

Towards the end of the experiment the remaining sheep did not finish their rations very well. At first, however, they ate freely, and it will be seen from the table that during the first 12 days of the experiment the six sheep finished their 6 lb. of hay every day; in spite of this three sheep started vomiting on the 12th and 13th days.

Conclusion.—A supplementary ration of 1 lb. of hay per sheep per day given in addition to fresh *Geigeria* did not prevent *Vomeersiekte*.

Experiment 22.

Object.—Similar to that of the three preceding experiments.

Method.—Six sheep were selected and it was decided to offer them 2 lb. of hay each per day and then allow them to eat as much *Geigeria* as they would take.

Result.—On the first day of the experiment the six sheep were given 12 lb. of hay. This they had not finished by the end of the day. On the morning of the second day they therefore did not get fresh hay but were allowed to finish the hay of the previous day. After they had eaten all the hay, they were given fresh *Geigeria* and consumed 14½ lb. by the evening. On the third day they again started with 12 lb. hay which they only finished in the course of the fourth day; and thereupon they ate 12 lb. of *Geigeria*. The same thing happened the following two days and so on right through the experiment.

It will be seen, therefore, that instead of each of the sheep consuming 2 lb. of hay every day, they only did so every second day. On an average they, therefore, only consumed 1 lb. per day (the same as in Experiment 21), and this rate of consumption was kept up throughout the experiment. Although in this experiment they were free to cover their whole requirements on hay alone, and eat as little *Geigeria* as they pleased, they made no attempt to avoid the plant producing the disease.

A detailed table need not be given; suffice it to say that the experiment lasted 42 days and that during that time the sheep consumed on an average little over 1 lb. of *Geigeria* per day and exactly 1 lb. of hay.

One sheep vomited on the 11th day of the experiment, a second one on the 14th, and a third on the 26th day. The other three sheep remained healthy till the conclusion of the experiment on the 42nd day.

Conclusion.—Again, as in Experiment 21, a liberal supplementary ration of hay did not prevent *Vomeersiekte*, and the sheep took no advantage of the opportunity to reduce their intake of *Geigeria* to sub-toxic limits.

These experiments seem to dispose definitely of the farmers' theory that supplementary feeding will prevent the disease. Obviously if 1 lb. of hay or 10 ounces of maize cannot stop the disease from appearing amongst a flock, the method has no practical value. To feed more would mean discarding the natural pasture altogether, at all times when *Geigeria* was abundant.

**J.—HAS BONEMEAL ANY INFLUENCE ON THE INCIDENCE OF
VOMEERSIEKTE.**

Experiment 23.

Object.—To see whether a dose of bonemeal daily can prevent Vomeersiekte or influence the incidence of the disease in any other way.

The reason why bonemeal was tried was that this substance had been found to improve the general condition of sheep and other animals, and to increase their power of resisting disease, probably owing to the fact that it supplies the phosphorus lacking in so much of the natural pasturage of South Africa.

Method.—Ten sheep were fed for three weeks on an ordinary ration of maize and hay (six ounces maize per head per day, and hay *ad libitum*). In addition to this, each sheep was dosed every day with $\frac{1}{2}$ ounce of bonemeal.

After three weeks of this preliminary feeding the sheep were put in a Geigeria feeding test. They still got their dose of bonemeal every day but were then allowed to eat as much fresh Geigeria as they would take.

The following table records the results for this second period of the experiment:—

