolve an Indian strain of rabbit-adapted and fixed virus for general use in the field. The only strain of Lapinized Rinderpest Virus found useful for universal application in the control of Rinderpest among cattle today is the Nakamura III strain of lapinized virus and its sub-strains. This strain, after its 630th passage in rabbits by September 1945 was studied by Cneng and Fischman (1949) in China, and later by other workers in Egypt, Kenya, Siam, Formosa and Indian Veterinary Research Institute, Mukteswar. The Nakamura III strain of Lapinized Virus seems to be the only strain now available, which has been accepted by a number of workers in various countries as a standard strain for the manufacture of a suitable vaccine for protecting the highly susceptible cattle and buffaloes against Rinderpest. Its applicability seems to cover bovine breeds of a relatively wide range of susceptibility, and satisfactory results of vaccinations were reported in native cattle and buffaloes, by Cheng and Fischman (1949) in China, in Mangolia, Thailand, Hong Kong, West and East Africa and in India. According to Nakamura (1953), though that strain of Lapinized Virus has undergone over 1000 passages, it is still too strongly pathogenic as a vaccine for the hypersusceptible Japanese and Korean breeds of black cattle. There seems to be no indication that this strain may become more attenuated and safe

for these hyper-susceptible breeds of cattle by further rabbit passages. Hence Nakamura et al (loc. cit) have resorted to passage of this lapinized virus through chick embryos from the 736th passage with the hope of developing a less pathogenic variant of the virus, and a certain degree of success is reported to have been achieved in this attempt. At the other extreme, Haddow and Idnani (1947) found that the Mukteswar strain of lapinized virus lost its invasive power and antigenic qualities for the hill cattle by the 174th passage in the local rabbits.

While striving to profit by the experience of these workers, about the varied behaviour of different strains of the lapinized virus in the different breeds of cattle having varying thresholds of suceptibility, it was felt that it would be more practical and nearer the ideal, if attempts were made to adapt the Madras strain of bovine Rinderpest virus to local rabbits. Efforts to secure the Nakamura III strain of lapinized virus from elsewhere for experimental study, having proved unsuccessful, a scheme was accordingly formulated and implemented to adapt the local strain of Rinderpest bovine virus to local rabbits with a view to evolve a cheap, efficient and safe strain of Lapinized virus useful for the mass vaccination of the more susceptible cattle, buffaloes, sheep, and goats in the Madras State. Success was achieved in this attempt and the Madras strain of Rinderpest virus has so far undergone 194 successful passages in rabbits. In this paper, an attempt is made to detail the observations made on the gradual adaptation of the Rinderpest bovine virus to rabbits, the changes noted in the behaviour of the virus, its attenuation in the rabbits, the pathological lesions seen in them, and a comparison of the observations with those recorded by other workers on the subject in other parts of the world.

Adaptation of rinderpest virus to rabbits

Materials and methods:—The ability of the Rinderpest virus to produce illness in rabbits has been a subject of controversy among workers for many years. Workers in various parts of the world have used several methods to successfully infect rabbits with the virus. Hall (1933) reported his failure in infecting the rabbits by intravenous inoculation of infective blood, and was unsuccessful in producing reliable signs of illness in them; the blood from these rabbits also failed to infect calves. The Japanese workers, Nakamura *et. al.* (1938) could successfully infect rabbits, sub-cutaneously or intravenously with a strain of virulent bull-virus which had been maintained in the laboratory for more than 10 years. They found that an intravenous injection of 0·5 cc. or less of bovine blood per 1·5 to 2 kilograms body weight was quite safe for rabbits and caused more marked thermal reaction than the subcutaneous injection. Using an old laboratory

strain of ox virus, causing about 12% mortality in their buffaloes, Haddow *et. al.* (1948) were at first unsuccessful but succeeded later by giving 5 cc. of blood from a freshly isolated epidemic strain of Rinderpest virus, either intravenously or sub-cutaneously into rabbits. Baker (1946), at Gross Isle, using the strain of virus available in his laboratory found it impossible with the methods described by others to transfer the virus into rabbits, beyond one passage. It was only by using alternating inoculations between calves and rabbits, that the serial passage was accomplished and definite signs of illness were produced in rabbits.

In this laboratory, earlier (1949 and 1950) two attempts to infect the local rabbits with the then available laboratory strain of bovine Rinderpest virus (which caused in buffalo calves a mortality of 45%) proved unsuccessful.

Later, in 1952, attempts were renewed to adapt the same bovine virus to rabbits. In this series of experiments, the laboratory strain of bovine virus was injected intravenously into rabbits using the alternating technique between rabbits and buffalo-calves. The Rinderpest bull-virus was passaged alternately between rabbits and buffalo-calves for the first six passages, and later it wss possible to continue it serially in rabbits. This time the attempt could be said to have been quite successful as judged from the characteristic thermal reaction, symptoms of sickness, and the various pathological lesions observed in the infected rabbits. No attempts were made to passage the virus serially in rabbits from the beginning, nor was any necessity felt for procuring a freshly isolated epizootic strain of Rinderpest virus.

The material employed for the original inoculations into rabbits was spleen from a calf made ill by a sub-cutaneous injection of laboratory strain of Bovine Rinderpest virus that had been maintained by successive passages in buffalo calves for about 3 years and causing about 45% mortality in them. Blood was drawn from the infected calf at the height of thermal reaction, the calf was slaughtered and the spleen removed. A concentrated emulsion (10%) of the mixture of blood and spleen was made in normal saline using a glass pestle and mortar, the suspension was allowed to stand for a few minutes to permit the coarse particles to settle down, and 2 c.c. of the supernate were injected intravenously into a pair of healthy rabbits.

The rabbits used in the experiments were either bred locally or purchased from outside dealers. When purchased from outside, they were of mixed ancestry and some of them were infected with coccidiosis. Since the number of rabbits bred at the Institute was not sufficient to meet our demands, we were obliged to supplement them by purchase

of young rabbits bred by local dealers. As a proportion of these rabbits were affected with coccidiosis, they were subjected to a routine treatment with sulphamezathene for a week or two prior to bringing them under the experiments, as, such intercurrent infections had a tendency to damp the reactions caused by the virus in them. Normal temperatures of these healthy rabbits ranged from 102·0°F to 103·0°F when kept under experimental conditions. In no instance was the temperature of a healthy rabbit found higher than 104·0°F when maintained under normal conditions.

Thermal reaction :—Though the adaptation of Rinderpest virus to rabbits, when given intravenously, does not appear to be very difficult to attain, the symptoms and lesions created in these animals by the virus during the first few passages are neither obvious nor clearly defined sufficient for easy recognition. Edwards (1924), Inoue (1934), Nakamura *et al* (1938), and Haddow (1948) reported a slight temperature elevation which became more marked and definite after the virus was passaged in rabbits a few times. Cheng and Fischman (1949) observed that thermal reaction, ordinarily not produced by the initial injection of bovine virus, becomes more marked and definite after three serial passages. Experiments in this laboratory have also confirmed the above observation. The first pair of rabbits injected intravenously with the virus evinced no thermal or any other reaction. As already stated above, the virus strain was maintained alternately in rabbits and buffalo-calves for the first six passages and later continued serially in rabbits. From the 2nd to 13th passage, the thermal reaction in rabbits, though present, was very irregular the highest rise observed being 3·6°F and the lowest 1·0°F above the initial temperature before inoculation. After the 13th passage the thermal rise became clearer and steep. The initial thermal rise commenced between 24 to 36 hours and reached the peak in 48 hours. This rise in temperature was ordinarily maintained for a day and sometimes even two days. In a larger proportion of the rabbits, the first evidence of the drop in temperature was observed on the third day i.e. between 60 hours and 72 hours. The peak temperature was anything between 104·5°F to 107·0°F. There used to be occasional variations in reactions but a consistent pattern was easily observed (vide typical temperature chart.) In the initial stages, the thermal reaction was regarded as one of the more reliable signs of adaptation. A typical temperature curve consists of a sharp rise of 2·5 to 4·0°F at 36 to 48 hours, which persists for 1 or 2 days. It may be seen from the analysis (Table No. 1) of the temperature charts of rabbits from the 1st to 191st passages that on the average, the thermal rise from 1st to 10th passage is only 1·6°F, whereas from 11th to 150th analysed at intervals of every 50 passages, it is about 2·9°F.

TABLE I

Analysis of thermal rise at various passage levels among lapinized virus rabbits.

From 1st to 10th Passage.		From 11th to 50th passage.		From 51st to 100th passage.		From 101st to 150th passage.		From 151st to 191st passage.	
No. of rabbits injected	Average thermal rise.	No. of rabbits injected.	Average thermal rise.	No. of rabbits injected	Average thermal rise.	No. of rabbits injected.	Average thermal rise.	No. of rabbits injected.	Average thermal rise.
23	1·6°F	81	2·9°F	105	2·6°F	111	2·7°F	63	2·5°F

As the Japanese workers have done, the thermal reactions are classified into 4 types and analysed (vide Table No. II) 1. Typical fever with a rise of 2·5°F to 3·5°F for 2 to 3 days; 2. Slight fever with a rise of 2·0°F for 1 or 2 days; 3. Irregular fever; and 4. No. fever. It may be observed from the above analysis that the pathogenicity of the virus has considerably increased along with the number of passages in rabbits as could be judged from the increase in the percentage of typical fever. As compared with the behaviour of the Japanese strain in their rabbits, the rate of increase in the percentage of typical fever was more gradual with the Madras strain and it was most marked between the serial passages 11 to 50 (Table II). It may also be observed that the actual average thermal rise was maximum (2·9°F) at that level (11 to 50 passages). After the 100th passage, as judged from the almost constant percentage of typical fever and the steady average thermal rise in rabbits, it would appear that the virus commenced getting fixed in its virulence for rabbits.

Other symptoms and mortality :—Most of the workers make no mention about symptoms other than fever, but Baker (1946) at Gross Isle observed that at the height of fever, the respiration of the infected rabbit was markedly hurried, appetite lost and general illness apparent. Occasionally, diarrhoea set in. These symptoms subsided as the temperature returned to normal and prompt recovery followed. Cheng and Fischman (1948), working with the Nakamura III strain of Lapinized Virus at National Research Bureau of Animal Industry, Nanking, China, noticed dullness and anorexia in about 80% of the rabbits during the fever stage and diarrhoea occasionally. Recovery was the rule, except in cases of rabbits infected with coccidiosis and with other disease complications. In these cases, when the rabbits were not destroyed, a mortality as high as 60% was observed. At Mukteswar, Datta *et al* (1951) observed that the sharp rise and fall in body temperature resulted

in the death of a small percentage (4 to 10%) of rabbits before the virus was harvested. The rabbits, whether infected with coccidia or not, invariably died by the 4th to 6th day if not destroyed for collection of virus material. In our work here, during the initial stages i.e. up to the 40th passage, both the infected rabbits of each passage were destroyed on the 3rd or 4th day, as our aim was to look for the characteristic postmortem lesions at the height of reaction or at the first evidence of thermal drop rather than to wait and observe the course of the disease. It was only from the 40th passage onwards that the better reactor was killed for observing the typical, classical lesions and for collection of seed material for further passage, and its pair was left for observation on the course of the disease. In general, there was dullness and inappetence in the infected rabbits, during the period of fever i.e. from the 2nd day to 4th or 5th day. Some of them evinced laboured or hurried breathing at the height of thermal reaction. But this, however, was not a constant symptom. Diarrhoea was observed in about 20·0% of the infected rabbits. Regarding mortality amongst the infected rabbits isolated for observation, the results of our observation here would appear to be almost similar to the experience of Cheng and Fischman in that normally the rabbits recovered in the early passage levels when left unkilled, and when they were free from Coccidiosis or other intercurrent infections. But Coccidiosis, snuffles, mange and other infections were unfortunately prevalent in some of the rabbits, and these accounted for the mortality amongst infected rabbits to a small extent. An analysis of the percentage of mortality (Table III) among the infected rabbits, left

TABLE II

Statement of thermal reaction caused by rinderpest virus in serial passages in rabbits.

No. of serial passages.	1 to 5		6 to 10		11 to 50		51 to 100		101 to 150		151 to 191	
Nature of thermal reaction.	No. of rabbits.	Percent.	No. of rabbits	Percent.	No. of rabbits.	Percent.	No. of rabbits.	Percent.	No. of rabbits.	Percent.	No. of rabbits.	Percent.
Typical fever.	2/13	15·4	2/10	20·0	58/80	72·5	61/100	61·0	71/113	62·8	30/66	45·5
Slight fever.	7/13	53·9	3/10	30·0	18/80	22·5	27/100	27·0	29/113	25·7	30/66	45·5
Irregular fever.	1/13	7·7	2/10	20·0	1/80	1·25	2/100	2 0	1/113	0·9	4/66	6·0
No fever.	3/13	23·0	3/10	30·0	3/80	3·75	10/100	10·0	12/113	10·6	2/66	3·0

TABLE III

Analysis of mortality percentage at various passage levels among Lapinised virus rabbits.

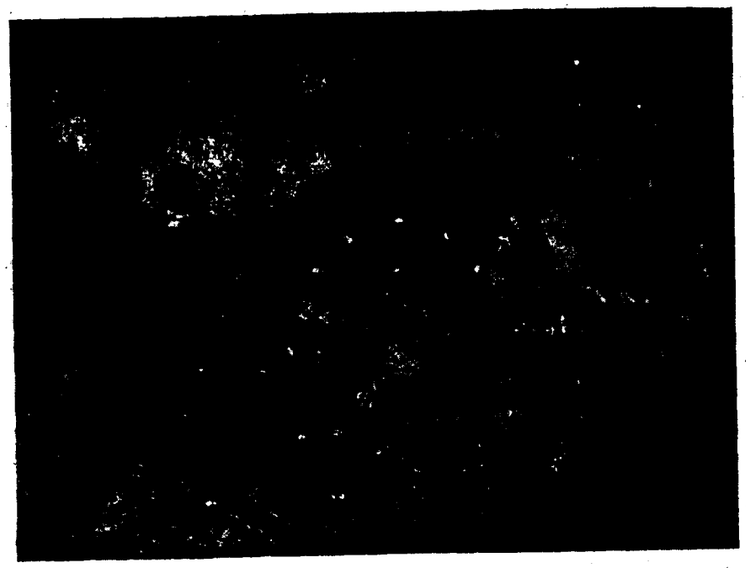
From 40th to 100th passage.			From 101st to 150th passage.		From 151st to 191st passage.		
No. of rabbits observed.	No. died.	Percent.	No. of rabbits observed.	No. died.	Percent.	No. of rabbits observed.	No. died Percent.
58	14	24·0%	52	30	57·7%	30	22 73·3%

for observation at various passage levels, shows a steady increase. Between the 40th to 100th passages it was 24·0%, from 101st to 150th it was 57·7%, and from 151st to 191st, 73·3%. Between the 40th passage and 191st passage, among 140 rabbits left for observation, 66 died, 39 of which (i.e. 59·1%) showed clear and typical lesions of Rinderpest, and their death could justifiably be attributed to Rinderpest.

Pathological lesions observed in rabbits

No report of the presence of definite lesions in rabbits infected with bovine rinderpest virus has been made by Edwards (1927), Inoue (1934), Haddow (1948) etc. But Nakamura *et al* (1939) have mentioned the appearance of well defined lesions after 3 or 4 serial passages in infected rabbits. Cheng and Fischman (1949) also have observed such lesions in the spleen, Peyer's patches, intestinal lymph glands and other lymphoid tissues such as in the appendix and mesentry. (These Peyer's patches were raised and the lesions in them appeared on the serous side as patches of numerous greyish sago-like granules.) Baker (1946) observed in the rabbits killed during the fever stages, a swelling of the spleen, congestion of stomach and intestines, and sometimes a thin layer of whitish exudate over the glandular region of the stomach.

During the course of adaptation of the Madras strain of bovine virus to rabbits, very clear and characteristic lesions were observed in the Peyer's patches of the small intestine, caecum, and mesenteric lymph glands, only from the 12th passage onwards. Autopsy of over 200 infected rabbits invariably showed numerous, closely-packed, greyish or dull whitish, granular foci which were most pronounced in the lymphoid tissues, especially of the Peyer's patches of the small intestines. These Peyer's patches were much swollen, congested, spread out and even, sometimes stood out prominently as buttons. The appendix and Sacculus rotundus were observed to be thickened and enlarged, sometimes even 3 or 4 times their normal size. The lymphoid follicles of these parts also appeared as sago-like, greyish white granular foci. The swollen Peyer's patches and the greyish white granular lesions of the appendix, Sacculus rotundus and the Tonsilla caecalis major were prominently seen on the serous membrane surface of the parts, on stripping open the abdomen. (Vide Photo: Lesions.) Lymph glands also revealed pathological changes similar to those found in Peyer's patches though they were less frequently involved and often failed to present distinct naked-eye lesions. However, in some cases, when present the mesenteric lymph glands were found to be enlarged and hyperaemic. The glands were studded with whitish granules and were felt to be slightly fibrous and harder than normal, while being scissored into bits and ground in a glass Ten Broeck grinder for being freeze-dried. The spleen was generally observed to be congested, swollen and darker in colour. The mucous-membrane of the stomach and small intestines were found to be congested, at times. Occasionally, even the thymus and the tonsils were observed to be much congested though no clear greyish-white pin-point necrotic foci, similar to those in the Peyer's patches, were seen.



Lesions in rabbit infected with lapinized rinderpest virus
1. Peyer's patches. 2. Sacculus rotundus.
3. Tonsilla Caecalis major. 4. Appendix.

These characteristic lesions appear in the infected rabbits on the third day quite distinctly, though they were occasionally observed even in rabbits which died on the 2nd day (i.e. after 36 or 40 hours) after showing a high thermal reaction. These lesions appear to be at their best on the 5th or 6th day, and persist up to about the 7th or 8th day, though in isolated instances faint lesions could be seen even on the 10th day after infection when the rabbits died. After this period, the lesions tended to gradually fade out and the parts returned to normal apparently. No systematic study could be conducted, as done by the Japanese workers, to observe the pathological lesions in the infected rabbits, at various stages, by killing them at regular intervals from the time of infection up to the 10th or 15th day, for the reason that rabbits were scarce. The number of rabbits available were just sufficient to maintain the serial passages and to conduct some very essential experiments.

The lesions were always observed to be much more distinct and prominent in rabbits, in good condition, of 4½ to 6 months of age than in the very young or old ones. The thermal reactions and pathological lesions were definitely damped down in sickly rabbits affected with

Coccidiosis or other intercurrent infections. As far as possible, such rabbits were avoided, and materials from rabbits subsequently found on opening to be affected with Coccidiosis were rejected. Occasionally these lesions could be seen even in those rabbits which did not react thermally or otherwise to the injection of the lapinized virus and died on 5th or 6th day, or were killed on the 3rd or 4th day. From the analytical study of thermal reactions and post-mortem lesions over a number of serial passages (Reference—Table IV) no systematic correlation could be traced between the severity of thermal reaction and the intensity of macroscopical pathological lesions, i.e. in some rabbits showing much higher thermal rise, the lesions were not so prominent or intense, as one would have expected, and in some rabbits showing only an ordinary thermal rise of about 2°F, the lesions were very prominent and clear.

In the course of our study, it was observed that no macroscopical lesions could be noticed at all in the infected rabbits, during the first 11 passages (of which the first 6 were alternated with buffalo calves and subsequently serially in rabbits). In the 12th and 13th passage rabbits in which the thermal rise was 1·4°F and 1·8°F respectively, only very faint lesions could be seen. Though the lesions were quite prominent in the 14th and 15th passage rabbits, the lesions of the 16th passage were not as clear or regular. It was only from the 17th passage onwards, vide Table IV consistently clear and definite lesions could be observed. Compared with the observations of the workers in Japan and at Gross Isle, who reported definite lesions even after 3 or 4 serial passages in rabbits, the appearance of definite lesions in our local breed of rabbits set up by the Madras strain of Lapinized Virus was a little delayed. The pathological lesions appeared later in the passage levels than fever was first observed. Though the typical thermal curve began appearing as early as from 3rd or 4th passage and became regular from about the 12th, typical lesions could be noticed regularly only from about the 17th passage.