Day of Expt.	No. of Sheep in Expt.	Amount Eaten.		Symptoms shown by Sheep.									
		Geigeria.	Bone-meal.	No. 193.	No. 194.	No. 195.	No. 196.	No. 197.	No. 198.	No. 199.	No. 200.	No. 201.	No. 202.
		lb.	oz.										
1st...	10	26 $\frac{1}{2}$	5										
2nd...	10	10 $\frac{1}{2}$	5										
3rd...	10	16 $\frac{1}{2}$	5										
4th...	10	16 $\frac{1}{2}$	5										
5th...	10	18	5										
6th...	10	14 $\frac{1}{2}$	5										
7th...	10	27	5										
8th...	10	22 $\frac{1}{2}$	5										
9th...	9	18	4 $\frac{1}{2}$							vom. hosp.			vom. hosp.
10th...	8	19	4										
11th...	8	15 $\frac{1}{2}$	4										
12th...	8	16 $\frac{1}{2}$	4										
13th...	6	11 $\frac{1}{2}$	3										
14th...	5	10 $\frac{1}{2}$	2 $\frac{1}{2}$										
15th...	5	9	2 $\frac{1}{2}$										
16th...	3	10	1 $\frac{1}{2}$	Vom. Hosp.									
17th...	3	8	1 $\frac{1}{2}$										
18th...	3	4 $\frac{1}{2}$	1 $\frac{1}{2}$										
19th...	2	5	1										
20th...	2	2 $\frac{1}{2}$	1										
21st...	2	5	1										
22nd...	2	2	1										
23rd...	2	3	1										
24th...	2	2	1										
25th...	1	1	$\frac{1}{2}$										
26th...	1	1 $\frac{1}{2}$	$\frac{1}{2}$										
27th...	1	1	$\frac{1}{2}$										
28th...	1	$\frac{1}{2}$	$\frac{1}{2}$										
29th...	1	2	$\frac{1}{2}$										
30th...	1	1	$\frac{1}{2}$										
31st...	1	1	$\frac{1}{2}$										
32nd...	1	$\frac{1}{2}$	$\frac{1}{2}$										
Total.	158	302 $\frac{1}{2}$	79										

It will be seen that nine out of the ten sheep vomited and were transferred to the hospital camp. The tenth sheep (No. 194) was dull towards the end of the experiment but was never seen to vomit actually.

The average consumption of Geigeria in this experiment was nearly 2 lb. per head per day. Of the bonemeal each sheep received $\frac{1}{2}$ ounce per day with a spoon.

Conclusion.—The addition of $\frac{1}{2}$ ounce bonemeal per day to sheep feeding on Geigeria seems to have no influence on the incidence of the disease.

K.—CONTROL AND SPECIFIC EFFECT OF SALT.

Experiment 24.

Object.—To note the incidence of Vomeersiekte amongst sheep running on Geigeria veld; and, at the same time, to determine whether common salt has any influence on the disease when given as a lick. As already mentioned some farmers were of opinion that the symptoms of Vomeersiekte only appeared when sheep had access to salt, and others considered that the actual licking of salt accelerated an attack of vomiting.

Method.—Thirty sheep were run on Geigeria veld on the farm Pienaarsfontein where all the above experiments were conducted. The sheep were herded during the day and kraaled at night. Before kraaling, 15 sheep were allowed access to a salt lick, whereas the other 15 were kept away from the salt.

Result.—Of the 30 animals not one escaped completely.

Amongst the 15 controls which received no salt, one vomited on the 6th day and was transferred to the hospital camp; a second one vomited on the 8th day, a third and fourth on the 9th day, and a fifth and sixth on the 10th day; one of these latter died the next day. On the 14th day a seventh sheep vomited (which died two days later), and on the 15th day three more sheep (8th, 9th, and 10th of the experiment) showed definite symptoms of the stiff form. An eleventh animal was stiff on the 19th day, and a twelfth vomited on the 24th and died the next day. The thirteenth sheep vomited on the 29th, the fourteenth on the 34th, and the fifteenth on the 36th day of the experiment.

Of the 15 which had access to the salt lick two vomited on the 6th day, and three more on the 10th day. Six further sheep were stiff on the 15th day and another one (the twelfth sheep) on the 17th day. The thirteenth sheep vomited on the 29th day and died the next day. The fourteenth sheep was stiff for a few days and vomited on the 34th day. The fifteenth sheep was apparently well for more than seven weeks; on the 53rd day of the experiment it began to develop the stiff form of the disease and had to be transferred to the hospital camp on the 58th day.