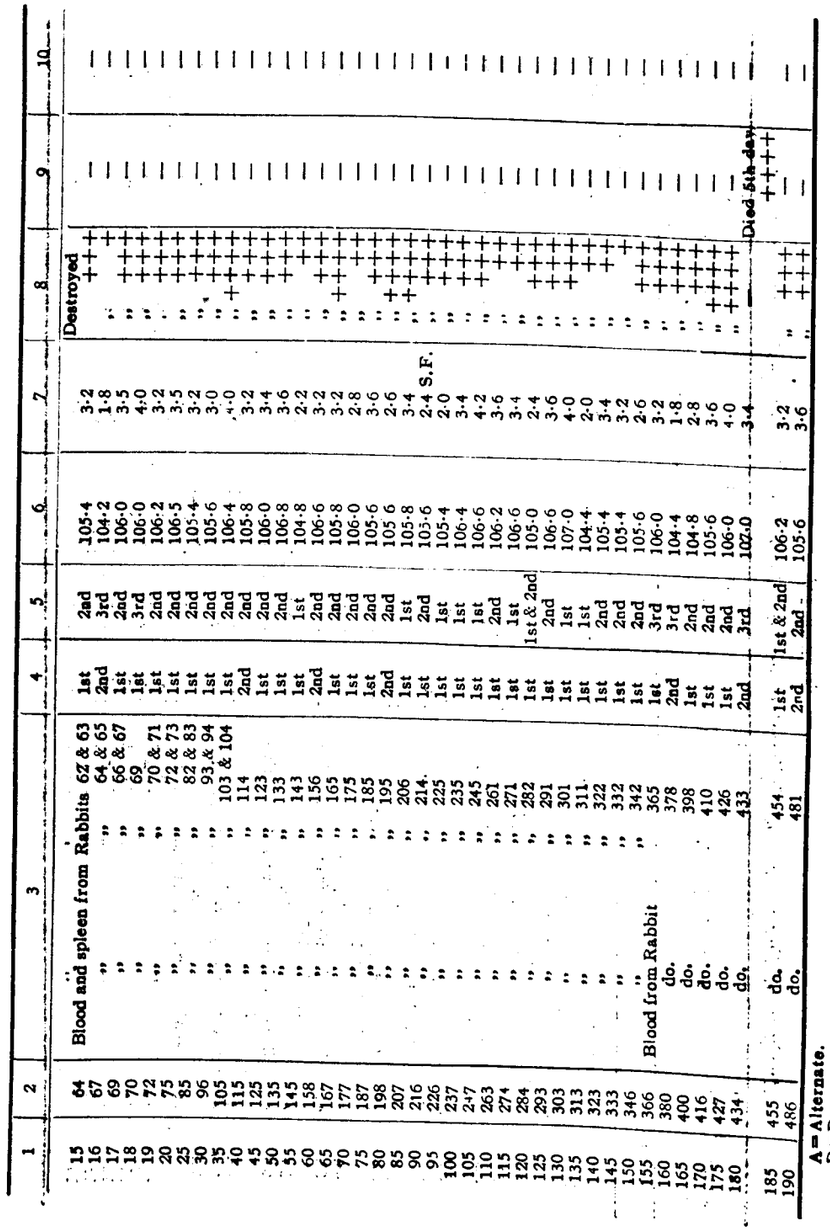
Histo-pathological changes:—Though no systematic histological study of the pathological lesions in the infected rabbits, at various passage levels, could so far be carried out here, just enough was done to recognize the degenerative and necrotic changes in the lymphoid tissues as compared with those tissues of a normal rabbit.

From the results of our observations of the post-mortem lesions detailed above, it will be recognized that the main pathological changes are in the lymphatic tissues of the whole body. These changes, to commence with, are degenerative in nature, and may further lead to formation of necrotic lesions when the infection is severe as is the

TABLE IV

Analysis of thermal rise at different stages of adaptation of Rinderpest Virus in rabbits.

Passage No.	Rabbit No.	Material injected.	Thermal Reaction. Day of initial rise.	Day of peak reached.	Peak temperature.	Rise in temperature.	Fate. Destroyed P.M. results. + or —	Died P.M. Results. + or —	Discharged.
1	2	3	4	5	6	7	8	9	10
1	19	Blood & spleen from Buff. Calf. No. 163	—	—	Normal	Nil	—	—	Discharged
1	20	do.	—	—	—	Nil	Destroyed —	—	—
2D	27	Blood from R. 19 and Blood and spleen from R. 20	5th	6th	104·5°F	2·0°F	—	—	Discharged
2A	34	Blood & spleen from Buff. calf No. 176	3rd	3rd	105·6	2·6	Destroyed —	—	—
2A	35	do.	1st	2nd	103·6	1·6	,, —	—	—
3D	38	Blood and spleen from Rabbits No. 34 and 35	1st	2nd	106·6	3·6	—	—	Discharged
3D	39	do.	2nd	2nd	104·6	1·6	—	—	—
3A	40	Blood and spleen from Buff. calves No. 184 & 185	1st	1st	105·0	1·5	Destroyed —	—	—
3A	41	do.	1st	2nd	105·0	2·5	,, —	—	—
4A	42	Blood and spleen from Buff. calves Nos. 194 & 195.	1st	2nd	104·5	2·2	,, —	—	—
4A	43	do.	1st	2nd	105·8	2·8	,, —	—	—
5A	44	Blood and spleen from buff. calves Nos. 196 & 197	1st	2nd	105·5	1·3	,, —	—	—
5A	45	do.	1st	3rd&4th	104·0	2·0	,, —	—	—
6A	46	Blood and sp'een from Buff. calves 202 & 203	3rd	3rd	104·5	1·0	,, —	—	—
6A	47	do.	—	—	Normal	Nil	,, —	—	—
7D	48	Blood and spleen from Rabbits 46 & 47	2nd	2nd	105·4	2·4	,, —	—	—
7D	49	do.	—	—	Normal	—	,, —	—	—
8	50	Blood and spleen from Rabbits 48 & 49	1st	2nd	105·2	1·5	,, —	—	—
9	52	,, ,, ,, 50 & 51	1st	3rd	104 4	2·0	,, —	—	—
10	54	,, ,, ,, 52 & 53	1st	2nd	104·6	2·4	,, —	—	—
11	56	,, ,, ,, 54 & 55	2nd	3rd	104·2	2·0	,, —	—	—
12	58	,, ,, ,, 56 & 57	2nd	3rd	104·2	1·8	,, —	+	—
13	60	,, ,, ,, 58 & 59	1st	3rd	105·2	1·4	,, —	+	—
14	63	,, ,, ,, 60 & 61	1st	3rd	106·0	3·0	,, —	—	—



1	2	3	4	5	6	7	8	9	10
15	64	Blood and spleen from Rabbits 62 & 63	1st	2nd	105·4	3·2	Destroyed		
16	67	,, 64 & 65	2nd	3rd	104·2	1·8			
17	69	,, 66 & 67	1st	2nd	106·0	3·5			
18	70	,, 69	1st	3rd	106·0	4·0			
19	72	,, 70 & 71	1st	2nd	106·2	3·2			
20	75	,, 72 & 73	1st	2nd	106·5	3·5			
25	85	,, 82 & 83	1st	2nd	105·4	3·2			
30	96	,, 93 & 94	1st	2nd	105·6	3·0			
35	105	,, 103 & 104	1st	2nd	106·4	4·0			
40	115	,, 114	2nd	2nd	105·8	3·2			
45	125	,, 123	1st	2nd	106·0	3·4			
50	135	,, 133	1st	2nd	106·8	3·6			
55	145	,, 143	1st	1st	104·8	2·2			
60	158	,, 156	2nd	2nd	106·6	3·2			
65	167	,, 165	1st	2nd	105·8	3·2			
70	177	,, 175	1st	2nd	106·0	2·8			
75	187	,, 185	1st	2nd	105·6	3·6			
80	198	,, 195	2nd	2nd	105 6	2·6			
85	207	,, 206	1st	1st	105·8	3·4			
90	216	,, 214	1st	2nd	105·6	2·4 S.F.			
95	226	,, 225	1st	1st	105·4	2·0			
100	237	,, 235	1st	1st	106·4	3·4			
105	247	,, 245	1st	2nd	106·6	4·2			
110	263	,, 261	1st	1st	106·2	3·6			
115	274	,, 271	1st	1st & 2nd	106·6	3·4			
120	284	,, 282	1st	2nd	105·0	2·4			
125	293	,, 291	1st	1st	106·6	3·6			
130	303	,, 301	1st	1st	107·0	4·0			
135	313	,, 311	1st	1st	104·4	2·0			
140	323	,, 322	1st	2nd	105·4	3·4			
145	333	,, 332	1st	2nd	105·4	3·2			
150	346	,, 342	1st	2nd	105·6	2·6			
155	366	,, 365	1st	3rd	106·0	3·2			
160	380	Blood from Rabbit 378	2nd	3rd	104·4	1·8			
165	400	do. 398	1st	2nd	104·8	2·8			
170	416	do. 410	1st	2nd	105·6	3·6			
175	427	do. 426	1st	2nd	106·0	4·0			
180	434	do. 433	2nd	3rd	102·0	3·4		Died 8th day	
185	455	do. 454	1st	1st & 2nd	106·2	3·2	,,	,,	
190	486	do. 481	2nd	2nd	105·6	3·6	,,	,,	

A = Alternate.
D = Direct.

constant feature in the Peyer's patches of infected rabbits. While the classical rinderpest lesions in cattle are characterised by an extensive severe inflammatory condition of oral, gastric and intestinal mucosa, which is usually recognized as pseudo-membranous (diphtheritic) inflammation, the mucosa of the digestive tract of our infected rabbits had never shown any severe inflammatory changes, but for the above described localized lesions in lymphatic tissues.

Variability in pathogenicity

It is usual to judge the virulence of a virus by the intensity and magnitude of the resultant infection, which in its turn is assessed by the thermal and other reactions set up, and the nature of post-mortem lesions observed, when it is injected into a susceptible animal. In the case of rinderpest, it can be safely concluded from the results of various experiments already analysed above, that its virulence for rabbits can be increased by serial passages. Judging from our above-mentioned observation that the virus could set up characteristic thermal reaction and pathological lesions in the rabbits, as the serial passages are continued, it is found that the virus acquired an increased pathogenicity for the rabbit in consequence of its passage through this species. On the contrary, the virus has been undergoing a decrease in its pathogenicity for cattle after the rabbit passages. The increase in pathogenicity of the rinderpest virus for the rabbit during lapinization was simultaneously accompanied by a decrease in its virulence for the bovine species. It would appear, from the analysis of the control charts (Ref. Table No. V) that in the buffalo calves injected with the Lapinized virus at various passage levels and of the charts of the serial passage rabbits, the rate of increase in virulence for rabbits was faster as compared to the rate of decrease in its virulence for bovines. From our experimental observation, it is obvious that while the rinderpest virus could be fully adapted to rabbits as early as from the 17th passage, it was virulent for the buffalo-calves and bull-calves even after 70 serial passages. It was only after about the 90th or 100th passage that it commenced getting milder in its pathogenicity for the bovines. Safety and potency tests carried out on adult male buffaloes (serum makers) at various passage levels also confirmed this observation (Reference—Composite charts 8).

The Madras strain of Lapinized virus has so far undergone 194 serial passages in rabbits. From the constant temperature findings, constant incubation period and constant post-mortem findings, the conclusion that the virulence of this strain of virus for rabbits is 'fixed' would appear to be justified. Also, in the control buffalo-calves and in adult buffaloes on which safety and potency tests were conducted at various levels, the severity of reactions has gradually subsided after the 90th serial passage in rabbits and in the 100th passage, the buffaloes

injected with the virus evinced only a very mild thermal rise (Vide Table V). In subsequent passages also, the virus sets up, if any, only

TABLE V

Potency tests of Lapinised Virus on buffaloes, white cattle, sheep and goats at different passage levels.

Passage No.	Material injected.	Time of collection of material & period of storage.	Dose.	Animal and Number.	Reaction to primary Inoculation.	Immunity Test and result.
1.	2.	3.	4.	5.	6.	7.
1	Blood & spleen.	4th day, Fresh	5 c.c.	2 Buff. calves	1 Thermal reaction—destroyed 1 do. & diarrhoea-died	—
2	do.	4th day, 24 hours in frigidaire	,,	,,	1 Thermal reaction—destroyed 1 do. diarrhoea—survived	Immune
3	do.	4th day, Fresh	,,	,,	Reacted thermally—survived	,,
4	do.	4th day, 24 hours in Frig.	,,	,,	1 thermal reaction—destroyed 1 do. & diarrhoea-died	—
5	do.	4th day, Fresh	,,	,,	Both reacted thermally—1 destroyed	Other Immune
6	do.	do.	,,	,,	Thermal & diarrhoea—survived	Immune
10	do.	4th day, 24 hours in Frig.	,,	,,	do.	Immune
15	do.	3rd and 4th day, Fresh	,,	,,	Thermal & diarrhoea—1 died 1 survived	Immune
17	do.	4th day, Fresh	,,	2 Bull calves	Reacted thermally and survived	Immune
21	do.	3rd day, Fresh	,,	2 Buff. calves	Slight reaction—survived	Immune
24	do.	do.	2 c.c.	10 Buffaloes	6 reacted severely, 4 reacted slightly—All survived	5 tested & found Immune
25	do.	3rd and 4th day, Fresh	5 c.c.	2 Buff. calves	Reacted and survived	Immune
26	do.	do.	,,	2 Bull calves	1 slight reaction, 1 severe reaction—Both survived.	Immune
31	do.	3rd day, 24 hours in Frig.	,,	2 Buff. calves	Reacted and survived.	Immune
36	do.	do.	,,	,,	Slight reaction—survived	Immune
42	do.	do.	,,	2 Buff. calves	Reacted and survived	Immune
				2 Bull calves	Mildly reacted & survived	
51	do.	3rd day Fresh	,,	2 goats	Slight reaction—survived	Immune
51	do.	do.	,,	2 Buff. calves	1 Reacted and died. 1 No reaction—survived	Immune
60	do.	3rd day, 24 Hrs. in Frig.	2 c.c. 1 in 10	12 Buffaloes	3 slightly and 9 severely reacted—1 died of Rinderpest	Immune

TABLE V—*contd.*

1.	2.	3.	4.	5.	6.	7.
61	Blood & spleen	do.	5 c.c.	2 Buff. calves	Reacted and survived	Immune
71	do.	do.	,,	2 Buff. calves, 4 Bull calves	Reacted and survived	Immune
81	do.	do.	,,	2 Buff. calves	Slight reaction 1 died of Rinderpest	Other Immune
90	do.	3rd day. Fresh	,,	,,	Slightly reacted and survived	Immune
100	do.	3rd day, Fresh 2 c.c.	2 c.c.	2 Bull calves, 3Heifer calves	Reacted mildly and survived	Immune
100	do.	do.	,,	12 buffaloes	Mild reaction and survived	Immune
100	Freeze Dried Blood and spleen & lymph glands 4 : 1	3rd day, 8 months in deep freeze	5 c.c. of 1 in 20 I/V	2 goats	No reaction—1 destroyed	Other found Immune
111	Blood and spleen	3rd day, Fresh	2 c.c.	2 Buff. calves	Reacted mildly and survived	Immune
118	do.	do.	1 c.c.	10 Buffaloes	All reacted, 9 mildly & severely. All survived	9 challenged & found Immune
120	do.	do.	2 c.c.	2 Buff. calves	Both reacted and survived	Immune
130	do.	do.	,,	,,	Reacted mildly and survived	Immune
140	do.	do.	,,	,,	do.	Immune
144	Spleen	3rd day 11 days in Frig.	2 c.c.	6 Buffaloes	All reacted mildly and survived.	Immune
150	Freeze Dried Blood spleen, lymph glands 1 : 4	3rd day 24 days in deep freeze	2 c.c. of 1 in 30	3 Buffaloes	Reacted mildly and survived.	Immune
150	do.	do. 48 days	do.	6 ,,	do	Immune
150	do.	do. 54 days	do.	6 ,,	do.	Immune
150	do.	do. 71 days	do.	6 ,,	do.	Immune
150	do.	do. 60 days	1/v 1 in 10 5 c.c.	2 goats	No reaction	Immune
159	Wet spleen and lymph glands	3rd day 10 days in deep freeze.	I/v 5 c.c. of 1 in 15	,,	1 No reaction—survived 1 died of corraphylactic glwck	Immune

TABLE V—*contd.*

1.	2.	3.	4.	5.	6.	7.
159	Wet spleen and lymph glands	3rd day, 3 weeks	I/V 5 c.c. 1 in 30	2 goats	Only one reacted thermally	Both Immune
160	Freeze Dried spleen, lymph glands and blood 1 : 4	3rd day, 13 days	2 c.c. of 1 in 50	10 Buffaloes	9 reacted mildly and one died due to fracture.	9 Immune
165	Blood	3rd day 24 hrs. in Frig.	2 c.c.	8 Buffaloes	Reacted mildly and survived	Immune
168	Blood	3rd day, Fresh	I/v 5 c.c.	2 goats	No reaction—1 destroyed	Other reacted Immune
170	Blood	3rd day 24 hrs. in Frig.	2 c.c.	6 Buffaloes	All reacted mildly and survived	
170	Freeze Dried spleen and lymph glands and blood 1 : 4	3rd day, 13 days in deep freeze	2 c.c. of 1 in 50	,,	do.	Immune
173	Freeze Dried material	3rd day, 24 hrs. in deep freeze	1 c.c. of 1 in 10	4 sheep	1 reacted and 2 died of toxaemia	2 tested & found Immune
174	Blood	3rd day, Fresh	I/v 5 c.c.	2 goats	Mild delayed thermal reaction	Immune
178	do.	do.	,,	do.	Mild reaction—1 destroyed	Other Immune
181	do.	do.	2 c.c.	4 Bull calves	Mild reaction	Immune
182	do.	do.	2 c.c.	4 buffaloes	Reacted mildly	Immune
187	Wet spleen and lymph glands	do.	I/v 5 c.c. 1 in 10	2 goats	Very mild reaction 1 destroyed	Other Immune

mild thermal reaction in buffaloes and buffalo calves and at the same time is found to be highly antigenic. It would be interesting to compare here the experience of Haddow and Idnani (1948) who observed that their Mukteswar strain of Lapinized virus remained virulent for bovines up to about the 50th passage, and from the 55th passage, onwards there was a definite and gradual decline in virulence for bovines, that none of the inoculated bovines showed any ill-effect except a thermal rise, and that this type of reaction continued as far as

the 154th passage after which reactions were uncertain eventhough they remained characteristic in rabbits. This lapinized virus strain was, however, found to have lost most of its invasive power and antigenic qualities by the 176th passage in rabbits.

Tests on cattle and buffaloes:—Lapinized virus of the 100th serial passage in rabbits and subsequent passages were injected into 79 adult male buffaloes, 8 buffalo-calves and 9 bull-calves in doses of 5—10 milligrams dry weight (spleen, lymph glands and blood (1 : 4 parts) freeze-dried in an Edwards 3 P. S. Freeze Dryer.) Except for a slight rise of temperature between the 5th and 10th day, no other reactions were observed in these animals. When challenged after the 10th day with virulent bovine virus, all the vaccinated animals were found to be immune.

Six sheep and 18 goats vaccinated with the lapinized vaccine were found immune on challenge with virulent Rinderpest virus later, showing that this virus can be used as a safe immunizing agent for protecting sheep and goats also against Rinderpest. The reactions produced in the vaccinated sheep and goats are also of a mild nature.

The rabbits which recovered from the primary injection of lapinized virus were found immune when challenged with virulent lapinized virus 4 months later.

No systematic study of the period of immunity in bovines could be taken up so far.

Comparative tests on the immunizing value along with a strain of Lapinized virus obtained from Kabete through Food and Agriculture Organisation

A Nakamura sub-strain of lapinized virus obtained from Kabete when propagated and tested at the Institute gave a titre of 1/200 to 1/250 only for buffalo calves, and when tested on 10 adult buffaloes in doses of 25 m.i.ds protected only half the number against a subsequent challenge with virulent bovine virus.

Against this, the Madras strain of lapinized virus gave a titre of 1–1000 for buffalo-calves and immunized all the 43 adult buffaloes when injected in doses of 5 to 10 milligrams dry weight, which corresponds to 20 to 25 m.i.ds. All these animals withstood a subsequent challenge with virulent bull virus.

In another experiment, the Kabete strain of lapinized virus required 0·1 gram of freeze-dried vaccine to successfully immunize 4

adult male buffaloes while the Madras strain required only 0.01 gram of freeze-dried vaccine (173rd passage) to immunize another set of 4 buffaloes. The reactions produced by both the lapinized viruses in the buffaloes were more or less the same, viz., of a very mild thermal nature only; and all these animals resisted a subsequent challenge with virulent bovine virus.

Minimum infective dose in rabbits:—Titration of wet material harvested from infected rabbits (spleen and mesenteric lymph glands mixed with blood–1:4 parts) on normal healthy rabbits showed that it was infective in a dilution of 1 in 1,00,000. The blood alone has given a titre of 1–10,000 to 20,000 and the liver a titre of 1 in 1000.

In buffalo-calves the freeze-dried material consisting of spleen and lymphatic glands mixed with blood, has given a titre of 1 in 1,000.

The yield of vaccine from an average rabbit, 3 to 4 lbs. body weight

An average rabbit weighing 3 to 4 lbs. yields 10 to 12 grams of wet vaccine, and at the rate of 40 m.i.ds. per animal (field dose) the materials harvested from each rabbit will be sufficient to protect 250 to 300 bovines. This is expected to work out much cheaper than the present goat blood-virus or goat-tissue vaccine.

Viability of Lapinized virus:—Viability experiments to assess the keeping qualities of the virus were conducted with freeze-dried Lapinized virus in high vacuum-sealed ampoules in both deep-freeze (–20°C) and at room temperature. In the deep-freeze at –20°C, the virus was found viable after nine months' storage, as tested on buffalo-calves, and these calves withstood a subsequent challenge with virulent bovine virus. Fresh spleen and lymph glands stored in the deep-freeze at –20°C were found viable for a period of 3 months. At room temperature of 95°F to 98°F the freeze-dried virus in ampoules was found viable after 10 days but not at 12 days' exposure when tested as above on buffalo-calves. Tests on the above lines for further periods will be taken up shortly.

Reactor virus experiments:—Experiments carried out with this virus to find its suitability for producing a reactor virus in goats show that goats can be easily infected with this virus and they are immunized as judged by their reaction to subsequent challenge with goat-virus. The 178th passage virus has been carried in goats by the direct and alternate methods. In the direct passage series, it has been carried to 7 passages and in the alternate it has reached the 6th passage in goats.

The thermal reaction in the goats is very mild or not clearly marked, though occasional goats show a slight rise in temperature. But the blood from these goats is able to infect the rabbits producing the characteristic thermal and pathological lesions, and the goats are found immune on subsequent challenge. 6 adult he-buffaloes inoculated with 5 c.c. of a 1/10 spleen emulsion of a 1st passage reactor goat of the 182nd passage in rabbits were found immune on challenge with virulent bovine virus. The reactions noticed in these buffaloes to the primary goat reactor virus was only of a very mild thermal nature. The titre of the virus for rabbits was found to be low viz., 1 in 100 only.

Back passaging of Lapinized Virus in buffalo-calves

Experiments were conducted to determine whether the virus was fixed in its virulence for rabbits or would revert to its original virulence through serial passages in buffalo-calves. Though this series of experiments is not yet complete, it is observed, that the blood from the first passage buffalo-calves injected with Lapinized virus, of the 178th passage though it could not infect a rabbit, could protect the second passage buffalo-calves against bovine virus. Up till now the virus has undergone 16 serial back-passages in buffalo-calves without any apparent increase in its virulence and the calves of the first 15 passages have been observed to withstand subsequent challenge with virulent bovine virus. It shows that the virus loses its capacity to establish itself in the rabbits even in its very first passage through bovines. Further studies of this aspect are in progress.

Interference phenomena:—A study was made of the capacity of the lapinized virus to confer immunity in vaccinated animals by the so-called interference phenomenon. Experiments were conducted to find out the earliest period in which the Lapinized virus could interfere with virulent bovine virus effectively during the process of immunization in the field and prevent the bovine virus from acting. Adult buffaloes susceptible to Rinderpest were used in these experiments. Our observations indicate that the Madras strain of lapinized virus could afford protection in 4 days by the interference phenomenon against subsequent challenge with virulent bovine virus.

Availability of the virus at different passage levels.

To ensure the ready availability of the lapinized virus at various passage levels so that we can promptly revert to any stage of attenuation of the virus in case the virus is found, at a future date, to be over-attenuated due to continued serial passage for long in rabbits, the virus has been collected and freeze-dried at various levels of its attenuation in rabbits after the 100th passage and stored in a deep-freeze at –20°C.

Discussion.

In the control and eradication of Rinderpest envisaged under the National plan, we require the use of cheap and efficient vaccines which will confer good and lasting immunity on the inoculated animals. From a study of the goat virus strains available in India, "the Mukteswar 'W' line of goat virus" appears to be a very mild and useful product suitable for immunizing the cattle and buffaloes of the plains of India. But this goat virus strain is still virulent for use on the imported cattle, cross-bred animals, highly susceptible buffaloes, animals in advanced stages of pregnancy, sheep and goats in which a suitable dose of hyperimmune serum also has to be administered, and this makes the protection of these animals somewhat expensive and cumbersome.

A Rinderpest vaccine strain of lower virulence like the Nakamura III strain of lapinized virus and its substrains may be nearer the ideal and useful for the protection of the above types of susceptible cattle, sheep and goats. This strain of lapinized virus has been propagated successfully and studied in China, Siam, India (Mukteswar), Egypt, Kenya and West Africa, where it has been found very useful and safe for protecting the highly susceptible cattle and buffaloes, without provoking any serious reactions. The only reaction observed in the majority of the cases was a mild thermal rise, though in some cases, among the humpless cyrenecian cattle of Egypt, it produced diarrhoea and inappetance lasting for 2 to 4 days.

This lapinized virus has been passaged successfully over 400 times in the local rabbits at Mukteswar from the time of its receipt there at its 795th passage in 1948, and a reactor vaccine has also been produced successfully from it at various passage levels using goats to increase the yield of vaccine.

In Thailand, a reactor vaccine has been produced using pigs as the reactor animal to produce larger yields of vaccine for immunization. The study carried out in that country indicates that this lapinized virus by its long and continued passages in rabbits and high attenuation is useful for protecting animals ranging from moderate to extreme susceptibility, but failed to protect some of the resistant types of cattle and buffaloes unless a heavy dose of vaccine was administered. The field dose used to immunize their cattle and buffaloes was 5 c.c. of 1 in 10 dilution of fresh vaccine consisting of spleen and lymphatic glands from infected rabbits mixed with blood in the proportion of 1 : 20. Experiments carried out at Ranipet with a sub-strain of Nakamura lapinized virus received from Kabete through the Food and Agriculture

Organization, and propogated in local rabbits, showed that in the freeze-dried form the virus (spleen, lymph gland and blood) gave titre of 200 to 250 only for local buffalo-calves and out of 10 adult buffaloes injected with 25 m.i.ds. of the vaccine in three tests, only 5 buffaloes were immunized successfully and the other five buffaloes reacted to subsequent challenge with virulent bovine virus.

This indicates that by its continued passages in rabbits, this lapinized strain has become highly attenuated and mild, and may gradually fade out or fail to protect a considerable number of the resistant types of cattle in which it is used, unless large doses of the vaccine are administered which will make it very expensive. This requires the discontinuance of the passages at an optimum level of attenuation, when it is safe and at the same time capable of conferring sure and satisfactory immunity on both the highly susceptible and resistant type of cattle and buffaloes. Haddow (1948) working with an Indian strain of lapinized virus found that it gradually lost its immunizing power after the 155th passage in rabbits and faded out after the 176th passage when it lost all or nearly all its invasive power for buffaloes and cattle, and suggested that at intermediate stages the virus appears to constitute a suitable vaccine.

At Madras, we have been successful in adapting the laboratory strain of bull virus in the local rabbits by using the alternating technique suggested by Baker (1946) though we failed in our early attempts to infect rabbits by the sub-cutaneous routes and straight passages using the same strain of bovine virus. Unlike the lapinized virus of Haddow (1948) which became attenuated and lost its virulence for bulls from the 55th passage onwards, when it produced only a mild thermal reaction, and which was obtained till the 154th passage after which the reactions became indistinct, the present Madras strain showed a decrease in its virulence for buffaloes only after the 90th passage in rabbits after which till the present 190th passage, it is producing a constant mild thermal reaction only in the highly susceptible buffaloes, buffalo-calves and bull-calves on which it was tested. All these animals, without an exception, have withstood a subsequent challenge with virulent bovine virus showing that they have been satisfactorily immunized by this vaccine. The dose used in the above animals was 5 to 10 milligrams of dry tissue consisting of spleen, mesenteric lymph-glands mixed with blood in the proportion of 1 : 4 and freeze-dried. The temperature reactions, incubation period and pathological changes produced in rabbits in all these passages were also more or less constant.

We have been fortunate in having at the Institute, a freeze-drying equipment (Edwards' 3PS Model Centrifugal Freeze Dryer) obtained

through the Food and Agriculture Organization of the United Nations, in which the Madras lapinized virus has been freeze-dried at various passage levels from the 100th passage onwards and stored in a deep-freeze unit at –20°C so that we could always resort to a particular level of attenuation and antigenicity to suit animals of varying degrees of susceptibility, should the strain by any chance show a tendency to fade out or lose its antigenic value in its further rabbit passages. The titre of this virus in rabbits and buffalo-calves compares favourably with the titre reported for the Nakamura III strain and its sub-strains, and the reactions and pathological changes produced in the local rabbits are also more or less similar. The yield of virus for immunizing cattle from each rabbit also compares favourably with those reported for the Nakamura strain. It has also been found possible to evolve a reactor virus using local goats to have a larger yield of vaccine for undertaking mass vaccinations. The titre of virus in the blood and tissues of the reactor goat for vaccine production is under study. Six susceptible buffaloes immunized with 5 c.c. of a 10% emulsion of spleen from a 1st reactor goat have withstood challenge with virulent bovine virus. This lapinized virus is also found to confer protection in adult buffaloes in 96 hours by the so-called interference phenomenon showing that it can be used in actual outbreaks of Rinderpest where immunity or adequate protection will be conferred in a period of 4 days' time. Comparative test on susceptible buffaloes carried out along with the Mukteswar 'W' line of goat virus indicate that the reaction produced in these buffaloes by the lapinized virus is much milder than the reaction produced by the goat virus. The lapinized virus is also found safe and useful for protecting sheep and goats.

It has not been possible to try this lapinized virus under field conditions and on the highly susceptible foreign breeds of cattle and cross-bred animals so far, nor test the period of immunity conferred by the vaccine. It is proposed to take up this study shortly.

Since this new strain appears to be the only Indian strain of lapinized virus available now and the reactions produced by it in the susceptible buffaloes appear to be milder than the reactions set up by the Mukteswar 'W' line of goat virus, and its antigenic qualities, fixation in rabbits and immunizing capacity are similar to the Nakamura III sub-strain available at Mukteswar which by its prolonged passage and high attenuation may fail to protect a certain percentage of the resistant types of the cattle of India, it is expected that this Madras strain of lapinized virus will be a very useful and cheap agent for use in the Rinderpest Eradication Programme proposed to be launched by the Government of India shortly.

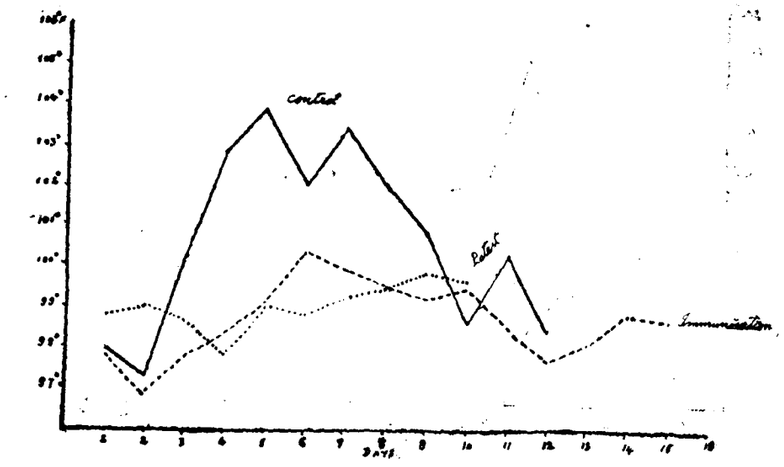


Fig. 1

Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 100th passage and during test.

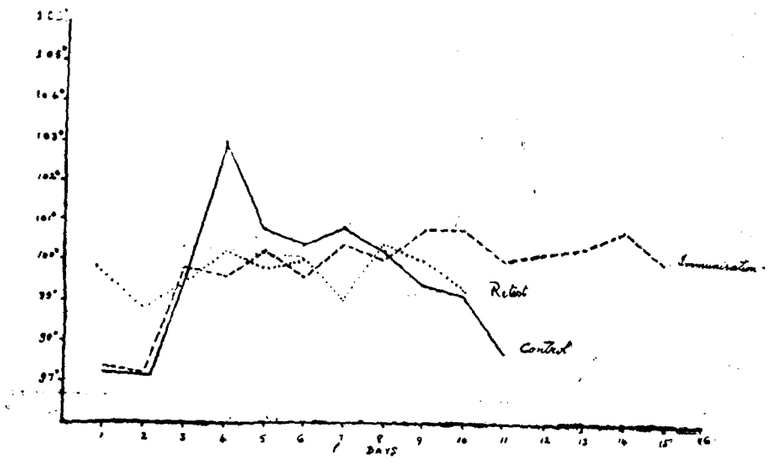


Fig. 2

Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 118th passage and during test.

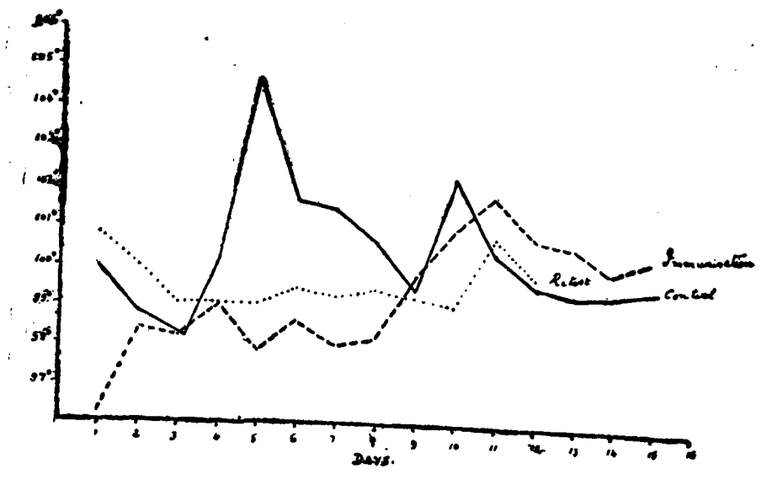


Fig. 3

Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 144th passage and during test.

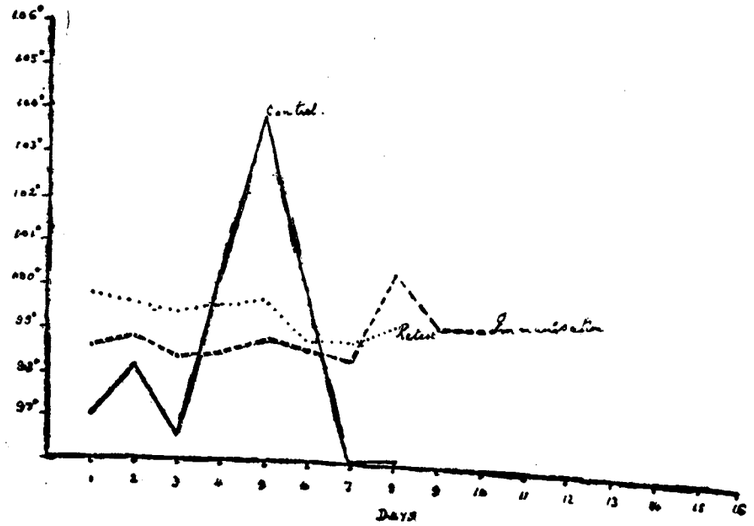


Fig. 4

Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 130th passage and during test.

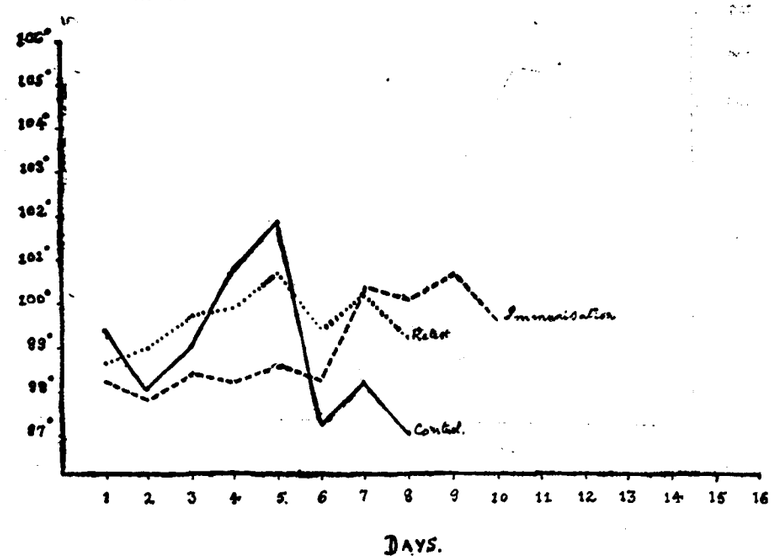


Fig. 5

Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 160th passage and during test.

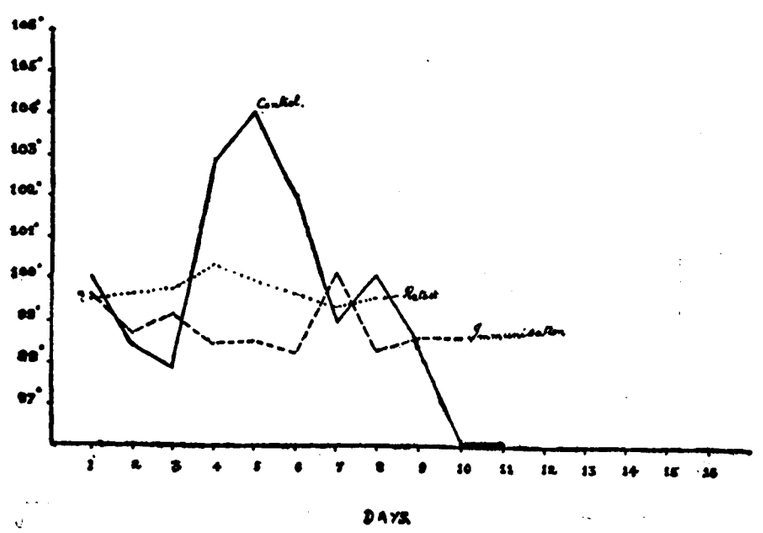


Fig. 6

Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 165th passage and during test.

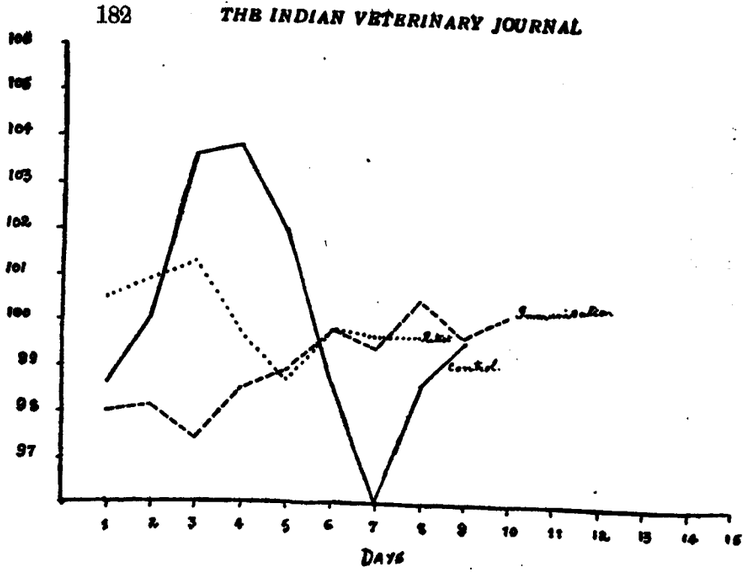


Fig. 7
Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus at 170th passage and during test.

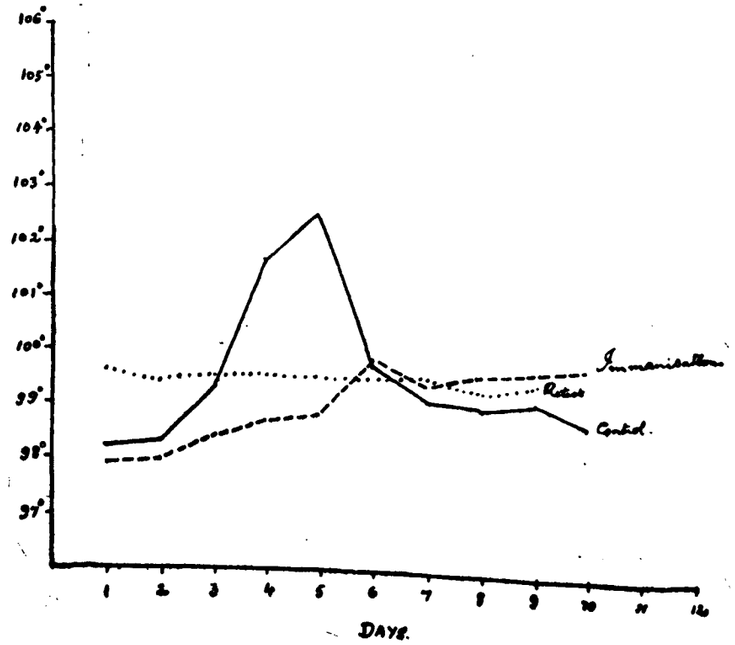


Fig. 8
Composite Temperature Chart of Buffaloes during Immunisation with Lapinised Rinderpest Virus from 100th to 170th passage and during test.

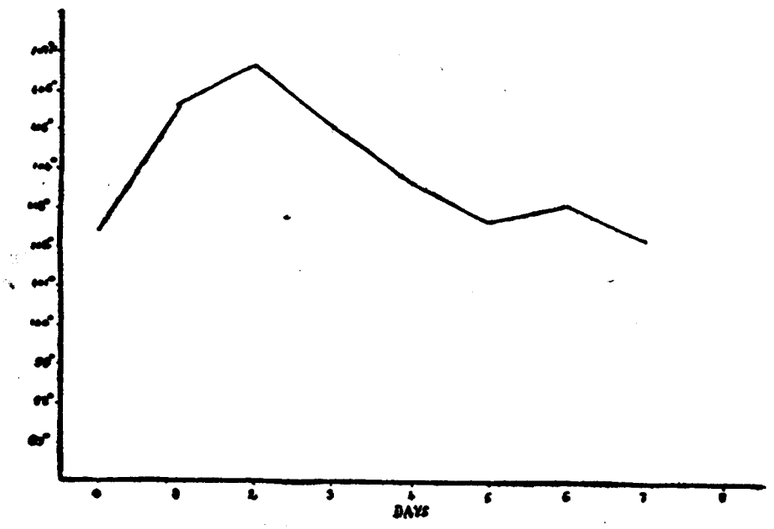


Fig. 9
"Typical Temperature Charts"
Reaction in Rabbits inoculated with the Lapinised Rinderpest Virus.

Summary

1. It has been possible to adapt the Madras strain of Bovine Rinderpest Virus to rabbits in which it has undergone 194 passages so far.

2. The virus produced definite and constant lesions in the rabbits after the 17th passage and showed definite signs of attenuation for the bovines after the 90th passage in rabbits.