Conclusion.—If sheep are left on Geigeria veld for a sufficiently long period, 100 per cent. may contract Vomeersiekte. It seems to make no difference whether the sheep have access to salt or not.

L.—DO OTHER ANIMALS GET VOMEERSIEKTE?

Experiment 25.

Object.—To find out whether Geigeria will produce Vomeersiekte in cattle.

Method.—Six small cattle were kept in a small enclosure and fed on fresh Geigeria every day. The plants were weighed before and after feeding so as determine the quantity consumed.

Result.—The experiment was continued for 29 days and the total weight of Geigeria consumed by the six cattle during that period was 1,714 lb. or an average of 9.85 lb. per head per day.

None of the cattle showed symptoms of Vomeersiekte during that period.

Conclusion.—In the present experiment six head of cattle fed on fresh Geigeria for 29 days and consuming on an average nearly 10 lb. per head per day (as sole ration) did not contract Vomeersiekte, and the only conclusion which can be drawn is that cattle are less susceptible than sheep.

The experience of farmers, however, is that cattle can contract the disease. In bad years, such as 1923 and 1924, cattle have definitely been known to show symptoms of Vomeersiekte (vomiting, etc.) and even to die. It will also be recalled that in an experiment conducted at Armoedsvlakte in 1912 (see page 113 of this report), a cow vomited after having been drenched with Geigeria daily for over a month.

It is likely that if the experiment now recorded had been continued longer, some of the cattle would have contracted the disease. Cattle are undoubtedly much less susceptible than sheep, and even in this latter class of animals many individuals will resist the action of the Geigeria poison for a month and more, as the preceding experiments have shown. Unfortunately the experiment could not be extended owing to cessation of the main programme of work on the farm concerned.

Experiment 26.

Object.—To determine whether Geigeria will produce Vomeersiekte in donkeys.

Method.—Six donkeys were fed on fresh Geigeria for 29 days and the weight of plant consumed determined.

Result.—The total amount of Geigeria consumed was 1998½ lb., which works out at 11½ lb. per head per day.

None of the donkeys showed any suspicious symptoms.

Conclusion.—In the experiment, six donkeys eating fresh Geigeria at the rate of about 11½ lb. per head per day for 29 days did not contract Vomeersiekte.

Here again it should be noted that donkeys have been reported to die of this disease. The symptoms, according to report, are not very definite, the animals just falling off in condition and ultimately dying of emaciation and weakness. The duration of this experiment was too short to obtain verification.

Experiment 27.

Object.—To see whether goats will get Vomeersiekte when fed on Geigeria, and if so, to note the symptoms.

Method.—Twenty goats were fed on fresh Geigeria daily as in the previous experiments.

Result.—All 20 goats contracted the "stiff" form of the disease. One goat began to show symptoms on the second day of the experiment; it grew steadily worse and was transferred to the hospital camp on the 20th day. On this latter day three more goats showed definite symptoms and were transferred. Two days later seven more goats had to be transferred. The twelfth goat was stiff on the 24th day, and three more on the 26th day of the experiment. The last five goats were all stiff and had to be transferred on the 34th day. During this period five of the goats died.

The average consumption of *Geigeria* was 3.4 lb. per head per day, which is considerably more than the sheep ate. The selection of flowering heads and leaves from the tougher stems, however, may have been less perfect in the case of the goats.

Conclusion.—Goats seem to contract *Vomeersiekte* readily when fed on *Geigeria*, which they relish. However, they were not observed to vomit but without exception showed the stiff form of the disease. This is strictly in accordance with the experience of farmers.

SUMMARY OF CONCLUSIONS REACHED AT BOETSAP.

1. Sheep, if kept in confinement in small enclosures and fed on fresh *Geigeria passerinoides*, develop a specific disease "*Vomeersiekte*" or "*Vomiting sickness*." When confined to the plant they consume an average of about 2 lb. of "*tops*" (flower-heads, leaves, and small twigs) per head per day. This amount, however, seems to cover their actual food requirements, since those which survive longest remain in fair condition.