3. From the 100th rabbit passage, the virus appears to be fixed in its virulence for rabbits and to have lost its pathogenicity for cattle and buffaloes in which it produces only a mild thermal reaction.

4. The virus harvested from rabbits at different intermediate stages after the 100th passage has been freeze-dried and preserved in a deep-freeze at -20°C.

5. The freeze-dried virus is found to confer adequate protection in highly susceptible buffaloes and buffalo-calves in doses of 5 to 10 milligrams dry weight and all these animals have withstood a subsequent challenge with virulent bovine virus.

6. The titre of the virus in the tissues of the rabbits compares well with the titre reported for the Nakamura III strain and its substrains.

7. It has been found possible to produce a reactor vaccine from this virus using goats as reactor animals to produce higher yields of vaccine for mass vaccination campaigns.

8. Back passage of the virus in bovines upto 16 passages has not changed the characters of the virus or its virulence for bovines.

9. The keeping qualities of freeze-dried lapinized virus in a deep-freeze at -20°C and at room temperature is more or less similar to the Mukteswar 'W' line of goat virus.

10. Being a lapinized virus of recent origin, derived from an Indian strain of Bovine virus having high antigenic qualities and at the same time mild for use on the highly susceptible buffaloes and white cattle of Madras, it may prove to be a good, cheap and useful product for the mass immunization of cattle and buffaloes under the Rinderpest Eradication Plan.

11. This vaccine is found useful for protecting sheep and goats against Rinderpest.

12. Further studies on the lapinized virus are being continued.

Acknowledgment

The authors wish to thank Dr. V. R. Rajagopalan, Director of Animal Husbandry, Madras, for the facilities afforded and for his continued interest and guidance in this study, Mr. G. G. Alton, F.A.O. Expert, for his suggestions and freeze-drying the virus at different passage levels, and the staff of the Veterinary Biological and Research Institute, Ranipet, for technical assistance.

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THE COMPOSITION AND NUTRITIVE VALUE OF *PROSOPIS JULIFLORA* POD

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There are many varieties of leguminous species of Prosopis, such as *Prosopis Spicigera, Prosopis Chilensis* and *Prosopis Juliflora,* the common desiduous thorny trees, which are found in the arid dry zones of India and South Africa. They are called commonly as Mesquite. The ripe pods of some of these trees are reported to be used even as human food at times of food scarcity in many parts of India. Most of them are known to contain considerable quantity of a sweet farinaceous substance, which is relished well by cattle and sheep.

The ripe pods of *Prosopis Juliflora,* found in the government livestock farm at Kurukuppi, Bellary district, (now in the Mysore state) are analysed for their chemical composition and nutritive value for use as livestock feed [1]. The leaves are eaten by sheep and goats. The percentage composition on dry matter basis is given in the table 1. Assuming the digestibility coefficient of nutrients in similar Prosopis pods, reported in the literature [2], the percentage of digestible nutrients and the Total Digestible Nutrients in the pods analysed are calculated.

TABLE I

Composition and Nutritive Value of *Prosopis Juliflora* pods.

Nutrients.	% on D.M. Basis.	Digestibility Coefficient.	% Digestible Nutrient	T.D.N.
Dry Matter per cent.	84·57			
Crude Protein	10·06	65	6·86	
Ether Extractives	4·26	48	2·45	
Crude Fibre	30·77	81	24·92	
N.F.E.	50·33	66	33·22	**70·51**
T. Ash.	4·59			
Ca.	0·33			
P.	0·23			

Palatability and Feed Value

When the pods are given in the dry or semi-dry condition preferably in the crushed state, cattle, sheep and goats relish them well and consume easily without any adverse effect. The farm animals are reported to eat them well, when given as a concentrate food. Even camels are said to relish other varieties of prosopis pods.

The *Prosopis Juliflora* pods did not show the presence of any cyanogenetic glycoside.

Discussion

The pods of *Prosopis Juliflora* possess a high nutritive value, viz., 70, similar to that of any other concentrate food. They are rich in carbonaceous matter and have fair amounts of digestible nutrients like protein and fibre. The nutritive ratio too is not very wide and hence its usefulness to cattle as a balanced feed is high. Calcium, Phosphorus ratio also is not ill balanced, thus increasing its feed value.

The composition of these pods compares well with the values reported for pods of this family. The ripe pods of mesquite *Prosopis Chilensis*, which are used as cattle food in South Africa, have the following composition. Crude Protein 14·7%; Ether Extractive 3·0%; Crude Fibre 18·3%; N. F. E. 59·7%. The planting of these trees is recommended in the drought districts for using their pods as cattle feed. [3].

The leaves of *Prosopis Juliflora, Spicigera* and *Chilensis* are reported as good feed for sheep and goats. The small leaflets of *Prosopis Juliflora*, when they are young and tender, are said to be relished by cattle also [4].

All varieties of *Prosopis* leaves are not good feed to even goats and sheep. *Prosopis Glandulosa* leaves are reported to be poisonous to goats [5].

Summary

1. *Prosopis Juliflora* pods have the following composition: C.P. 10·06; E.E. 4·26; C. Fibre 30·77; N.F.E. 50·33; D.M. 84·57; T. Ash 4·59; Ca. 0·33; and P. 0·23. (Percentage on dry matter basis.)
2. The pods are rich in digestible nutrients and T.D.N. is about 70. Hence they have a high nutritive value.
3. They do not contain any cyanogenetic glycoside.
4. They are highly palatable to cattle, sheep, goats and camels. Therefore they can be used as a nutritious feed for livestock.
5. The growing of *Prosopis Juliflora* trees in drought areas and other waste lands to serve as cattle food is recommended as they are popular in various parts of India and Africa.

Acknowledgment

Grateful acknowledgment is made to (1), the Famine Commissioner Board of Revenue, Madras, for suggesting the above investigation, (2), the superintendent, government livestock farm, Kurukuppi, Bellary district for the supply of the material, (3), the Director of Animal Husbandry, Madras, and Principal, Madras Veterinary College, for their keen interest, and (4), Sri K. Satyanarayana Rao, for technical assistance rendered.

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THE PERFORMANCE OF INDIGENOUS AND INTRODUCED GRASSES IN MALABAR

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Soil:—Generally the soil obtained in Malabar is of the laterite type, slightly reddish in colour, porous, and though it has been subject to continuous leaching of soluble salts due to torential rains, still it contains considerable amount of plant foods like Nitrogen and Phosphorus. The soils are quite rich in Potash but somewhat deficient in Calcium.

An analysis of a representative sample of soil in District Livestock farm, Malabar has indicated these results, which are tabulated below:

Soil analysis results.

Depth of soil.	0-6"	6"—12"	12"—24"	24"—36"	36"—48"
Moisture % ...	5·19	5·09	5·16	5·18	5·23
Loss on ignition ...	11·76	11·37	9·11	9·21	9·17
Insolubles:					
Iron $Fe_2 O_3$ / Alumina ($Al_2 O_3$) / Lime (CaO) ...	25·35	24·37	24·34	23·87	24·67
Magnesia (Mg.O) ...	...	...	...	...	...
Potash (K_2 O) ...	1·24	1·054	1·34	0·95	1·09
Phosphoric acid ($P_2 O_5$) ...	0·16	0·14	0·093	0·086	0·043
Sulphuric acid (SO_3) ...	...	...	...	...	...
Nitrogen (N) ...	0·26	0·22	0·16	0·16	0·15
Available potash (K_2 O) ...	0·024	0·036	0·045	0·028	0·019
Available phosphoric acid ($P_2 O_5$) ...	0·010	0·010	0·0095	0·0089	0·0078
B. Mechanical analysis.					
Clay ...	31·25	34·73	42 02	45·93	44·14
Silt ...	13·69	14·90	11·09	10·86	9·18
Fine sand ...	9·12	8·62	9·42	8·32	2·98
Coarse sand ...	39·14	39·23	35·67	33·73	44·91
pH. ...	6·69	6·45	6·30	6·30	6·30

Necessity and advantages of pastures in Malabar:—The District comprises of only a narrow strip along the west coast of India about 160 miles in length and 60 miles in breadth lying between the western ghats on one side and the Arabian Sea on the other. Being blessed with abundant rainfall i.e. on an average of 120" per year the District has varied vegetation and different types of grasses. The terrain of the land is very uneven and steep, and flow of rivers and streams is extremely fast especially during the monsoon seasons with immense possibility of erosion. It is only the dence forest on hill slopes that checks erosion to a great extent, and hence when the forests are progressively cleared during the grow more food campaign vast tracts of lands are laid bare for erosion. Much of the fertility of the tract lies in virgin areas and when once the forests are felled and land put under plough there is rapid deterioration of soil, manifested in the alarming and progressive reduction of yield. As such it has never been paying to reclaim forest areas and putting it under food crops like, paddy, millets and pulses. The only suitable crops that can be profitably taken on these hilly tracts without the area itself losing fertility are commercial crops like pepper, cardamums, rubber, tea and coffee, which are either permanent trees checking erosion or which do not require much of a fertile soil, and the total clearance of forest or good tillage. As such if a tall clearing of forest is to be successfully taken up without the tract losing fertility it is essential that it should be put under grass to conserve soil, water, and fertility, which incidentaly will also permit taking a grain crop once in

five or six years in regular rotation. Hence the importance of pasture in a tract like Malabar coast can never be underestimated.

Indigenous pasture and cultivated fodder grasses:—Grasses can be generally distinguished as of two different types. (1) Those that are laid out as pasture and animals allowed to graze on the same. They are mostly characterised by smaller leaves spreading subterranean habit, hardiness, adaptability to varied soil and climatic conditions and power of smothering other grasses and weeds. (2) Those that are grown entirely for taking cuttings for stall feeding purposes. These are generally erect types with broader leaves and yield abundant fodder. A little care in management of these cultivated fodder grasses is necessary to ensure maximum production.

Indigenous grasses:—The Botanical names of some of the local grasses which have been identified are given below:—

(1) Andropogan contortus (Spear grass)
(2) Ischeum Rangacharianum.
(3) Arundinella species.
(4) Elusine indica.
(5) Setaria pallidifusca.
(6) Ophisminus compositus.
(7) Dactelotenium aegyptium.
(8) Bracheria ramosa.
(9) Echinochloa colona.
(10) Chrysopogan asper (Korai)
(11) Themedatriandra (Odian)

Of the above grasses, Spear grass (*Andropogan contortus*) and *Ischeum Rangacharianum* alone are of any importance for development as good grasses which can be laid as pasture with advantage, while two other grasses i.e. Korai (*Chrysopogan asper*) and Odian (*Themedatriandra*) only can be developed as good cultivated grasses for stall feeding purposes with certain limitations. The results of the analysis of these grasses which are cut just before flowering and dried in the shade are given below:

Name of grasses.	Spear grass.	Ischeum Rangacharianum.	Korai.	Odian.
Moisture ...	50·00	60·00	60·00	60·00
Ash ...	2·00	2·22	2·96	2·64
Crude protein ...	1·87	1·90	2·02	2·38
Ether extractives ...	0·26	0·87	0·48	0·84
Carbohydrates or N. F. E. ...	34·66	21·74	23·19	21·72
Crude fibre ...	11·12	13·27	12·82	9·95
Phosphoric acid ...	0·124	0·05	0·102	0·103
Lime ...	0·222	0·202	0·171	0·177

1. *Spear Grass* : (*Andropogan contortus*) :—Spear grass is one of the most widely distributed pasture grass seen throughout the length and breadth of Malabar District. The grass is of a very hardy type with narrow leaves and each clump has a starlike shade and has got a distinct matting habit which smothered other grasses and weeds. Though the feeding value of the grass is rather poor the relative ease with which the grass can be established, its exceptionally high yield, hardiness, adaptability to varied soil and climatic conditions, and capacity to thrive on poor and shallow soils have made it the most popular pasture grass in the tract. The grass gives on an average a yield of 6000 lbs. per acre when fully mature. The disadvantages of this grass are (i) It does not give a good tonnage before flowering (ii) it gives only one cutting per year in November—December. (iii) Its seed has got long and pointed needle shaped structures called awns, which when ripened hurt very badly the mucous membranes of mouth and tongue of grazing cattle. Its feeding value is also comparatively poor, since the crude fibre contents are high (11·12%) and crude protein content extremely low (1·87%).

2. *Ischeum Rangacharianum* :—This is a slightly reddish pigmented grass and is also very widely distributed in the District. As far as feeding value, adaptability and hardiness are concerned it is more or less like the spear grass but the yield is much less and gives only on an average of 4,500 lbs. per acre. This grass also gives only one cutting, as such it is not of much importance but can be tried in limited areas to provide variety and a change for grazing animals.

3. *Chrysopogan asper* (*Korai*) :—Another type of local grass found commonly in these hill slopes is Korai. This is not a spreading grass but an erect type with distinct clumps. It requires fairly good soil to ensure good yields, the grass specially prefering fertile valleys and hill slopes. It is considerably hardy. The grass is rather rough and the crude fibre content (12·82%) is very high and consequently of low feeding value. The average yield per acre under rainfed conditions i.e. 22116 lbs. per acre in three cuttings is rather low compared to other introduced cultivated fodder grasses.

4. *Themedatriandra* (*Odian*) :—Odian grass is similar to Korai in its habbits. Its crude protein content (13·38%) is higher than that of Korai and the crude fibre content (9·95%) is extremely low. Hence the grass has good feeding value. The yield per acre of the grass 21570 lbs. in three cuttings is low compared to other introduced cultivated fodder grasses.

The reduction in yield of Korai and Odian is due to the fact that only three cuttings can be obtained per year under rainfed conditions

while other introduced grasses like Guinea, Elephant and Buffalo grasses give atleast four cuttings per year under identical conditions.

Introduced grasses :—The following are the important grasses introduced in the District Livestock farm, Malabar, to try its suitability to the tract.

(1) Kolakattai.
(2) Rhodes grass.
(3) Australian drought resistant grass.
(4) Guinea grass.
(5) Buffalo grass.
(6) Elephant grass.

Of the above the performance of the Rhodes and Australian drought resistant grasses have been disappointing but Kolakattai has made a good headway as a pasture grass while Guinea grass, Buffalo grass, and Elephant grass have come to stay as cultivated fodder grass for stall feeding purposes on account of their promising yields.

The results of analysis of these grasses which are dried in shade are furnished below.

Name of grasses.	Kolakattai grass.	Guinea grass.	Buffalo grass.	Elephant grass.
Moisture ...	60·12	60·00	50·00	50·00
Ash ...	...	4·23	5·00	5·58
Crude protein ...	3·00	3·9	4·35	1·89
Ether extractives ...	1·64	1·01	1·25	0·82
Crude fibre ...	12·36	19·21	25·24	29·38
Carbohydrates ...	21·88	11·65	14·16	12·33
Phosphoric acid ...	—	0·16	0·159	1·137
Lime ...	0·88	0·37	0·24	0·248

1. *Kolakattai grass* :—This grass is reputed to grow extremely well under semi-arid condition in Kangayam taluk of Coimbatore District from where the seeds were first obtained and sown in District Livestock farm, Malabar. The warm and humid climate of this tract is found equally suited to the grass and its growth is quite good. It grows in distinct clump and does not mat as spear grass. It has got the power of smothering other grasses and weeds. The analysis of this grass shows a low crude fibre content (12·36%) and a high crude protein content (3·00%) and hence it has a high feeding value. Though it prefers good deep soils it can also thrive on inferior ones. It is hardy like spear grass and can well stand adverse seasonal conditions. The advantages of this grass over the spear grass are (i) that it can give atleast 3 cuttings per year and hence the yield is considerably more (ii) that it has a high feeding value and (iii) it is more succulent and better relished by cattle,

reducing wastage to the bare minimum. The average yield of the grass is 7500 lbs. per year per acre compared to 6000 lbs. per year per acre in spear grass. The only disadvantage is the great difficulty to get the pasture established under this grass. The seeds and seedlings are extremely delicate and slightest adverse seasonal conditions affect the pasture very badly in its initial stages, but once the pasture is established the grass can well stand on its own and is a match to the hardiest of the local grasses. Hence it is worth investigation over a series of years the comparative merits of Spear grass and Kolakattai grass to arrive at the most suitable pasture grass under Malabar conditions.

2. *Guinea grass* :—Ever since the introduction of Guinea grass in 1950 it has continued to do well. The grass thrives well both under rain fed and irrigated conditions and has given on an average 31,424 lbs. per acre in four cuttings under the former, and 74220 lbs. per acre in six cuttings under the latter respectively. The grass appears to be well suited to fertile valleys with deep and porous soils with good humus content and organic matter. In water logged and clay types of soils the growth is generally poor and ultimately it dies out. Its growth is marked when planted on newly formed bunds, soils of which are necessarily porous and loose. The grass is extremely succulent and relished much by cattle. The feeding value also is good when compared to other cultivated grasses, with a relatively high crude protein content of 3·9% and low crude fibre content of 19·21%. It is markedly rich in calcium and this attribute can well be utilised to supplement the calcium deficiency manifested in the undersized animals for which this district is well known.

3. *Buffalo grass* :—Buffalo grass is characterised by hollow and spreading stem and narrow leaves. The grass is adaptable to varied type of soils and climate. It comes up well under water-logged conditions and rather poor types of soils which is a distinct advantage going to its credit. The ease with which it can establish and spread by rooting at nodes and smothering down all other grasses and weeds in its way has paved its way to make it an excellent cultivated fodder grass beyond doubt. Introduced in 1951 it has shown certain promise and the yield of the grass in District Livestock farm, Malabar is 58,800 lbs. per acre. in six cuttings under irrigated condition and 28,160 lbs. per acre in four cuttings under rain fed conditions. Its performance has been exemplary both under normal and water logged conditions. The stem of the grass which goes to form a good part of the yield is tough and hence the crude fibre content (25·24) is very high ; all the same it is very rich in crude protein content (4·35) and hence there is little doubt regarding its good feeding value.

4. *Elephant grass* :—Elephant grass has rough leaves and a tall woody stem. This does very well under irrigated condition and has given on average 76,860 lbs. per acre in six cuttings. The feeding value is poor in as much as it has got a high percentage of crude fibre (29·38) and a very low crude protein content (1·89) and as such is not relished by cattle and hence a good part of it wasted.

1. The analysis of soil and grasses were done by the Agricultural Chemist, Agricultural Research Institute, Lawley Road, P.O., Coimbatore.

2. Samples of grasses were cut just before flowering and were dried in shade before despatching to the chemist for analysis.

3. The samples of soil were taken by digging trial pits and representative samples were taken from different layers of soil i.e. 0"–6", 6"–12", 12"–24", 24" to 36" and 36"–48".

Conclusion :—Summing up, it may be seen that of the indigenous pasture grasses Spear grass, and of the introduced ones, Kolakattai, can be developed as good pasture grasses. Observations made so far indicate that it is best to confine Kolakattai to pastures with good and deep soil whereas spear grass can be religated to less fertile areas. In laying out the tract to pastures it has to be borne in mind that every new area put under grass should be protected by fence other wise indiscriminate grazing which is rampant in the hills of this district will wipe them out in due course. It is also desirable that the pasture is limed atleast once in three years to supplement the calcium deficiency of laterite soils. Regarding cultivated grasses Guinea grass is the ideal fodder grass for fertile soils of Malabar, while Buffalo grass can be grown with advantage in water logged places and in less fertile soils. The performance of the local grass Odian also justifies, a more detailed investigation regarding its fodder productive capacity in various types of soils under irrigated and rainfed conditions.

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APPLICATION OF STATISTICS IN ANIMAL HUSBANDRY

By

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Introduction

The utility of statistical methods in the field of research in biological sciences is now fairly recognized and no inductive conclusion is generally accepted as valid unless statistically tested. Though these methods have been in wide use for some years in agriculture, their application in the allied field of Animal Husbandry is of a recent origin. This lag might partly be attributed to the fact that the pioneering work in the development of statistical methods was done by Fisher and his co-workers mainly in relation to agriculture. Other reasons for it may be the limited available material, the high heterogeneity and the difficulty in conducting animal experiments under controlled condition.

In spite of their initial hurdles, thanks to the efforts of Snedecor, Lush, Cochran and others, a good amount of progress has been achieved, and the development of theory of small samples, formulation of the convariance technique and the device of switch-back and switch-over trials have widened the scope for the application of statistical principles in every important branch of Animal Husbandry.

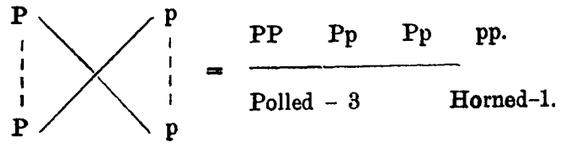
In India the utilization of statistical technique in the planning of animal experiments and the interpretation of their results have not yet become universal. The I.C.A.R. having recognized their value, has been making efforts to spread their use. It is the object of the present paper to present a review of the scope of the use of statistical methods in the various fields of the animal science.

2. *Statistics in Animal Genetics* :—It has truly been said that for genetical research some insight into the principles of statistics is very essential. It may be seen that even the fundamentals of genetics are based on statistical principles. The statistical basis of the Mendelian laws concerning the independent assortment and the random segregation of chromosomes which constitute two of the basic principles of inheritance explains the genotypic and phenotypic proportions observed in the progenies obtained by various types of crosses.

Mendelian Principles :—A simple illustration of Mendelian segregation is furnished by a cross between a polled (dominant) and a horned cattle.

PP × pp ⟶ Pp. F1 generation.

Polled pure Horned pure. Polled heterozygous. The crossing of two heterozygous parents, Pp × Pp, gives



Each Pp produces gametes of two types P and p in equal numbers. In a cross, a male gamet of either type has an equal chance of fertilizing an egg of either type. It follows from the principles of probability that the progeny is likely to be genotypically PP, Pp or pp, with chances ¼, ½, ¼ respectively. Phenotypically, therefore, we shall expect to see on an average, proportion of ¾ (P) types, ¼ (p) type. The fact to note is that the expected proportions may not always be realized in practice and it is essentially a statistical problem to infer from the observations as to whether they can be regarded as compatible with a particular hypothesis regarding segregation. Similarly the detection and estimation of linkage are also problems of statistical testing of significance and estimation.

Biometrical principles—Inheritance of quantitative characters exhibiting continuous variation, formerly attempted to be explained away by the so called blending theory of inheritance is now recognized to be mendelian in nature explainable on the multiple factor hypothesis with the aid of statistical concepts. This theory postulates that many pairs of genes on one or more chromosomes act in an additive or cumulative manner in bringing the character to expression. The technique employed in investigating the mode of inheritance of such characters consists in the study of the characteristics of populations of successive generations obtained by crossing differing types. The investigation, designed Biometry, involves statistical methods of a different type than that involved in the linkage and segregation problems of qualitative characters cited above.

The modern methods of progeny-testing of a sire, calculation of sire indices and studies on heritability of different characteristics in herd are only the beginnings of the fruitful results that biometry can provide.

3. *Statistics in animal breeding* :—In all livestock breeding operations, the primary endeavour is to change the genetic constitution of a stock to the pattern we desire. Selection is known to change the genetic composition of the population by changing the gene frequency

and the frequency of gametes carrying certain gene combinations. Selection with a suitable intensity, based on a definite organised programme, is essential to achieve fruitful results.

Progeny Testing :—The evaluation of the breeding worth of an animal by body conformation in order to base selection on it, has often proved to be deceptive. The use of an animal's own performance for the purpose is inapplicable to one of the sexes in the case of sex limited characters like the milk yield. Pedigree estimates of an animal are rarely precise due to the non-availability of adequate pedigree records. Further identical pedigree does not mean identical inheritance due to the sampling nature of gene inheritance except in the case of identical twins. The only universal method available for assessing the transmitting ability of an animal consists in mating it with a number of animals of opposite sex and comparing the performances of the progenies with the respective parents thus mated to it. This method known as progeny testing is the ideal one for sire selection in a breeding programme aimed at improving the milk potentialities of a herd. It is essentially a statistical test of significance of the difference in yields between the daughters of a sire and their dams which will show whether a sire can produce daughters which on an average are better or inferior in milk production than their dams.

Denoting by S, M and D the potentialities of the sire, the dam and the daughter, it can be shown that $\bar{D} > \bar{M}$ and $S > \bar{M}$ if $\overline{D\text{-}M} > 0$ provided that the dams form a representative sample of the herd, the daughters are an unselected lot and the environmental conditions for the dams and daughter are not widely different. The proper test is therefore to see whether D-M is positive allowing for variations due to environmental causes. Statistically this amounts to a paired 't' test. If this average difference is significantly positive we say that the sire tested is a proven one.

Sire index :—In breeding cattle for dairy purposes, the calculation of sire index is of great value. It is an estimate of the breeding value of a sire in terms of yield of milk and can tell a breeder how a sire can be used with advantage on dams of a particular level. It also enables the comparison to be made of the worth of two sires.

If D and M represent the milk yields of the daughter and her dam, the sire index 'S' is given by $S = \bar{2D} - \bar{M}$. This index besides requiring the fulfilment of the conditions necessary for the validity of the progeny testing also makes an additional assumption that the sire and the dam contribute equally to the milk potentiality of the daughter. This is a valid assumption provided that there is no sex linkage. For obtaining the sire index the milk yield records with the corresponding

number of days of like lactations of dams and their daughters should be known. The yields are adjusted to a standard lengh of, say, 300 days by the method of regression, and sire index calculated as above. This estimate is likely to vary on either side of its value, the extent to which it will vary depending upon the value of the standard error of the sire index. The estimate of the Sire index the product of its standard error by the 't' value at 10% level of significance gives the limits within which we may expect the true value of the sire index to lie. In breeding problems 10% level of probability has been found to be suitable to use as due to continuous selection the genetic variance is reduced to a level difficult to detect. This index after making allowance for variation due to chance causes will give a reliable estimate of the true breeding worth of the sire measured in terms of milk yield.

Draught Quality :—No satisfactory yard stick has yet been developed for assessing the draught capacity of animals. Work is being carried out in this direction in Hissar Cattle Breeding Farm and at I. V. R. I. Izatnagar. Scientific selection of sires for draught qualities requires as a pre-requisite the formulation of such a measure.

4. *Statistics in Animal Nutrition* :—The art of feeding animals was developed by means of trial and experience. Statistical methods can be used effectively for planning these trials and in drawing objective conclusions from them. In feeding trials, animals are divided into different homogeneous groups and alloted to different feeds to be tested and the effect of feeds observed. The effect measured may be growth rate in young animals, milk yield and butter content in dairy cattle, egg laying capacity in poultry, wool and mutton yield in sheep etc.

Group feeding vs individual feeding :—Formerly in most of the feeding trials animals were fed in groups. The data collected was for the group as a whole which was examined to find the response to the feed. This the simplest procedure with regard to the arrangement and recording but it has the serious drawback that it provides no estimate of the sampling or experimental error to which the estimated response is subject. For this reason the individual feeding trial is to be preferred. In this method records of feed as well as response are kept separately for individual animals. Further improvement in the design of such feeding trials which lead to reduction in error are discussed below.

Paired feeding :—Two feeds say A and B may be compared by this method. The experimental animals are grouped into different pairs such that animals within a pair are as similar as possible in respects of of the age, weight, breed, yields, previous performance etc., but there may be variation from pair to pair. The two feeds are alloted at random to the members of each pair. 10 to 12 such pairs are necessary to render the test sufficiently sensitive. The

important feature of this feeding trial is the adaptability of the data to statistical treatment. The data collected in this manner may efficiently be examined by the 'paired t' test of significance.

Randomised block design:—This design, so very common in agricultural experiments, is suitable for comparing more than two treatments at a time. If there be t feeds, and the number of animals available in n = (tk), these may be divided into k homogeneous groups in respect of some major character affecting the production record such as age, weight, breed etc. The efficiency of this design will increase if the material within the group is as homogeneous as possible, but there may be a certain amount of variation from group to group.

The different treatments are allotted at random to the animals within each group. This will give t x k experimental observations which may be analysed to obtain the response as also the estimate of error and objective comparisons may be made between them.

Latin Square:—In agricultural experiments it some times becomes possible to eliminate the major effect to soil heterogeneity not only in one direction across the field but at the same time at right angles to it which may exist due to fertility gradient in the field. This two way elimination of variation is effected by the latin square arrangement, a method which is singularly effective in giving precise comparisons when the number of treatments to be compared is from 4 to 8.

In animal husbandry experimental problems where animals are the subject material, this design may be effectively utilized to eliminate simultaneously the variations in respect of two characteristics such as breed and age (lactation no :) weight and age etc. In this respect latin square is superior to randomised block design. But this design has got its own limitations in the sense that it entails a number of replications equal to the number of feeds to be examined. Tables of latin square are available in Fisher and Yates tables for ready reference. If there be 4 feeds, one of the possible latin square arrangements would be as follows :—

		Breeds.				
		B1	B2	B3	B4	Where A, B, C, D are 4 feeds 1 to 16 are experimental animals Nos. 1, 5, 9, and 13 in the same column are animals of same breed but of different age group, while no. 1, 2, 3 and 4 in the same row are animals of the same age group (lact. no. being same) but are of different breeds.
	L1	1 A	2 B	3 C	4 D	
Lactations.	L2	5 B	6 C	7 D	8 A	
	L3	9 C	10 D	11 A	12 B	
	L4	13 D	14 A	15 B	16 C	

If there were n feeds total no : of animals would be n^2. The data obtained in this manner may be analysed to obtain the variations between breed, between lactations, between feeds and the estimate of error, and objective comparisions may be made between the responses to different feeds on the basis of estimated error.

Switch-back and switch-over trials:—Variations from animal to animal is the major component of error variation in experiments with animals and it is essential for any good design to eliminate this variation to the possible limit. Attempts to achieve this by testing in turn the different treatments with each of the animals is made use of in the techniques of switch back and switch over trials.

Switch back trial:—This is meant for testing 2 feeds. Both the feeds, say A and B are given in two periods of experimentation P_1 and P_2 to every animal under test. In order to ensure, however, that the estimate of the difference between the feeds is not affected by the advance in period the trials on the two feeds start simultaneously. The animals even in number, are divided into pairs and the two feeds are allotted to the two members of each pair at random. After a certain period, the feeds are reversed as shown below :

	C1	C2	
P_1	A	B	Where C_1 and C are the two experimental animals, P_1 and P_2 the two different periods and A and B the feeds under test.
P_2	B	A	

For obtaining the estimate of error, a number of such pairs of animals have to be taken where-in each pair form a replicate :

Switch-over trial:—When more than two feeds are desired to be tested, the switch over design is recommended. If there are 3 feeds to be compared, the experimental animals are divided into sets of 3 each and the programme of the experiment proceeds in a manner similar to the switch back trial.

		C1	C2	C3	
Set I.	P1	A	B	C	Where notations stand as in former case.
	P2	B	C	A	
	P3	C	A	B	

It will be noticed that the three treatment schedules form a latin square of side 3. A switch overtrials for a number of treatments similarly involves a corresponding latin squre arrangement of treatment schedule. A number of such sets are taken to give a valid estimate of error. An important factor in such trials is the residual or carry over effect of a treatment during the period subsequent to its application.

The carry over effects of different feeds may in some cases be climinated by allowing a sufficient pre-experimental period e.g. if feeds are changed say every 5 weeks, the first week of each period may be considered non-experimental period which is exactly analogous to allowing for border effect in agricultural experiments. Carry over effects may also be separately estimated along with direct effects for doing which, however, the design has to be modified suitably.

Analysis of Covariance:—This is a statistical device for controlling the experimental error in cases where a concomitant cause of variation can not be controlled but can be measured. For instance, in a feeding trial on the growth rate of lambs, the initial weights of animals may not be the same but may be measured. Now the growth rate is known to depend on the initial weight. The possible variation of the observed growth rate on account of differences in initial weights can be assessed and allowed for if initial weights records have been maintained. The proper technique of doing so is the analysis of Covariance. The technique is often effective in increasing the precision of the estimates of treatment effects.

5. *Statistics in Disease Control*:—The problems posed in the disease control are (i) to find out an efficacious medicine, serum or vaccine for curative or prophylactic measure against the disease, (ii) to determine the proper dosage of the agent to be employed, (iii) the mode of administering the drug, (iv) the preservative to be used, (v) the keeping quality under different environmental conditions and (vi) the period of effectiveness of the serum or vaccine. The investigation of any of these problems in a scientific and systematic manner, the knowledge of statistical principles will be of immense help.

It is known that the age, sex, susceptibility, weight and breed or the type of the animal play an important role in determining the response of a particular drug, chemical or of biological origin. Proper weightage is given to all these factors while designing experiments based on statistical principles for testing the response of the drug under test. The data so obtained is then subjected to analysis to yield unbiased results.

Most of the designs met with under this head are similar to those described earlier. A method based on X' test is of special importance here.

Chi-square 'X²' test:—In exploratory trials for the hunt of the efficacy of a serum as a curative agent or a vaccine to prevent the occurence or spread of a disease, X' test will be quite useful. This test will reveal whether the serum or vaccine under test is having any effect. It is applicable where the association between different factors are to be

examined. The presumption that there is no association between the treatments will be proved or disproved will depend upon the value of X'.

A simple illustration of its application to detect the efficacy of a particular drug (say vaccine) is given here. In the first instance, a number of animals are selected to form a representative sample taking care of sex, age, breed, health etc. of the animals in the group. Out of these some will be vaccinated by the vaccine under test while the rest will serve as control. Observations are recorded in the following way.

	Attacked	Not attacked	Totals.
Inoculated.	a	b	a+b
Not inoculated.	c	d	c+d
Totals.	a+c	b+d	a+b+c+d

$$X^2 = \frac{(ad-bc)^2}{(a+b)} \frac{(a+b+c+d)}{(c+d)} \frac{}{(a+c)} \frac{}{(b+d)}$$ for 1 degree of freedom.

If the value of X^2 is significant, it will be concluded that the vaccine was effective.

Probit Analysis:—Having ascertained that a particular drug is having effect the next problem is to determine the dosage and the concentration. Probit analysis and other techniques employed in the study of biological assays will be of immense help in finding a satisfactory solution to this problem. The relationship is studied by drawing a dosage-response curve from which optimum dosage for producing the desired effect on any given proportion of the individuals can be read off. These methods will also be of use if any new drug is to be tested against a standard one and corresponding dosages of the two to be fixed. For this purpose the experiments can be carried out on experimental animals.

The technique to be employed in studying the effect of storage, preservative used, etc. on the potency of the medicine are also essentially the same. If a number of medicines are under test, advantage can be taken of the designs like the Randomised Blocks and Latin Squares in order to achieve greater precision. When a number of factors are to be tested at different levels, techniques making use of the factorial concept may be employed.

The statistical treatment of quantal assay data has been greatly aided by the development of probit analysis. This method, which is usually attributed to Gaddum (1933) and Bliso (1934) though in fact, it has, a much longer history has now been widely adopted as the standard method of reducing the data to simple terms. Reference may be made in this connection to Finney's ' Probit Analysis '.

6. *Statistics in animal management:*—In all livestock improvement operations, management plays a very important role. Animal is a delicate machinery and the effects of good management reflected on the better produce from the animal. Yield can form the basis of judging the good or bad management as it existed in the past. This may be assessed in a better way by statistical tests.

In many foreign countries, several items of work of this nature have been worked out for their own breeds. These elaborate methods of their management may either be inapplicable here or are beyond our means. Some of the common ones have been practised in this country but their results need proper scrutiny and checking before they can be accepted.

Under management can be mentioned all the policies adopted on the farm which provide an animal the optimum set of conditions to yield at its maximum capacity by way of work, milk, butter, meat or wool. A few of them may be mentioned here viz., the effect of calving seasons, times of milking, weaning, different ways of milking, watering, stall feeding or out grazing, service period etc. on milk yield, the method and periods of shearing, lambing, mating etc. on wool production; the best age of bacon, ham and pork production, the utility life span of poultry, acclimatization of different strains of poultry in different areas of the country and their performance with special reference to egg laying capacity.

All these problems can be successfully tackled only through planned experimental investigation and objective interpretation of the data on the basis of statistical analysis.

7. *Statistics in determining the growth rate of animals* :—The other problem which has drawn the attention of the research workers since long is the study of the growth rate in animals as a response to different feeds and environmental conditions. The determination of growth rate depends on finding the relation between measure of time and size, size may be expressed in terms of weight or height or any other variate which shows variation with time. It has been found that the relation between time and size algebrically is generally of form. $Y = yoe^{kx}$ where y is some variate like height, weight, etc. under study, x is the time index, yo and k are some constants. The fitting of the growth curve is again a statistical problem.

Regression:—In the parlance of biological statistics, Galton's descriptive terms, regression has largely replaced the technical word function used in mathematics. Growth curves are referred to as regression of height on age. Investigations of this type, two questions present themselves (i) Does the sample constitute evidence for uniform growth

at this stage in the life of the animal or for a growth curve different from a straight line. (ii) If uniform growth is postulated, what is the best way to evalute the average growth rate. This can be answered by fitting a regression line which is a kind of moving average passing among the points that determine it in a manner specified by the particular hypothesis set up.

The growth rate $\frac{E(x-\bar{\pi})\ (y-\bar{y})}{E\ (x-z)}$ is known as the regression coefficnien ordinarily symbolized by 'bl' where x is the limit of time, the independent variate with mean X and y represents the unit of measurement of the body characteristic in terms of which growth is measured with mean $\bar{y}$.

8. *Statistics in estimation of Livestock numbers and Livestock products:*—Cattle occupy a unique position in the rural economy of India and hence attempts have been made from the Moghal period to take a cattle census but it was only from the later period of nineteenth century that any regular census system was initiated.

The importance of reliable statistics of livestock numbers and their products for any plan of livestock development hardly needs any comments.

Statistics of livestock numbers are at present obtained through a quinquennial census covering almost all the states of the Union. It is conducted by the Patwari from house to house enumeration of the number of animals of various description. Although the method of complete enumeration is sound in principle, doubts have been expressed in some quarters as to the reliability of statistics of livestock numbers collected therefrom due to the inadequate attention paid by the Patwari to this work and the slackness in supervision.

If the accuracy of the data collected is to be ensured it is necessary to insist that the census is carried out in a systematic manner by a house to house enquiry. The reliability of the data can be enhanced by providing an adequate and effective supervision over the work of the patwari. The supervisory check should preferably be carried out by an independent agency and to be effective should be based on rationalized methods. Pilot surveys are at present being carried out by the I.C.A.R. to devise a proper programme of supervision and results already obtained indicate that it is possible to obtain independent and fairly precise estimates of the numbers under major heads of cattle and buffaloes for the State as a whole.

The feasibility and desirability of super imposing rationalized methods of supervision whenever livestock censuses are carried out, also demonstrates the applicability of the procedure of random sampling for

getting aenual estimates of livestock numbers during intercensul period.

No attempt has so far been made to collect statistics of livestock products on a country wide scale in scientific manner. What ever statistics available at present are only subjective estimates based upon scanty data. As performance records are rarely maintained for livestock in India, the only method of getting reliable estimates of livestock products is the adoption of random sampling procedure. This has been recognized by the I.C.A.R. which contemplates initiating surveys with the above purpose under a five years scheme for improving the fishery and livestock statistics.

Summary

The application of statistical principles in the field of research in Agriculture and Animal Husbandry sciences is becoming very popular these days. These principles are now applicable in every branch of Animal Husbandry where proper planning and assessment of improvement achieved is envisaged. It is expected that statistics may play greater and greater role in the near future when more research workers in the field of Animal Husbandry begin to appreciate the applicability of statical principles to this science.

This paper is meant to give in a simple and lucid form the scope of various statistical principles which are applicable to different branches of Animal Husbandry for the benefit of research workers.

Acknowledgment

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A NEW SPECIES OF HYMENOPTERA — *Telenomus* sp. n.— PARASITISING EGGS OF *Tabanus* FLIES

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During the course of a survey of *Tabanus* (horse flies) in a few selected villages around Izatnagar, Bareilly (U.P.) with a view to work out control measures, it was noticed that in certain sites of observation, namely, Kareli Kargana and Muttrapur villages, and Deorania and Nakatia rivers, a large number of egg clusters of *Tabanus* were parasitised by small hymenopterous insects (Plate No. 17, Fig. 1-3) which have been reported by the Commonwealth Institute of Entomology, British Museum, London, to represent a new species of *Telenomus*.

There are a few reports of various species of parasitic Hymenoptera infecting the eggs of different orders of insects. Of these, the family Scelionidae comprises a considerable number of species which are parasitic. Clausen (1940) reported that all the known species of this family are parasitic in the eggs of other insects, particularly Lepidoptera, Hemiptera, Orthoptera, Diptera and on those of the Arachnida. The more common gene of this family are *Phanurus, Telenomus, Scelio* and *Rielia*. Representatives of this family have been successfully utilised in several places for the control of crop pests. Parman (1928) undertook the liberation of *Phanurus emersoni* Gir, in sections of Texas where it previously did not occur, and a marked reduction in the population of the horse fly *Tabanus hyalinipennis* Hine resulted. Isaac (1924) reported that a scelionid parasitised the eggs of *Tabanus* in Pusa. It was found to destroy every egg in an egg mass. From this it is clear that there is every possibility of utilising these parasites for biological control of *Tabanus* flies.

The study on the life history and taxonomy of these parasites is in progress with a view to its utilization in the biological control of *Tabanus* flies.

Summary

The presence of small hymenopterous insects belonging to a new species of *Telenomus* parasitising the eggs of *Tabanus* flies in Izatnagar area is recorded.

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FURTHER OBSERVATIONS ON PARAFILARIASIS (?) OF ELEPHANTS

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Since the finding of microfilariae in a cutaneous nodule of an elephant of the Forest Department of Madras State and the publication of a paper (Ramanujachari and Alwar, 1954), similar smears from two more elephants of the department were found positive. On enquiry it was found that the nodular condition was fairly prevalent amongst the elephants. An investigation into this disease was thought worthwhile and a tour of those areas made.

In consultation with the Inspector of Livestock who is in charge of the elephants, three important regions were taken up for investigation. They were Wynad, Ooty and Nilambur areas. The animals were kept in several ambulatory camps in these areas. Two or three elephant camps in each one of the tracts were visited. The camps visited were Chembangolli and Muthanga of Wynad, Kargudy and Teppakadu of Ooty and Pokkodu and Kanjeerakadavu of Nilambur. In all 65 elephants were examined, 25 in Wynad, 23 in Nilambur and the rest 17 in Ooty.