2. The addition of salt does not effect the consumption of *Geigeria* nor the incidence of the disease.

3. The first symptoms of *Vomeersiekte* may be observed on about the 4th day of feeding exclusively on *Geigeria*, but most sheep do not react so rapidly.

4. If sheep showing symptoms of *Vomeersiekte* are removed from their *Geigeria* feed and given an ordinary ration of hay and maize, they may continue to show symptoms for a considerable time and may ultimately die of *Vomeersiekte*.

5. The smallest quantity of fresh *Geigeria* that will produce *Vomeersiekte* seems to be about 5-6 lb.

6. On the other hand, some sheep can eat very large quantities of *Geigeria* (up to 80 lb. over a period of six weeks) without showing symptoms.

Individual susceptibility seems to play an important rôle.

7. It is not certain whether the minimum observed period of three days must elapse between feeding of the plant and appearance of the disease; in other words, whether or not there is a "*latent period*" in *Vomeersiekte*. It seems more likely that the quantity of plant eaten is the deciding factor; thus after consumption of the minimum "*toxic dose*" the disease may appear very rapidly irrespective of the fact whether the feeding was limited to three days or extended over eight or ten days.

8. Sheep which pass through an attack of *Vomeersiekte* and recover can contract the disease again when again fed on *Geigeria*. No "*immunity*" against *Geigeria* toxin is produced by such an attack.

9. There is no reason to believe that some sheep possess a natural "*immunity*" against *Vomeersiekte*. The individual susceptibility is, however, so variable that in some cases feeding with *Geigeria* has to be continued over a long period (42 days) and large quantities (80 lb.) have to be fed before symptoms are produced.

10. Sheep which contract the "*stiff form*" of the disease may subsequently show vomiting either in the course of the same attack or in a later attack; and conversely, sheep which first vomit may later on show stiffness or paralysis. There is no doubt that both types of symptoms are produced by *Geigeria passerinoides*.

11. Geigeria dried in the sun until the leaves are quite brittle will still produce Vomeersiekte; the toxin is not destroyed by this process. One sheep vomited after having eaten only about 3 lb. of dried Geigeria.

12. Wilted Geigeria or Geigeria "autolysed" by chloroform vapour produces Vomeersiekte; the toxin appears to be unaltered.

13. The addition of maize, as supplementary concentrate, to a ration of Geigeria, did not prevent Vomeersiekte in sheep. Even when the supplementary ration of maize was increased to 10 ounces per sheep per day, so covering a fair proportion of total energy requirements, the amount of Geigeria consumed remained high and its toxic effect unaltered.

14. The same negative result was obtained when a bulky fodder (hay) was substituted for maize. A supplementary ration of 1 lb. hay per sheep per day reduced the consumption of Geigeria but did not prevent Vomeersiekte.

15. A ration of $\frac{1}{2}$ ounce of bonemeal per head per day, to improve the general nutritive condition of the sheep, had no influence upon the incidence of Vomeersiekte due to Geigeria feeding.

16. If sheep are grazed on Geigeria veld for a sufficiently long period, the incidence of the disease may rise to 100 per cent. Of 30 control sheep running on such veld, the last one showed symptoms during the 8th week of the experiment.

17. It seems to make no difference to the onset of symptoms whether the sheep have free access to a salt lick or not.

18. In the feeding experiment conducted with six cattle, no symptoms of Vomeersiekte were produced within a month although the animals consumed about 10 lb. fresh Geigeria per head per day; and cattle are therefore less susceptible than sheep.

Cattle have, however, been known to contract the disease, and it is probable that symptoms would have appeared if the experiment had been continued for a sufficient length of time.

19. Negative results were obtained with six donkeys fed exclusively on Geigeria for nearly a month, and consuming about $11\frac{1}{2}$ lb. per head per day. In the case of these animals, however, a few farmers have reported illness, and death due to Geigeria, but without symptoms of vomiting.

20. Goats contract Vomeersiekte readily, but show the "stiff" or "paralytic" form of the disease. In an experiment conducted with 20 goats all 20 contracted the disease in this form within five weeks but none vomited.