Of the 65 examined except for 6, all were adults with 40 years as the average age. The 6 calves were all below the age of 2 years. In Chembangolli camp two pensioned elephants were also examined. The haemorrhagic filariasis is found fairly widely prevalent in all these areas. Wynad tract is highly endemic, while Nilambur is least so. Nineteen of the 25 elephants of Wynad tract exhibited the nodular condition. Of these 10 were positive for filariasis. Diagnosis was by finding the microfilaria in the blood oozing out of the nodule. In Ooty area 10 out of 17 exhibited the nodules with 3 positives. Only 2 of the 4 animals having nodules were positive in Nilambur.

Regarding seasonal occurence, those connected with the elephants, both officials and attenders are of the opinion that the disease is noticed in all seasons. But they are not definite about their having observed fresh bleeding nodules in all the seasons. The nodules once formed get fibrosed and persist for the life of the animal. Perhaps the presence of old nodules might give the idea of the disease being prevalent throughout the year. It is well known that all insect borne diseases either occur or flare up only during seasons when fly breeding is intense and that is usually early in summer. Hence it is presumed that this disease should be prevalent and be capable of dissemination

A NEW SPECIES OF HYMENOPTERA — *Telenomus* sp. n.— PARASITISING EGGS OF *Tabanus* FLIES

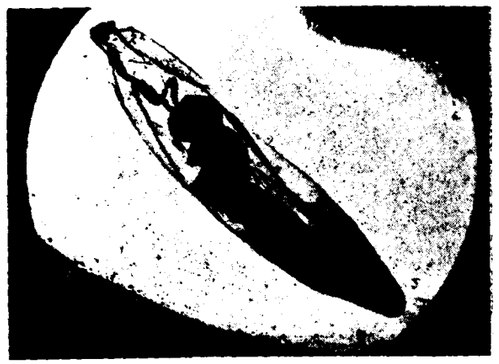

Fig. 1. The parasite inside a *Tabanus* egg.

Fig. 2. Female specimen of *Telenomus* sp.

Fig. 3. Male specimen of *Telenomus* sp.

Plate No. 16 Vol. XXXI, No. 3

Parafilariasis (?) of Elephants

Fig. 1
Elephant showing the nodules.

Fig. 3
× 75
Bit of the worm with a portion of the uterus.

Fig. 2
× 75
Microfilariæ in nodular smears.

Fig. 4
× 75
Uterine tubes with microfilariæ.

in the early summer months. This has to be confirmed by further observations.

The arthropods frequently met with on and about the animals are mosquitoes – *Aedes sp.*; tabanids – *Tabanus sp.* and *Pangonia sp.*; muscid flies – *Lyperosia sp.*, *Chrysomia sp.* and *Musca sp.* and louse – *Haematomyzus elephantis*. A few of these insects were dissected to find out if they harbour the microfilaria. None yielded any results. Dissection of a large number of mosquitoes and flies is necessary before arriving at any definite conclusion, since it has been established that even in very highly endemic areas of arthropod borne diseases of animals and man only a small percentage of the insects pick up the infection. But the one interesting fact noticed in the endemicity of the disease is that in Nilambur tract where antimalarial work is being vigorously carried out, only about 16% of the elephants are affected with about 8% being positive. In other tracts where antimalarial work has just begun or not put through, the percentage of affection is very great. This gives a fair indication that the incidence of the disease is directly connected to the incidence of mosquitoes, though tabanids may also play a part in the transmission of the disease.

The disease Parafilariasis (?) is manifested by nodular eruptions on the skin which in their earlier stages of development bleed suddenly and freely to heal up spontaneously. The nodules are located on the lateral and ventral aspects of abdomen. A few are found on the outer aspect of the thighs. Nowhere else they are noticed. Fresh nodules are of the size of a gooseberry and soft to feel. Old nodules are fibrosed and very hard and are of the size of a small lime fruit (Vide Plate no. 16. photo 1). Tendency to bleed is seen only in fresh nodules. Bleeding is noticed early in the mornings, when the sun is just up. It looks as though the warmth of the sun is necessary to stimulate the opening of the nodule. During cloudy days and the hottest part of the day bleeding is seldom noticed. Initially bleeding is observed as a small ruby placed on a raised platform. In a few minutes copious and free flow of blood is seen at that region. This continues for about half to one hour to be followed by a spontaneous closing up of the nodule and stoppage of bleeding. These nodules are known to be alive for about 2-3 months, later getting fibrosed and hardened. Once fibrosis takes place bleeding is not seen and it is presumed the worm responsible for the nodule must have died and disintegrated. Fresh nodules may arise due to further infection. It is felt that the worm has no tendency to wander about from its original site to cause fresh nodules in other places.

Blood oozing out of a nodule is found to teem with microfilariae (vide Plate no. 16 photo 2). In a few instances microfilariae are seen even in nodules undergoing caseation. Older and fibrosed nodules do not yield any positive results. Blood samples from areas well removed from such

nodules, fly bitten wounds and auricular vein are negative for the larvae even in those cases declared positive for the disease by examination of nodular blood. A few bits of a worm were secured from a fresh bleeding nodule after incision under local anaesthesia. It is found very difficult to extract the full worm without any incision and especially in such a restive and dangerous animal. It should be possible only at post-mortem and that too immediately after death. The pieces removed are the middle regions of a female filarid worm. The uterine tubes are filled with numerous embryonated eggs (vide Plate No. 16. Figs. 3 and 4). The morphological features of the bits are distinct from those of *Onchocerca sp.* another filarid worm causing nodules under the skin. Further, the nodules of Onchocerca are never haemorrhagic and do not bleed. The clinical picture of the disease, the presence of microfilaria of unsheathed variety in the nodular blood and the recovery of a filarid from a bleeding nodule conform to the picture of the disease 'Parafilariasis' in bovines and equines. Hence the bits of the helminth extracted from the nodule of the elephant is presumed to be that of a species of *Parafilaria.*

The pathogenesis of the condition is mainly two fold. Primarily the bleeding nodules are seats of mild but a chronic type of inflammation. This naturally results in a severe form of pruritis at that region. The elephants frequently try to relieve themselves of this itching sensation by rubbing those regions on hard objects usually large trees. The very nature of the nodule combined with the vigorous rubbing usually tends to more copious and continued bleeding. Besides, these wounds frequently get contaminated by bacteria deposited by visiting flies and also from the mud thrown on the body by the animals themselves, resulting in small caseating nodules. Some of these nodules become very big in course of time if no attention to treatment is paid. Such large wounds usually necessitate the affected animals being kept off work, at times even for a long time. Occasionally pathogenic bacteria like *Bacillus anthracis* may gain entry resulting in the death of the individual besides becoming dangerous to other elephants in the camp. This type of predisposition of the animal is to be more feared at than the actual verminous condition itself. Further, affected animals are always subjected to a constant worry by mosquitoes and flies. Such harried animals do not eat and rest properly and hence are bound to go down in condition gradually. Lastly, grossly affected elephants give an unkempt appearance as if no attention to grooming has been paid for a long time.

As for treatment, nothing definite can be stated at present. The usual practice is to give arsenicals. In a few animals some improvement was said to have been noticed. But the nodules were found to bleed and appear in other areas after a couple of months. The filaricidal property of arsenic with regard to haemorrhagic filariasis is yet to be

assessed. Trials with antimonials have been suggested. But even here the animals under treatment must be screened from further infection before one can know the efficacy of the drug. Research on rational therapeutic measures in non-endemic area in some of the pensioned elephants should be undertaken.

Control of this disease in these animals is a difficult problem. The nature of work the elephants are put to, means the keeping them in thick forests abounding in myriads of mosquitoes and biting flies. It is also possible for these tamed animals getting the infection from other denizens of the forests which act as reservoirs, when they go out during nights deep into the forest for grazing. This practice of leaving the animals for grazing cannot be discontinued for reasons of economy. Besides, the elephants are bathed twice a day, once in the morning and the other late in the evening. This routine naturally is not compatible to the application of insecticides. Until some rational and economic measure is found out by research, routine treatment of all the affected animals and with frequent applications of fly repellants like neem oil will go a long way in checking the incidence of this disease.

Summary

The occurence of haemorrhagic filariasis in elephants of the Forest Department of Madras State has been established.

The forest areas of Nilambur, Ooty and Wynad have been found to be endemic. Wynad is highly endemic, while Nilambur is least so.

The clinical picture of the condition is furnished in detail.

Transmission of the helminth is thought to be through the agency of a 'diptera' probably a mosquito (*Aedes sp.?*)

That the disease is caused by a filarid is proved by the recovery of a few bits of a worm from a fresh bleeding nodule and also by the presence of microfilariae in the blood oozing out.

The sequelae, treatment and control of the affection are discussed.

The clinical feature of the disease, the presence of microfilaria of unsheathed variety in the nodular blood and the recovery of a filarid from a bleeding nodule all conform to the picture of 'Parafilariasis' in bovines and equines. Hence the condition encountered in elephants is presumed to be 'Parafilariasis'.

Acknowledgments

We wish to acknowledge with thanks the interest evinced by the Director of Animal Husbandry, Madras State and the Principal, Madras Veterinary College in this investigation. Our thanks are also due to Messrs. S. Gopalan, Inspector of Livestock and P. R. Chidambaram Assistant Veterinary Inspector for their unstinted co-operation throughout the period of investigation.

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SELENIUM POISONING IN MEN AND ANIMALS

By

V. MAHADEVAN, M.A., D.SC., F.R.I.C.,
Professor of Animal Nutrition, Madras Veterinary College.

Selenium closely resembles Sulphur and Tellurium in its physical and chemical properties and is used in many industrial applications such as photoelectric cells and insecticides. But Selenium is very poisonous to men and animals, even more so than Arsenic. The " Alkali Disease," or " Blind Staggers," noticed in animals in 1857 by the army officers in the United States, remained an enigma at first and after 75 years, it was known in 1932 to be produced from Selenium contained in cereals and forage plants grown on Selenium bearing soils. This peculiar form of stock poisoning by forage has been described long ago by Marco Polo in Western China, in the 13th. century thus, " A poisonous plant growing there, which if eaten, has the effect of causing the hoofs of animals to drop off."

Selenium is the only mineral element to be absorbed from the soil by food and forage plants in sufficient amounts to make them lethal when consumed by men and animals. Thus the biological role of Selenium illustrates the importance of the closely related fourfold aspects of nutrition concerning Soils, Plants, Animals and Men. Though Selenium is present in all soils in trace amounts, certain soils derived from the Cretaceous shales in semi-arid climates, contain very large amounts of this toxic element. The distribution of Selenium in different soils is given in Table I.

TABLE I

Selenium Content of Different Soils.

Soils.		Selenium content in parts per Million.
Yellow sandy soil to grey shale soil	...	0·2 - 0·7
Silt loam	...	0·7—1·0
Clay loam	...	1—3
Shale	...	3 - 52
Chalky soil	...	8—30

Seleniferous soils, are usually found in areas of low rainfall having less than 20 inches per year and their Selenium content varies with the depth of the soil from the ground. Soils containing more than 0·5 part per million of Selenium, produce toxic vegetation. The soils, rich in iron oxide, seem to bind the Selenium in the form of insoluble basic ferric selenite and make it not available to the plants even to a small extent.

Though Selenium is toxic to many plants, some species tolerate and concentrate the poisonous element to a very high degree and use it in their normal physiological processes. Other plants, which normally contain very low amount of Selenium, seem to absorb more of this

element under adverse conditions like drought and absence of Sulphur compound in the soil. Narrow leaf milk-vetch, stanleya and golden-weed concentrate large amounts of Selenium and are highly toxic to animals. Sulphur containing plants like cabbage, onion, cauliflower, mustard, broccoli and common cereals like wheat and sunflower absorb from moderate to large quantities of Selenium in the place of Sulphur. Grasses absorb the least amount of Selenium from the soils and seem to have only a limited tolerance for it. Selenium contents of plants grown on a soil containing 2 parts per million of Selenium are given in Table II.

TABLE II

Selenium Concentration in Plants grown on soil with 2 parts per million Selenium.

Common name.	Botanical name.		Selenium conent in parts per million.
Narrowleaf milk-vetch,	*Astragalus pectinatus.*	...	4000
Stanleya,	*Stanleya pinnata.*	...	330
Goldenweed,	*Aplopappus fremontii*	...	320
Turpentine weed,	*Gutierrezia sarothrae*	...	70
Wheat,	*Triticum vulgare*	...	30
Cabbage (on selenised soil.)	*Brassica oleracca capitata*	...	758
Onion,	*Allium cepa*	...	18
Corn or Maize,	*Zea mays*	...	10
Russian-thistle,	*Salsola pestifer*	...	5
False Buffalo grass,	*Munro squarrosa.*	...	4
Blue grama,	*Bouteloua gracilis.*	...	2
Sunflower,	*Helianthus annuus.*	...	2

Leaves of wheat, grown on soils containing 30 p.p.m. of Sodium selenate, when young, contained 1120 p.p.m., of Selenium, which decreased to 220 p.p.m., of Selenium at maturity. Thus young plants contain more Selenium than plants at maturity. Plants normally high in Sulphur absorb more Selenium, than those low in Sulphur, which suggests a functional relationship between these two elements. Plants, grown on irrigated soils, contain generally lower levels of Selenium than those cultivated under dry conditions. If the plants contain more than 5 p.p.m., of Selenium, they are potentially dangerous to the stock, which pass on this element in their animal products consumed by men. The Selenium contents of animal food obtained from animals and poultry getting seleniferous plants and their products, are given in Table III.

TABLE III

Selenium Content of Animal Products used by Men.

Livestock Product.		Selenium in parts per million.
Egg	...	9·14
Meat	...	8·0
Milk	...	1·28

Wheat grain and wheat flour having more than 16 p.p.m., of Selenium, are definitely toxic to men and animals. The concentration of Selenium in wheat is known to vary from 0 to 30 p.p.m. Water, in comparison with the above foods, has only 0·33 p.p.m., of Selenium as the maximum level, which is below the toxic level. The drinking water should not contain more than 0·05 p.p.m. of Selenium according to United States Public Health Standards, (1946). Crystallisable Selenium containing amino-acids similar to cystine, have been isolated from seleniferous grains.

Human cases of poisoning by seleniferous foods have been studied in detail in the states by various workers and their observations on the symptomology of Selenium toxicosis are :

(1) Gastro-intestinal disturbances and nervous and mental disorders that often terminate in complete dementia.

(2) On exposure to the bright light of sun during summer months, skin manifestations present themselves in the form of vesiculations and actinic dermatitis. The other symptoms present become more aggravated, and it is at this time that the mortality is highest.

(3) During the fall months the skin commences to desquamate, and by winter time atrophic and pigmented areas resembling vitiligo make their appearance.

(4) A garlic—like odour or an arsenic—like odour is observed in the mouth and breath.

The proper treatment for Selenium poisoning is Sulphur rich diet and dried yeast.

The symptomology of animals, which have been poisoned by Selenium containing forage, plants and feeds, is described as follows :—

(1) Necrosis and regeneration of hepatic parenchyma with periportal fibrosis and resulting cirrhosis combined with haemorrhages and secondary inflammatory reaction of lungs and kidneys.

(2) Reduced Selenium is found in the liver and spleen, and compounds of Selenium are found in all tissues, secretions, and excretions.

(3) Cattle, sheep, horses, and pigs show erosions on the ends of the weight-bearing bones, along with hoof abnormalities which impair locomotion, malaise, anorexia, stunted growth, loss of hair, loss of weight and emaciation, impairment of reproductive power, and severe anemia to be followed by exhaustion, toxemia and death.

(4) A garlic—like odour or an arsenic—like smell is noted in the mouth, breath and vicinity of Selenium poisoned animals.

(5) Chickens show a decided impairment of fertility ; if the eggs hatch, the young do not live long, and monstrocities occur among them frequently.

For dogs 4 milligram of sodium selenite or selenate per kilogram body weight, by oral or hypodermic or rectal administration, is fatal in a few minutes.

Prevention of Selenium poisoning is carried out by keeping the animals away from areas that produce toxic plants, which is not always an easy matter. Treatment of "alkali disease," or "blind staggers," is not entirely successful unless the treatment is done in the early stages, when the damage to internal organs has not been too great. The treatment to be carried out by a competent veterinarian, consists of hypodermic injections of strychnine and drenching with warm water. Or small amounts of arsenic (12 to 15 p.p.m.) in the feed or drinking water, are also effective in treating Selenium poisoning in cattle as well as in dogs and chickens. Changing the ration of the animal to Selenium free forage and cereal products, protein rich diet and good hay will bring about good recovery in the early stages of poisoning.

As the Selenium poisoning appears to be a general problem of universal importance in food for men and animals, controlled by the biological role of Selenium in soils, plants, animals and men, strict scrutiny of foods by analysis for the presence of Selenium levels is necessary for the assurance of the health of the people and livestock in a country, especially when foods are imported in large quantities. Drought conditions and low rainfall may bring about seleniferous vegetations to affect the health of livestock and their products.

It is suggested, if mild Selenium poisoning would not be the primary cause for the loose horns or falling of horns in cattle observed commonly in South India and arid regions of North Africa, in view of the close Sulphur—Selenium biological relationship and richness of keratin in quickly growing horn in the sulphur amino-acid cystine.

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THE
Indian Veterinary Journal
(The Journal of the All-India Veterinary Association)

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Editorial

IMPROVEMENT OF INDIA'S CATTLE WEALTH

1. THE GOSAMVARDHAN WEEK

On November 4th and the week previous to it, our land was echoing the fine sentiments, given expression to by various speakers, high and low, all over the country, of bringing about an improvement in the Cattle Wealth of our land. It was the annual Gosamvardhan Week. This idea of setting apart a full week to draw pointed attention to some of the vital subjects affecting the economics of our country, is indeed a very happy one and is well suited for conditions prevailing in our land. We should not lose sight of the fact that it is essentially a propaganda week and as such there is bound to be quite a lot of display of brass band and bugle. Even so, one thing we have to guard against is, that like all propaganda, it is likely to become stale and unprofitable if we merely indulge in talk and more talk and set up a parrot-cry without tucking up our sleeves and getting down to practical work.

These Nadaswarams, beating of drums, garlands, Go-pujas etc., are good no doubt up to a limit, to draw the attention of the public. But they by themselves are not going to bring about cattle improvement. What is needed therefore is a well planned scientific approach to the problem. We would appeal to these Go-samvardhan Committees to take up some form of practical work in addition to the propaganda work they are doing now.

Within their jurisdiction, they can take each locality by turn and see that all scrub bulls in the area are castrated and that only approved bulls are made available to cattle-owners ; or that artificial insemination units are opened at convenient centres.

They should have a definite policy and programme to suit the locality and act as a liaison body between the Government and the cattle-owners. They could think out ways and means of improving the supply of cattle feeds and fodder. Their constructive proposals on all such matters must be made available to the Government and to departmental officers.

Again it was our misfortune to listen to some of the speeches made on all such occasions. One person speaks of cross-breeding as the only solution to solve our milk problem and another person condemns it by saying that we should not touch these foreign cattle even with a barge pole. A third person extends the argument a little further and says that even grading up work is not good and that only local non-descript cattle should be improved but how, he does not say. In the midst of all such confusing and conflicting ideas, the cattle-owners get puzzled and they disperse only to meet again next year and listen to such lectures!

We do not in the least under-estimate the value of propaganda. But our plea is that even that propaganda must be well planned with a scientific back ground and properly directed. Time has come when this propaganda may assume work of a practical and beneficial nature, year after year. The Gosamvardhan Committees may be entrusted with some definite work throughout the year, such as those we have indicated above and also propaganda work with regard to the care and management of calves, proper feeding of cows in milk, dry cows, work cattle, etc. They should have the necessary literature on the matter in the form of pamphlets with them, to conduct such propaganda. The speakers at meetings should be men who have made a study of the subject through such departmental pamphlets at least and not men who give expression to queer ideas and play merely on the sentiments and religious feelings of the masses. Let us face facts and be practical and make use of Science as our hand-maid for progress.

Perhaps the most neglected factor in the improvement of cattle wealth in our land is the nutritional aspect of cattle feeds and fodder. To this we shall return in our next article.

THE INTERIM INDIAN VETERINARY COUNCIL

The profession would have noted with great satisfaction the recent announcement in the newspapers of the formation of the Interim Indian Veterinary Council. We cannot be too grateful to the Government of India and the Animal Husbandry Commissioner for the very helpful attitude they had adopted in bringing into existence, this Institution. We have no hesitation in stating that it is a major step taken by the Government of India in recent years to give the necessary fillip to the progress of Veterinary Science in this land.

For very nearly 30 years now, the profession has been clamouring from time to time for this piece of reform, through the All-India Veterinary Association and through the pages of this *Journal*. At long last, our cry has been heard and the Indian Veterinary Council is an accomplished fact to-day. The part played by the All-India Veterinary Association to bring about this happy consummation cannot be over-estimated and none toiled so hard as its late General Secretary Rao Bahadur R. Swaminatha Ayyar. It is an irony of fate that he is not in flesh and blood to-day to see the fruition of his labours. What then is the next step? We expect that before long, the Interim Council will get into its stride and give the necessary lead in the matter. Even so, it is up to the members of the profession to be up and doing and not to rest on their oars. They should persuade their respective State Governments to undertake legislation immediately on the model of the U. P. Veterinary Council Act of 1947, a copy of which had already been supplied to them by the Central Government and thus set up a State Veterinary Council.

And all those States where no Veterinary Association exists to-day would do well to organise one and get it affiliated to the All-India Veterinary Association. That would entitle them for representation on the Indian Veterinary Council. Some of the existing Veterinary Associations require to be re-vitalised and work more effectively.

We had already published in the pages of this *Journal* the functions of this Indian Veterinary Counil. Each Association will be asked to elect a representative to serve on this Council. It is well to remember that the claims of only men with experience, capacity, moderation, tact and patience should be considered and the best amongst them chosen. No personal factors of any kind should come in the way of such selection. The interest of the profession should weigh supreme with all concerned. A stage has been reached when the profession as a whole should act as a disciplined body and pull its weight together.

In the light of this recent development, the coming session of the All-India Veterinary Conference in Madras assumes an added significance. We appeal to one and all to muster strong on the occasion and give the benefit of their advice and guidance.

THE GOLDEN JUBILEE

FIFTY YEARS in the life of an individual or an Institution, is indeed a matter for gratification, more particularly when that period has been spent in the service of the humanity at large. It is to this high category of enviable existence, that the Madras Veterinary College has qualified itself now. It is not without reason that such important landmarks in one's life have duly been celebrated all over the world ever since the dawn of history. These celebrations serve as an occasion for thanks-giving to the Power that rules the world and for introspection and future planning.

It is therefore pleasing to note that the authorities in Madras, from Government downwards, have fully realised the importance of the occasion and are determined to celebrate it on a fitting scale. Judging from the enthusiasm of the head of the Animal Husbandry Department in Madras, the Principal of the Madras Veterinary College and their staff, the function promises to be a great success, worthy of an Institution that occupies an honoured place in the history of Veterinary Science in this country. What is now required is the hearty and unstinted support of all Veterinarians in this country and elsewhere.

The occasion is to be made all the more happy, by the presence of a person who occupies a unique position in the affairs of the world and who stands on a pinnacle all his own. It is the Prime Minister of India, Pandit Jawharlal Nehru, who has consented to inaugurate the celebrations. He has honoured us and honoured the entire Veterinary profession in the world, by this graceful gesture in the midst of his international commitments.

We appeal more particularly to every Veterinarian in this land to realise the importance of this unique occasion and co-operate whole-heartedly with the Reception Committee and make the function a historic success. Money, no doubt, we want; but more than money, we would welcome delegates from all over the land. There is to be an All-India Veterinary Conference and a Provincial Veterinary Conference in conjunction with these celebrations. That is again an additional reason why members of the profession should muster strong on the occasion. To our North Indian friends we say, the month of January is ideal to visit also places of interest in the South — the home of great temples and architecture.

We invite the attention of our readers to an appeal issued in this connection by the President of the Golden Jubilee Celebration Committee published in this issue. We wish the function all success!

PASU SAMPADA

We welcome into the field of Veterinary Journalism, ***Pasu Sampada***, a Telugu bi-monthly published by the Andhra Animal Husbandry Association. We congratulate our friends in the infant State of Andhra, on their resourcefulness and courage. We only know too well the hazards of Veterinary Journalism in India and can well appreciate the amount of effort put in behind this new venture. But it is the pioneering spirit in a new field that overcomes all obstacles in the service of one's own land. Being in the regional language of the newly born State, the Journal is bound to have a wide circulation and considerable patronage.

May the Journal prosper and render utmost service in the cause of Veterinary Science in our land!

THE OLD BOYS' ASSOCIATIONS

We have had suggestions put before us of starting Old Boys' Associations for some of the Veterinary Colleges in India. Such Associations are common no doubt with regard to Arts Colleges; but we doubt much as to their utility where professional Colleges are concerned.

Each profession has a Scientific Association of its own, where both the new and the old boys meet like members of the same family and exchange ideas, experience and knowledge. The social aspect is not forgotten at such meetings and the *esprit-de-corps* is fully kept up. It is the common *Alma-mater* that draws all these men together and act as a common meeting ground. No body is going to prevent the old meeting the old also at such meetings and indulging in reminicenses of their own.

Such Associations are not possible in Arts Colleges and hence they have taken recourse to Old Boys' Associations. Further such water-tight compartments within a profession may not be conducive to unity and advancement, not to speak of financial strain on the members of the profession, in subscribing for several such Associations in these hard days.

In a profession like ours, the new and the old must meet more often than now. We want the latest from the new and the accumulated wisdom from the old. Let us therefore march together. There is nothing to gain in starting Old Boys' Associations within our profession and we therefore appeal to all those who entertain this idea to bestow enough thought over this question before they take a leap in the dark.

MADRAS VETERINARY COLLEGE GOLDEN JUBILEE CELEBRATIONS

APPEAL

The Madras Veterinary College has just completed fifty years of existence and it has been decided to celebrate the Golden Jubilee in January next. A Cattle and Poultry Show, an Exhibition, and the College Day and Sports will form an integral part of the celebrations. It is also proposed to bring out a Jubilee Commemoration volume of the College Magazine. I have no doubt that all old students and the public will rally round on this occasion to make the Jubilee a success.

A lavish programme of meetings and entertainments is being organized and it is the earnest desire of many *alumni* that advantage should be taken of this occasion to institute some prizes and medals available to students of the College who pass with distinction. I am sure that as an old student, or well-wisher of the Veterinary profession, you will approve of this laudable objective and signify your approval by sending in a generous contribution.

Donations may be sent by cheque or postal order drawn in favour of the Principal, Madras Veterinary College, Vepery, Madras 7.

A Reception Committee is to be formed for the occasion. Donors contributing not less than Rs. 20/- will be enrolled as members of the Committee.

V. R. RAJAGOPALAN,
Director of Animal Husbandry, Madras,
and
President, Madras Veterinary College
Golden Jubilee Celebrations.

Madras-5,
5th Nov. 1954.

THE TWELFTH ALL-INDIA VETERINARY CONFERENCE

The Madras Veterinary Association has invited the All-India Veterinary Conference to hold its next session in Madras on 18th January 1955, in conjunction with the Golden Jubilee Celebrations of that great institution. It is a unique occasion and Madras like Bombay, has done well to extend the invitation to all the Veterinary Surgeons of the land, through this graceful act. I am sure the response will be equally graceful and a big contingent of delegates will honour Madras, which has been

serving the cause of the profession so well and so long. Further Madras Veterinary College is a name to conjure with and it is one of the pioneer Veterinary institutions whose *alumni* have distinguished themselves in several fields of activities and have brought nothing but glory to their *Alma-Mater*. Let us therefore honour her without reserve.

There is one other reason which compels attention. The Prime Minister of India, Pandit Jawharlal Nehru, is to inaugurate the Golden Jubilee Celebrations. What better incentive can the profession have to attend this memorable session!

The name of the President of the Conference will be announced in all the newspapers in due course and all the affiliated branches of the All-India Veterinary Association will also be informed separately.

T. VINAYAKA MUDALIAR,
General Secretary,
The All-India Veterinary Association.

5-B, St. John's Road,
Bangalore-1.
20th November, 1954.

J. T. EDWARDS MEMORIAL FUND APPEAL

The *Veterinary Record* of the 18th September 1954 has issued an appeal for funds to perpetuate the memory of Dr. J. T. Edwards, who was the Director of the Indian Veterinary Research Institute at Mukteswar from 1921 to 1929. We should think this appeal was long over-due. But better late than never.

Let our professional posterity remember "the name of this great colleague and recognise in some measure the work he did". If to-day the effective immunisation of cattle against Rinderpest is a practical proposition in India and people have gone to the extent of thinking in terms of its complete eradication, the one man who laid the foundation for this achievement was undoubtedly Dr. J. T. Edwards. He was an inspired scientist who knew not the artificial barriers of geography, race or colour. India has cause to remember him in much greater measure than any other country. We wish the

Government of India sends in a substantial contribution to this Memorial Fund.

Poignant indeed are the words of a friend of his, who said "No man I have ever known has done so much of value and received so little in return". But they are true.

The contributions are to be sent to:—

D. B. DAVIES ESQ., M.R.C.V.S.,
Ministry of Agriculture, Lyric Buildings,
Carmarthen, England.

Notes and News

Pandit Jawaharlal Nehru laid the foundation-stone of yet another Agricultural College called the Birla College of Agriculture at Haringhata, 32 miles from Calcutta. Mr. G. D. Birla had donated 20 lakhs to the State Government for the construction and establishment of this College. As long as there are such philanthropists in our midst, India has no cause for despair.

* * * *

Speaking on the occasion Mr. Nehru said that it was strange that in countries where cow-worship did not exist, cattle were better looked after than in India. He opined that the agitation for cow-protection in this country, had a "political motive" behind it and as such should be opposed and he added that there were other methods for improvement of cattle. It is on those "other methods"—scientific and universally adopted—that we lay stress in our editorial on "Improvement of India's Cattle Wealth" in this issue.

* * * *

Dr. Rajendra Prasad, our President, in his broadcast talk on 'Gosamvardhan' day also said "We must not forget that mere sentiment however deep, is not going to be of much help. For improving the cattle wealth of the country, we have to adopt measures so that rearing of cattle becomes economically a sound proposition". Wise words indeed fit to be written in letters of gold.

* * * *

Sir Hugh Foot, Governor of Jamaica, said recently that a new breed of cattle had been produced in the Colony which may end the fresh milk shortage in the tropics. "It is called "Jamaica Hope" and is a

cross between the Jersey with its milk-yielding qualities and the heat-resisting Brahma from India" he said. "After 50 years of experiment it is now an established breed and will thrive any where in the tropics". All honour to Jamaica!

* * * *

We wish India evolves some such breed and calls it "Bharat Matha" or "Khamadenu". When such a type is evolved, fixed and made to breed true, it will be a worthy contribution befitting this great country.

* * * *

Kashmir with its intensive cold climate is perhaps well suited for an European breed of cattle. We read in the newspapers that "a special breed of cattle were imported from Ireland for a cattle development sheme of the Kashmir Government". They are "short-legged black cattle five cows and two bulls from the home country—six cows died on the way". Perhaps they are the Irish Kerry breed of cattle. We will watch this experiment with great interest. We wish Kashmir the best of luck!

* * * *

The Government of India's Pilot Project of a field campaign to eradicate Rinderpest from this country is to start from January 1st, 1955. A sum of Rs. 15·7 lakhs has been provided in the First Five Year Plan. At the initial phase, the scheme aims at the mass vaccination of about 10 million cattle with a newly-evolved freeze-dried vaccine to be flown from the Indian Veterinary Research Institute, Izatnagar. An FAO expert has been assigned to the Institute for this purpose. It is a gigantic organisational scheme where every limb has to be on the alert and act with honesty of purpose. We have not the least doubt that this great team of workers will acquit themselves creditably and well. We wish them all success!

* * * *

We take the following from the *Indian Express* dated 3rd November 1954.

"The Animal Diseases and Pests Committee of the Indian Council of Agricultural Research, which met at New Delhi recently, approved of a scheme for launching a pilot project for the control of rabies in a suitable town in the country.

The object of the scheme is to find out how far the measures commonly taken, viz. control of pariah dogs and registration and vaccination of pet dogs, can be practically applied in this country for the control of this dreaded disease.

The scheme will be jointly financed by the Union Ministry of Health, the Indian Council of Medical Research and the I.C.A.R.

We do not know which town has been selected for the purpose. Anyhow it is a scheme which has been long overdue. The results will be watched with interest.

* * * * *

D. T. Parnaik, G.B.V.C., Professor of Bactoriology, Bombay Veterinary College, has left for United Kingdom for taking Diploma in Bacteriology at Manchester University.

THE INTERIM INDIAN VETERINARY COUNCIL

GOVERNMENT OF INDIA
MINISTRY OF FOOD AND AGRICULTURE (I.C.A.R.)
JAMNAGAR HOUSE HUTMENTS, NEW DELHI

No. F. 26 (1)/54/A.H., dated the 29th October 1954.

Resolution

The need for setting up a central organization with legislative backing for controlling and regulating veterinary practice and the conduct of members of the veterinary profession in India, for effecting liaison between the profession and the Government, and for taking up other cognate functions—more or less on the lines of similar statutory organizations existing for the allied professions of medicine and dentistry—has been repeatedly urged by representative bodies of the veterinary profession as well as advisory bodies of the Government of India like the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India. The International Veterinary Congress (London, 1949) also recommended the establishment in each country of a National Veterinary Committee to effect liaison between the country and the Permanent Committee of the Congress.

These matters were discussed in December 1951 at the joint meeting of the All-India Veterinary Association and the Bombay Veterinary Medical Association. The Union Minister for Food and Agriculture, who presided over that meeting, appointed a Steering Committee to go into the question of establishing the National Veterinary Council. The Steering Committee, composed of official as well as non-official representatives of the veterinary profession, met at Bangalore made the following recommendations:—

Recommendations of the Steering Committee

(1) State Veterinary Councils should be set up by legislation in the States on the model of the U.P. Veterinary Council Act, 1947.

(2) A Statutory National Veterinary Council should be set up in due course by providing representation on this body from the State Councils and by nominations by the Central Government with the following objectives :—

(*a*) To provide a statutory organization representing the veterinary profession to serve as a liaison body between Government and the veterinary profession and between the Government of India and the International Veterinary Congress ;

(*b*) To control and regulate the practice of the profession and the conduct of its members and to uphold the status and dignity of the profession ;

(*c*) To arrange for reciprocity of recognition of the various veterinary qualifications in inter-state and international circles and also in the Indian army ;

(*d*) To maintain a recognised Register of Veterinary Practitioners in the country to remove handicaps to the profession such as (i) non-recognition of the graduates of Indian Veterinary Colleges by Turf Clubs, Livestock Insurance Companies, Chemists, Druggists, etc., (ii) non-recognition of these graduates to give evidence as an expert under Section 45 of the Indian Evidence Act on any matter relating to Veterinary Science ;

(*e*) To remove the difficulty experienced at present by the public to distinguish between a qualified and an unqualified veterinary practitioner.

As it will take time for the States to pass legislation on the lines mentioned above, the Steering Committee had further recommended that—

A. An *Interim* Indian Veterinary Council should be set up without legislative backing consisting of members nominated by the States, and the Union Government with the following functions and objectives .—

(i) To serve as a liaison body between Governments and the Veterinary Profession.

(ii) To help in the formation of State Veterinary Councils in all the States in the Indian Union till such time as the statutory councils have been formed.

(iii) To advise the Central and State Governments on all matters concerning the veterinary profession.

B. Till the Interim Veterinary Council is brought into being, the Steering Committee should continue to function as an advisory body to Government on veterinary matters.

These recommendations of the Steering Committee have been accepted by the Government of India and have also been forwarded to the State Governments for suitable action. The Government of India have in the first instance decided to set up an *Interim Indian Veterinary Council* in accordance with the recommendations of the Steering Committee.

The constitution etc. of the Interim Indian Veterinary Council will be as follows :—

Constitution

1. Members representing the Government of India :—

(*a*) The Animal Husbandry Commissioner with the Government of India.

(*b*) The Director, Indian Veterinary Research Institute.

2. Members representing the constituent States in the Indian Union nominated by the State Governments :—

(*a*) One official representative of the profession.

(*b*) One representative of the Veterinary Association nominated by the State Government in consultation with the Association of each State wherever it exists.

3. Not more than two members nominated by the Central Government representing Veterinary profession, including Veterinary Journalism, retired Veterinary Practitioners and private practitioners.

The personnel of the first Interim Council as constituted above is given in Annexure 1.

Chairman :—The Animal Husbandry Commissioner with the Government of India will be the Chairman for the first five years or till such time as the Statutory Councils come into being.

Terms of Office :—The term of the office of the members of the Council will be five years or till such time as a Statutory Council is set up. The official members will hold office so long as they hold official positions by virtue of which they hold membership of the Council. If, for any reason, a member vacates office before the expiry of the full term, the vacancy will be filled by nomination of another member for the balance of the period.

The Council shall meet once a year at such place and time as may be decided by the Chairman of the Council with the approval of the Central Government.

Executive Committee :—In order to transact urgent business that might arise in between Council meetings, an Executive Committee of the Council, styled the National Veterinary Committee, may be appointed with the Chairman of the Council as the Chairman, and 4 additional members consisting of :—

(*i*) a nominee of the Central Government ;

(*ii*) two representatives of the State Governments, and

(*iii*) one veterinary non-official representative, all the four members to be elected from among the members of the Council.

Functions and Objectives :—Functions and objectives of the Interim Council till such time as a Statutory Council comes into being will be as follows :—

(1) To serve as a liaison body between Government and the Veterinary Profession and between Government of India and the International Veterinary Congress.

(2) To help in the formation of State Veterinary Councils in all the States till such time as the Statutory Councils have been formed.

(3) To advise the Central and State Governments on all matters concerning the Veterinary Profession.

(4) To maintain a recognised register of Veterinary Practitioners in the country.

The recommendations of the Council will be made by the Council through its Chairman to the Central Government and through the Central Government to the State Governments.

The National Council will be attached to the Ministry of Food and Agriculture (I.C.A.R.), and the Secretary of the National Council will be an official of that Ministry nominated by the Minister for Food and Agriculture.

K. R. DAMLE, I.C.S.,
Additional Secretary to the Government of India.

ANNEXURE I

Members of the first Interim Council.

I. Representatives of the Government of India.

1. The Animal Husbandry Commissioner with the Government of India—Chairman, (*ex-officio*).
2. The Director, Indian Veterinary Research Institute, (*ex-officio*).
3. The Assistant Animal Husbandry Commissioner with the Government of India. } *Nominated by the Government*
4. Shri V. R. Phadke, G.B.V.C., President, Bombay Medical Veterinary Association, Poona. } *Nominated by the Government*

II. Representatives of the States of the Indian Union.

(a) One official representative of the profession.

plus

(b) One representative of the Veterinary Association of each State where it exists.

1.	BIHAR :	(a) Shri M. I. Malik, Director of Animal Husbandry, Bihar, Patna.
		(b) Dr. R. B. Prasad, Professor of Pathology and Bacteriology, Bihar Veterinary College, Patna.
2.	BOMBAY :	(a) Shri S. R. Chadha, Director of Veterinary Services, Bombay State, Poona.
		(b) Dr. C. S. Balakrishnan, Secretary, Bombay Veterinary Medical Association, Poona.
3.	MADHYA PRADESH :	(a) Shri M. Y. Mangrulkar, Principal Veterinary College, Jabalpur.
4.	MADRAS :	(a) The Director of Animal Husbandry, Madras.
		(b) The President, Madras Veterinary Association, Madras.
5.	PUNJAB :	(a) Shri B. N. Handa, Director of Veterinary Services & Warden of Fisheries, Punjab, Simla.
6.	U. P. :	(a) Shri B. N. S. Chowdhry, Deputy Director of Animal Husbandry, Lucknow.
7.	WEST BENGAL :	(a) Dr. S. Datta, Director of Veterinary Services and Animal Husbandry, West Bengal, Calcutta.
8.	HYDERABAD :	(a) Dr. K. S. Shetty, Director of Veterinary Department, Hyderabad-Deccan.
		(b) Dr. B. Madhava Rao, Technical Assistant to the Director of Veterinary Department, Hyderabad-Deccan.
9.	JAMMU & KASHMIR :	(a) The Director of Veterinary Department, Jammu and Kashmir State, Srinagar.
10.	MADHYA BHARAT :	(a) Shri H. K. Mehra, Director of Veterinary and Animal Husbandry Services, Madhya Bharat, Gwalior.
11.	MYSORE :	(a) The Director of Animal Husbandry, Mysore, Bangalore.
		(b) Dr. R. D. Nanjiah, Mastitis Investigation Officer, Bangalore.
12.	PEPSU :	(a) The Director of Veterinary Services, Pepsu, Nabha.
13.	RAJASTHAN :	(a) Dr. G. S. Rathore, Deputy Director of Agriculture (Veterinary), Rajasthan, Jodhpur.

14.	TRAVANCORE-COCHIN :	(a) Shri V. K. Madhava Menon, Director of Animal Husbandry, Travancore-Cochin, Trivandrum. (b) Shri V. Padmanabhan, Assistant Project Officer, Neyyatinkara, Travancore-Cochin State.
15.	SAURASHTRA :	(a) Shri K. B. Vyas, District Veterinary Officer, Saurashtra, Junagadh.
16.	AJMER :	(a) Shri D. P. Shukla, Director of Animal Husbandry, Ajmer.
17.	COORG :	(a) The Chief Veterinary Officer, Coorg, Mercara.
18.	HIMACHAL PRADESH :	(a) Shri J. N. Saini, Animal Husbandry Officer, Himachal Pradesh, Simla-4.
19.	KUTCH :	(a) Shri U. K. Asnani, Animal Husbandry Officer, Kutch. Bhuj.
20.	VINDHYA PRADESH :	(a) Shri N. G. Iyengar, Chief Animal Husbandry Officer and Director of Fisheries, Vindhya Pradesh, Rewa.
21.	BHOPAL :	(a) Shri Gurdev Singh, Animal Husbandry Officer, Bhopal.

Clinical Articles

VASECTOMY AND OVARIECTOMY IN THE BUFFALO

By

I. N. Mahmoud and E. S. E. Hafez,

Faculty of Agriculture University of Cairo, Egypt.

Introduction

Modern developments in the field of experimental physiology are often achieved after successful removal of specified organs of the living animal. A great deal of our knowledge of the reproductive physiology arises from a study of gonadal alteration. In the male, vasectomy destroys the germinal epithelium of the testis and increases the number of interstitial cells (STEINACH, 1920). In rodents, however, vasectomy does not preclude the proliferation of mature germ cells (MOORE, 1939). The presence of mature spermatozoa in homo-transplanted testes many months after insertion into the anterior chamber of the eye is evidence that sperm proliferation is not dependent upon patent excurrent duct. Even the congenital absence of the ductus deferens in the guinea-pig does not prevent spermatogenesis. At one time it was claimed that the increased interstitial cells yield an increased output of male sex hormone and this accounted for the restored vigour in the vasectomized senescent. However, it is known that such is not the case. In the vesectomized rabbit, the tail of the epididymis may become so distended by spermatozoa that the testis is pushed into the inguinal canal and out of the scrotum (TURNER, 1949).