The average consumption of Geigeria by the goats was over 3 lb. per head per day, as against about 2 lb. by sheep, but the selection of leaves and flowering heads was probably less perfect.

VI.—EXPERIMENTS AT ONDERSTEPSPOORT.

The results of Experiments 11 and 12 at Boetsap seemed to indicate very clearly that dried Geigeria retained its toxin in an unaltered form and was capable of producing Vomeersiekte as readily as the fresh plant. As soon as this fact was established, arrangements were made to dry large quantities of Geigeria so that the experiments could be continued "at leisure" at the Onderstepoort Laboratory. Accordingly, several hundred bags of Geigeria were dried and despatched from Boetsap to Onderstepoort during the early summer of 1924.

The experiments at Donderbosfontein and Boetsap had not yielded much of practical value to the farmer who was losing his sheep from Vomeersiekte. It was quite interesting to know definitely that *Geigeria passerinoides* caused the disease, although the majority of farmers felt certain of this all the time. Also the fact that a wire-worm infection or a salt lick was not necessary for the production of the disease, did not help the farmer much. His great hope had always been to prevent the disease by means of a supplementary ration, and his chief difficulty had been to procure the necessary foodstuffs; but now our experiments had shown that supplementary rations of maize or hay would not stop the disease however large the amount.

At this stage the only hope of finding some practical solution seemed to be to continue the work along chemical lines. If the nature of the *Geigeria* toxin were known it might be possible to devise some means of counteracting it.

The first experiments at Onderstepoort were, therefore, undertaken with a view to establishing the toxic dose of the dried material so that later on attempts could be made to extract the toxin from this material.

Experiment 1a.

Object.—To determine the toxic dose for sheep of dried *Geigeria* received from Boetsap.

Method.—The experiment was begun with four sheep and two goats, which received as much dry *Geigeria* as they would eat, the amount being determined by weight as in previous experiments.

Result.—The experiment was continued for 25 days, during which period the six animals consumed 105 lb. of dried *Geigeria*, i.e. on an average 0.7 lb. per head per day. No symptoms were shown by any of these animals.

Conclusion.—In the amount eaten the dried material did not produce the disease.

As will be seen from the above figures, the animals used in this experiment ate very little *Geigeria*, and this seemed to account for the negative results. It was thought that if sheep which were accustomed to this plant were to be used, positive results were more likely to be obtained. Accordingly a number of sheep were ordered from Boetsap and drafted into the following experiments.

Experiment 1b.

Object.—Same as in Experiment 1a.

Method.—Ten sheep received from Boetsap were added to the four sheep and two goats used in Experiment 1a, and the feeding with dried *Geigeria* continued as before.

Result.—During the first 32 days of the experiment the fourteen sheep and two goats consumed 665½ lb. of the dried *Geigeria*, that is on an average 1.3 lb. per day per head.

On the 31st day of the experiment one of the Boetsap sheep vomited. The next day two of the original sheep in Experiment 1a died, but in all probability these animals died of starvation since they ate very little from the start.

To prevent further losses from starvation, the sheep were thereupon given about ½ lb. of maize per head per day. It was felt that

this could be done without influencing the course of the experiment, since the results at Boetsap had shown that a supplementary ration of maize did not prevent Vomeersiekte.

Thereafter the experiment continued with 12 sheep and two goats for another seven days, during which time two of the Boetsap sheep were seen to vomit on one occasion (the 35th day of the experiment).

Conclusion.—During the 39 days that this experiment was conducted only three out of the 14 sheep were observed to vomit, a single time each. The two goats showed no symptoms.

Experiment 1c.

Object.—Same as in Experiment 1a.

Method.—Another 10 sheep from Boetsap were added to the 12 already in Experiment 1b and the feeding with Geigeria continued as before.

Result.—The experiment lasted 27 days and during that time the 22 sheep and two goats ate on an average just about exactly 1 lb. of Geigeria per head per day.

No symptoms of Vomeersiekte were shown by any of the animals.