In the female, ovariectomy has been performed to solve many problems in reproductive and lactational physiology. The effect of ovarian hormones on the fluctuation of the cellular content of the vaginal smear has been worked out on ovariectomized cows by HAZEL *et al* (1949). The levels of ovarian hormones required to induce oestrus and related phenomena have been determined on ovariectomized cows (ASDELL *et al.*, 1945). Oestrogen administration to spayed heifers causes the development of the udder capable of secreting milk (WALKER & STANELY, 1940, 1941), demonstrating the non-essentiality of luteal influence.

Experimental Material

The present work was an attempt to establish the technique necessary for ovariectomy in the buffalo so as to use the operated animals for experimentation.

A buffalo-bull aged 18 months and a virgin buffalo-heifor of three years of age were kept at the Animal Breeding Research Farm, Cairo,

Egypt. They were in a good condition and free from infectious diseases. The buffalo-bull did not show sexual libido whilst the size of testis was normal. The buffalo-heifer was showing normal oestrous cycles (every 21 days) but did not conceive when mated.

Surgical

1. *Vasectomy* :—The buffalo-bull was kept off feed for 24 hours and injected subcutaneously with a 4 ml. dose of "Coletyl" to unload the stomach (through stimulating the parasympathetic system). It was then cast on straw bedding, the left side being upward with the left hind limb drawn forward. Anavenol "K" anaesthesia was given slowly intravenously. It was given in three successive portions of 50, 25 and 25 ml. to prolong the anaesthetic period. The site chosen for the operation was the spermatic cord two inches above the top of the testis. The scrotum was cleaned, disinfected and swabbed with mercurochrome solution. The instruments prepared for the operation were previously sterilized. A two inch incision was carefully made through the skin and the subcutaneous tissues exposing about one inch of the spermatic cord. Since the anterior part of the cord was composed of a rich supply of blood vessels, lymphatics and nerves, the vas deferens was carefully separated and a curved needle with a handle was kept underneath. Meanwhile the rest of the vas deferens was not dissected out from the other constituents of the cord. Consequently the testes were not deprived of their normal vascular and nerve supplies. Two ligatures were made to the vas deferens, one and a half centimeters apart. One centimeter of the vas deferens between the two ligatures, was then excised. The operation wound was *soaked* with penicillin solution containing one million units. The inner membranes as well as the skin were sutured and the skin was smeared with tincture of iodine. The same was done with the other vas deferens. The routine measure of anti-tetanic serum was given. The animal was untied and was up on his legs after a few minutes.

2. *Ovariectomy* :—The buffalo-heifer was kept on a *regime* feed for four days. In each of these days, it was injected subcutaneously with 4 c.c. of "Coletyl" to unload the stomach. On each of these four days it was also injected with 500 c.c. of 10% glucose (in saline) and 200 mg. of vitamin K, "K—thrombyl". One day before the operation it was given a purge of Magnesium sulphate and Sodium chloride, 250 gm. of each in a sufficient quantity of water.

For operation, the animal was placed on its right side on a soft bed. The operation was carried out on the left side since the right side is occupied by the large bowel (O'CONNOR, 1941). Three legs were tied together while the left hind was drawn backwards by an assistant. General anaesthesia was induced by an intravenous injection of 150 c.c. "Anavenol—K". An area of about 400 cm.² was shaved in front of the external angle of the ileum and extending downwards. This area was cleaned, all aseptic and antiseptic precautions being taken. The seat of the operation was covered with a sterile piece of cloth having a slit in the middle. When the animal was completely under anaesthesia, an incision was made in the skin extending in front of the external angle of the ileum, downwards for about 6 to 7 inches. The skin thickness was about half an inch. The abdominal muscles were also incised in the same direction dividing the internal abdominal oblique in the direction of its fibres to help in healing. Haemorrhage was very little; a few cutaneous blood vessels were compressed by artery forceps. Puncture of the peritoneum was made with the finger and was then enlarged to admit the hand.

Rectal manipultation of the genitalia was made by an assistant to push the ovaries near the incision which helped the operator to grasp them. The left ovary was then grasped and tied a little below with catgut. With the help of an ecraseur the ovary was removed. From the same wound the procedure was repeated with the right ovary. The two ovaries were taken for serial sections.

Two million I.U. of penicillin in solution were sprayed internally at the seat of operation. The peritoneum and muscles were sutured and soaked with a 20% sulphanilamide solution. The skin was then sutured, painted with Tr. of Iodine and sealed with collodion. The buffalo was untied and recovery from anaesthesia took place within two hours of the commencement of the operation. It was then injected with 800,000 I.U. penicillin solution, 20 c.c. of antitetanic serum containing 1500 I.U. and 5 c.c. of "Leepticin", the last being a heart stimulant. Penicillin was continued for four successive days. The animal was kept on a soft diet of green fodder. Recovery took place within a fortnight.

Discussion

While there is no acceptable evidence that vasectomy is capable of restoring physiological vigour, it is an effective means of sterilization when executed properly. It must be noted here that vasectomy with poor surgical technique may lead to degenerative changes in the testis as a consequence of ischemia and denervation. Surgical injuries may be responsible for the formation of scar tissue in the scrotal wall which would prevent the scrotum from maintaining temperatures low enough for normal testicular function. It is not yet known how far spermatogenesis would proceed in the buffalo-bull after vasectomy. In the rabbit, for instance, the spermatozoa are present in both the epididymis

and the testis, six months after vasectomy. The vasectomized buffalo-bull will be used as a teaser to detect oestrus in non-pregnant buffalo-cows. It is of use to determine the age of puberty, the breeding season and post-partum oestrus in the female.

Work is still in progress in the ovariectomized buffalo. Subsequent research work will follow so as to understand the rôle of ovarian hormones in certain problems of reproductive and lactational endocrinology in the buffalo. It must be emphasized here that the removal of the ovaries does not exclude the extra-ovarian hormones. The chemical and physiological similarity of the steroid compounds derived from the adrenal cortex and the ovary is striking (SELYE, 1942). Any results on ovariectomized animals must be carefully interpreted. Meanwhile, the urine collected from the ovariectomized buffalo will serve as a blank for determining urine oestrogens in this species. A new chemical technique is now being developed in this respect (HAFEZ and ATTAR, 1954).

Thanks are due to Prof. A. L. Badreldin, Chairman of the Animal Breeding Department, Faculty of Agriculture, Cairo, for providing facilities.

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A CASE OF CALCULI IN A GROUND TORTOISE IN LARGE INTESTINES

By

D. S. LAUD, G.B.V.C., F.Z.S., F.R.H.S.,

Zoo Adviser, Peshwa Park Zoo Garden, Poona Municipal Corporation.

The Ground tortoise was an inmate of the Peshwa Park Zoo Garden in Poona for a long time. It came from the Victoria Garden Zoo, Bombay. It was blind in both the eyes.

Along with the Elephant (Big) tortoise, the ground tortoise is fed on biscuits, bread, plantains, green bhaji, and chopped green grass. The animal was alright till the time of its death which took place all on a sudden on the morning of the 9th Sept. 1954.

An autopsy was held on the carcass. Its hard shield in the upper surface of the body was removed. All the internal organs were exposed and these were examined in detail. The tongue, the pharynx, larynx bronchi were clear of all abnormalities; so also the heart, stomach, liver, spleen. But in the large intestines, there were found three calculi, one small and two big ones in a direct line blocking the intestinal tracts which caused the death of the tortoise. It may be mentioned that the

kidneys and the bladder which are the sources of affection of this kind, were free from all abnormalities.

One of the calculi smaller in size was sent to the Disease Investigation Officer, Boat Club, Poona for examination. His report is as follows :—

" With reference to your letter No. 450988 dated the 9th inst. I would like to inform you that the calculus sent by you per bearer was examined and was found to be composed of Calcium Carbonate ".

No weight of the Calculus sent to the Disease Investigation Officer was taken, but the other two calculi were weighed and each was found to weigh 4 ounces.

No evidence of their presence in the animal body was noticed when the animal was alive nor any surgical operation possible on account of the hard shield covering the body of the tortoise.

I am recording this case for the benefit of the readers of the *Journal* and send you the copy of the photograph of the specimen of the calculus, which has been sent to the Department of Pathology in the Bombay Veterinary College, Parel, Bombay, while the third specimen of the calculi is kept in the Peshwa Park Zoo Garden in Poona.

I am indebted to Dr. Manjrekar, G.B.V.C., Ph.D. (Poona) the Assistant Disease Investigation Officer for kindly examining the specimen and reporting on its contents.

URETHRAL CALCULI IN GOAT

By

MD. IFTAKHAR HUSSAIN, G.B.V.C.

Department of Animal Husbandry, East Bengal.

A large number of deaths have been noticed in cattle in the different parts of the country as the exact location of the calculi in bovine species is difficult to locate due to the sigmoid flexure of penis and small calibre of urethra. It is easier to find the location in the animal other than the bovine with the help of catheter and such cases are cured in horses and dogs.

Medicinal treatment has been successful in cases where the disease has been diagnosed at the early stage i.e. when the solid starts depositing. But it is very difficult to diagnose the case in early stage as the deposit starts slowly and the other symptoms are same as in other urinary diseases. The affect is marked only when the passage is blocked considerably so that the flow of urine completely stops. Due to this reason patients are brought for treatment, when the passage is completely blocked and the animal is exhausted. Experience in hospital practice shows that cent percent cases brought for treatment in the last stage die due to lack of knowledge about the exact

location of the calculi in goat. The author conducted a series of post mortems at different times and also tried to cure the animals by surgical technique evolved by the experience gained by post mortem examination. The result achieved were highly successful and the present contribution gives a surgical technique for the treatment of the disease.

Anatomy of the Penis

This resembles in general that of a bull (Fig. I). The only peculiarity is in the terminal end of it, in which urethra ends into a process (Fig. II). The urethra lies in a groove in ventral portion of the corpus cavernosum, its terminal end terminates an inch and half beyond the glans penis forming processus urethrae.

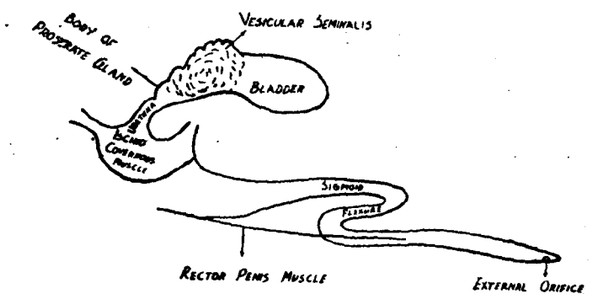

FIG. I GENERAL VIEW OF GENITAL ORGAN OF BULL.

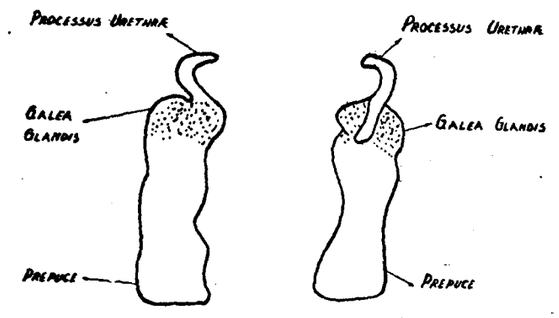

FIG. II. ANTERIOR PORTION OF THE PENIS OF RAM.

TABLE I

SEAT OF STONE

Cases met in Hospital practice with a complaint of urine retention and which died due to failure of treatment, were postmortomed and examined to find out the seat of stone; results are given in the table below:

Srl. No.	Date	Breed	Colour	Aproximate age.	Wheather attended before death	Condition of Animal	Location of stone	Remarks
1	6— 9—49	Country	Gray	1½ years	Yes	Healthy	Processus urethrae	Two stones have been found.
2	21— 9—49	do.	Black & White Patches	9 Months	No	do.	do.	
3	24— 9—49	do.	Gray	1 Year	No	do.	do.	
4	4— 4—50	do.	Black	1 Year 10 Months	Yes	do.	Not found	The whole urethra and kidney was searched but no stone was found. There was torsion of processus urethrae.
5	6— 7—50	Jamuna Pari	Red	7 Months	Yes	do.	Processus urethrae	
6	3— 8—50	C. B.	Black	10 Months	Yes	do.	do.	
7	6— 8—50	C. B.	Black	1 Year	Yes	do.	do.	
8	9—10—50	C. B.	Red & White Patches	9 Months	No	do.	do.	
9	12— 3—51	C. B.	Red	2 Years	Yes	do.	do.	Three stones in urethra and several in kidney were found.
10	27— 6—51	C. B.	White & black hairs mixed.	1 Year	No	do.	do.	
11	2— 8—51	C. B.	Black	8 Months	No	do.	do.	

In ten cases the location was found in the processus urethrae while in one there was no trace of stone upto the kidney and in this case the retention of urine was due to torsion of urethra at the processus urethrae.

Surgical technique.—With the location of the seat of stone the following technique for locating the stone and removing it from the live animal was successful in 25 cases out of 27 cases. In 2 cases the animals died as they were practically exhausted when brought for treatment.

The technique can be put under three heads :—

(*a*) Examination of the case and necessary precautionary measures in operation.

(*b*) Actual surgical process.

(*c*) After treatment of the case.

(A) Examination of the patient

(1) 100 c.c. and 50 c.c. of N.S.S. were injected to the animal exhausted and normal respectively.

(2) Some chloral hydras in narcotic dose was given to make the animal unconscious.

(3) Bladder was examined and in case it was distended with urine the bladder was emptied before starting the operation by rectal puncture to avoid the chance of rupturing the bladder.

(4) Hairs were Clipped round the sheath and washed with soap and water.

(5) The animal was kept in dorsal position, the back portion being raised ¼th foot than the head. This was done by putting some straw below the hind quarter, the legs and head were controlled by the attendants. In this manner some fold of skin occurred at the sheath. Folded skin was caught and drawn back and then by pushing the penis at the sigmoid flexure the anterior portion of the penis was exposed the penis was thoroughly cleaned with soap and warm water and then washed with N.S.S.

(6) Ethyle chloride was sprayed to anaesthetise the part.

(B) Actual surgical process

The processus urethrae was caught with a sterilised forceps and the presence of stone was examinied by sterilised hand and fingers. The stone was felt at the top of processus urethrae. At this stage two methods were followed.

(1) In the first a longitudinal incision was made from anterior to posterior end about ¼th of an inch, exposing the stone and then by the help of forceps it was gently removed. Sometimes more than one stone were found one after another ; in those cases all stones were removed by

the same opening by pushing the stone from its place to the opening by the help of fingers. The incised urethra should not be sutured as there is chance of its stricture.

(2) Secondly it was tried to remove the stone without making any incision. The stone was felt by thumb and fingers and then pressing and pushing the stone towards the external urethral orifice and with the help of left and right torsion the stone was removed.

As soon as stone was removed the urine came out with a jet.

(c) *After treatment*:—In case of incision method there was a chance of infection because urine continiously passes through it. In those cases penicillin treatment was adopted for preventing the infection. Total units given were 5 lakhs which prevented the infection. Then the animals were allowed to urinate. To enhance the passage of urine a gentle pressure was given by thumb from either side of the pelvic cavity. Sufficient water was given to the animal to increase the quantity of urine. The nitrogenous diet was stopped for one to two days.

Summary

(1) The seat of stone in urethral calculi in goat has been noted to be processus urethrae.

(2) Either by making incision at the seat of stone (i.e. processus urethrae) or by careful use of fingers the stones were removed.

(3) Goats suffering from this disease were successfully cured in almost all cases.

Association News

THE MADRAS VETERINARY ASSOCIATION

Minutes of the Managing Committee Meeting held at the Madras Veterinary College on 8-11-1954.

Members present:

1. Sri P. Sreenivasa Rao
2. ,, Bertie A. D'Souza
3. ,, M. N. Menon
4. ,, M. S. Ganapathy
5. ,, V. S. Alwar
6. ,, A. R. Vedanayakam
7. ,, M. Ranganathan
8. ,, D. Pattabhiraman
9. ,, K. P. Chandrasekharan

Sri P. Sreenivasa Rao was proposed to the Chair.

The question of filling up the Presidentship consequent on the sad demise of Sri R. Swaminathan, (as per rule 11 of the Association) was discussed by the members. Sri M. N. Menon proposed Sri P. Srinivasa Rao for the Presidentship and Sri Bertie A. D'Souza seconded. Sri P. Srinivasa Rao pleaded inability to accept the offer on account of his failing health and due to heavy work involved consequent on the impending Jubilee celebrations. But in view of the unanimous request from all the members, Sri P. Srinivasa Rao accepted the Presidentship.

2. The Committee discussed about the Provincial Veterinary Conference to be held along with the Jubilee celebrations of the Madras Veterinary College in January 1955 as per the resolution 5 of the general body meeting held in December 1953. Also it was resolved to request the General Secretary, All India Veterinary Association to take steps to call for an All India Veterinary Conference along with the Jubilee as envisaged in the above mentioned resolution of the general body. In connection with the Provincial Veterinary Conference, Sri V. S. Alwar and Sri M. Ranganathan were elected unanimously as Conference Secretary and Treasurer respectively. Sri Bertie A. D'Souza, was requested to be the Chairman, Reception Committee and he accepted the same.

K. P. CHANDRASEKHARAN,
Secretary.

Correspondence

[*The views and opinions expressed in correspondence are those of the writers themselves and are not always endorsed by the Editor. Ed. I.V.J.*]

Cooperiasis in buffalo calves

Under the above title (*I.V.J.*, **30**. 333) Messrs. K. P. Chandrasekharan Nair and M. Anantaraman have recorded the occurrence of nodules enclosing mature, but sexually immature *Cooperia sp.* in the small intestine of buffalo-calves (*Bos bubalis*). They have stated that there is no mention of the formation of nodules by *Cooperia sp.* in calves till then.

I wish to point out that nodules similar to the ones encountered in the calves of Visakhapatnam Farm were observed by Gomez (as stated by Schwartz, 1929) in Philippines as early as 1929 in a buffalo-carabao (*Bubalus bubalis*) and by Sarwar in 1944 in a buffalo-calf in our country itself. Both Gomez and Sarwar recovered the helminths from the nodules of small intestine and Schwartz clearly indicated the pathogenic role as well as the economic importance of the causative parasite

encountered in Philippines by Gomez. I feel that the condition met with among the buffalo-calves of Visakhapatnam Farm might be the same as those described by Schwartz (1929) and Sarwar (1944).

As regards the specific identity of the helminths recovered from the nodules there seems to be some difference. Though Schwartz named the Philippine helminth as *Cooperia nodulosa*, Travassos (1937) subsequently changed its nomenclature to *Paracooperia nodulosa*. Sarwar also described his collection as *Paracooperia nodulosa* only. Hence it would be better if the helminths recovered from the buffalo-calves of Visakhapatnam Farm are negativated for *Paracooperia nodulosa*.

I hope the authors will clear the doubts expressed in this letter in their detailed article which they hope to publish.

Literature cited:

1. Sarwar, M. M. (1944) ... *Ind. J. Vet. Sci. & Ani. Husb.*, **14**, 60.
2. Schwartz, B. (1929) ... *Proc. U. S. Nat. Mus.*, **74**, Art. 20. Quoted by Sarwar (1944).
3. Travassos, L. (1937) ... *Monographias Instuto Oswaldo cruz.*, **1**, Quoted by Sarwar (1944).

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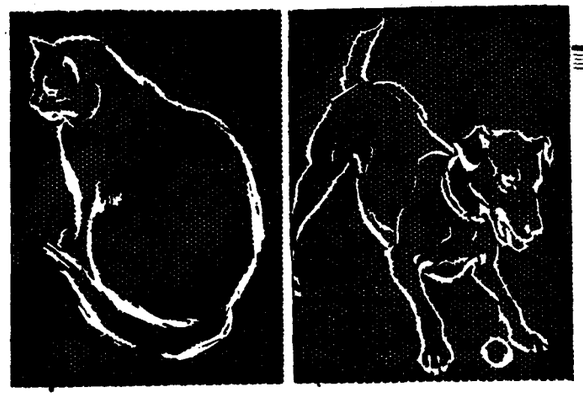
Review

Index of treatment in small animal practice.—By HAMILTON KIRK, M.R.C.V.S., Third Edition, 1954. Bailliere, Tindall & Cox, Ltd., London, W.C. 2. Price 45s net. Pp. 888.

The third edition on "Index of Treatment" by Hamilton Kirk brings to the hands of the small animal practitioner yet another useful and up-to-date treatise. As the author rightly points out "In this era of rapidly expanding knowledge it is almost impossible to keep pace with all the new ideas and new drugs which are daily revealed", but yet Dr. Kirk, we feel, has made a wonderful job of it, to bring the book up-to-date. A separate section on antibiotics and an alphabetical list with dosage of ready made proprietory drugs, now universally employed, will be greatly appreciated by the busy small animal practitioner. We again note the omission of the treatment of *B. gibsoni*, another important piroplasm of dogs in our country. Again, the treatment recommended for rabid dogs bite is far too severe and is not at all necessary, so long as the part is freely washed with soap and water.

The get-up of the book is excellent with good illustrations.



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