Conclusion.—In this experiment the dried Geigeria failed to produce cases of Vomeersiekte.

Experiment 1d.

Object.—Same as in Experiment 1a.

Method.—Twenty fresh sheep from Boetsap were fed on dried Geigeria for nearly seven weeks.

Result.—The 20 animals again consumed on an average just about 1 lb. dried Geigeria per head per day.

One sheep (No. 10234) vomited on the 26th day of the experiment and continued to do so at intervals until the end of the experiment. Between the 38th and 45th day of the experiment a few more sheep showed symptoms; one was observed to vomit, six others had dirty nostrils, possibly due to vomiting, and one developed the stiff form of the disease.

Conclusion.—Again, as in the preceding experiments the action of the dried Geigeria was slow and uncertain. After 26 days feeding the first case of Vomeersiekte was produced and the second after 38 days. These were the only two definite cases amongst 20 sheep.

It was difficult to account for this very weak action of the dried Geigeria after the positive results obtained at Boetsap. Perhaps the explanation is to be sought in the fact that the "dried" Geigeria of Boetsap had laid in the sun only for about a week to a fortnight and was then fed, whereas the material used at Onderstepoort was first collected and dried, then transported and stored for several months before being fed. This would lead us to surmise that the Geigeria toxin is of an unstable nature and affected by prolonged drying; or perhaps by slow processes of oxidative resinification known to occur with certain other plant toxins.

After the above unsatisfactory results another attempt was made to set up cases of Vomeersiekte with the dried Geigeria in the following ways:—

Experiment 2.

Object.—To produce cases of Vomeersiekte with dried ground Geigeria.

Method.—The dried plant was ground to a moderately fine powder and given to sheep mixed with some bran.

Four sheep were fed in two groups of two.

Result.—The first two sheep were fed on the powdered Geigeria for 24 days and consumed together on an average $3\frac{1}{2}$ lb. per day. This must be considered quite a large quantity seeing that the plant was dry and in powder form, so that there was no waste. Nevertheless, neither of these two sheep showed any symptoms.

Two more sheep were thereupon taken and treated in the same way. They were fed for 46 days on dried powdered Geigeria and consumed on an average very nearly $3\frac{1}{2}$ lbs. per day. On the 23rd day of the experiment one sheep vomited, but was not seen to vomit again during the remainder of the experiment. The other one had a dirty nose on the 41st day, but was never seen to vomit.

Conclusion.—The result was again disappointing. It was thought that the dried and powdered Geigeria would produce the disease without fail in a very short time. However, only one out of four sheep vomited after having consumed about 40 lb. We conclude that the toxin must have been partially destroyed.

Experiment 3.

Object.—To produce cases of Vomeersiekte by force-feeding.

Method.—Dried Geigeria ground up as in the preceding experiment was fed to sheep with a spoon so as to ensure a definite intake. The method proved to be exceedingly cumbersome. It took two natives several hours each day to get 1 or $1\frac{1}{2}$ lb. of the bulky powder down a sheep's throat.

Result.—The first sheep consumed during the first nine days of the experiment 13.6 lb., i.e., $1\frac{1}{2}$ lb. per day. It then showed digestive troubles and feeding was discontinued for a few days. Thereafter the sheep was again force-fed for a fortnight and took on an average 1.4 lb. per day, but never showed any signs of vomiting.

Another sheep was then taken into the experiment and given $1\frac{1}{2}$ lb. of dried powdered Geigeria per day. On the 34th day of the experiment the sheep vomited repeatedly, and again on the 35th, 36th, 39th, and 40th day. The experiment was stopped on the 47th day.

Conclusion.—With the material used it was possible to produce vomiting in a sheep but only after a very large quantity (about 50 lb.) had been fed over a long period (34 days). The toxin appeared to have fallen off in effectiveness during the long period elapsing between collecting and feeding the plant.

Experiment 4.

Object.—To produce a case of Vomeersiekte by drenching with a concentrated extract of Geigeria.

Method.—15 lb. of heads, separated from woody stems, were ground up, treated with 45 litres of hot water (about 95° C.) and allowed to stand overnight. The extract was then filtered and evaporated over a low flame, finally over a steam bath, to a bulk of about 700 c.c. This was then administered to one sheep during the course of one day.

Result.—The day after drenching the sheep showed diarrhoea, which remained for two days. The sheep was kept under observation for three weeks but never showed any signs of Vomeersiekte.

Conclusion.—Either that the aqueous extract made from 15 lb. of *Geigeria* did not contain sufficient toxin to produce Vomeersiekte or that the toxin was destroyed in the process of extraction.

NOTE ON THE ONDERSTEEPOORT EXPERIMENTS.

After the clear and convincing results obtained at Boetsap the Onderstepoort experiments were most disappointing. It was thought that the dried *Geigeria* would produce the disease as readily here as it did at Boetsap, and it was expected that with the large amount of dry material available (over 400 bags) a serious attempt could be made to study the nature of the toxin. However, as seen in the above experiment, the toxin seemed to have become so weak that amongst nearly 50 animals fed on the plant only a few vomited, and that only after a prolonged period of feeding. Even when the plant was given in powdered form or as a drench, the result was uncertain. There was therefore no object in starting chemical work with the dry material available, and this work was consequently abandoned until the following season.

REVIEW OF EXPERIMENTAL WORK.

It is unnecessary to summarise again the results of all experiments recorded in this paper. Summaries of the different groups of experiments have been given on pages 120 and 146.

The outstanding features of the work may, however, be recapitulated as follows:—

1. It was established for the first time experimentally that the disease “Vomeersiekte” is caused by *Geigeria passerinoides*, Harv.

2. Other factors previously suspected by farmers, such as the eating of salt and the concomitant occurrence of wire worm infection, have no influence on the disease.

3. The amount of *Geigeria* usually eaten by sheep varied up to 2 lb. per head per day of flowering heads and leaves. The minimal quantity necessary to produce Vomeersiekte was determined as about 5 lb. consumed over three days, although some sheep only showed symptoms after consuming 80 lb. over 42 days.

4. Various interesting points in connection with the disease were observed, e.g. that the symptoms may continue after removal of the sheep from a *Geigeria* diet, and that sheep may show the symptoms of Vomeersiekte in any order, first vomiting, then stiffness, or *vice versa*, or both forms together.

5. An attack of Vomeersiekte does not produce “immunity” nor does it seem likely that there are sheep which possess a “natural immunity” against the toxin; although the degree of susceptibility varies within wide limits.

6. Drying *Geigeria* in the sun does not destroy the toxin, nor is it destroyed by wilting. On the other hand, the final experiments showed that the toxin does deteriorate in dried plants after a few months. It seems, therefore, to be a “labile” toxin.

7. Contrary to the common belief of farmers, it was shown that the feeding of supplementary rations (maize or hay) to sheep on a *Geigeria* diet does not prevent the disease. So long as the plant is ingested at all the incidence of the disease appears to depend only on the amount consumed and the individual susceptibility of the sheep.

CONCLUSION.

The foregoing experiments were quite satisfactory from the point of view of elucidating the cause and nature of Vomeersiekte and determining many facts in connection with the disease. From the farmer's point of view, however, the results were disappointing. At the conclusion of our researches, sheep were still dying in hundreds of Vomeersiekte, but there was very little we could tell the farmer about the treatment or prevention of the disease.

Treatment.—It may be stated here, that some attempts at treatment were made during the course of the experiments, with a variety of drugs, but nothing was found that seemed in any way to counteract the Geigeria poison. There was, of course, a hope that when once the nature of the toxin was accurately known, treatment might be formulated. But even with a specific antidote no satisfactory solution of the problem would have been found. As pointed out previously, the sheep in the Vomeersiekte areas subsisted on a diet, 90 per cent. of which, in many instances, consisted of Geigeria. If, therefore, the sheep filled their bellies day after day with a plant containing an active poison, there would seem to be very little hope of keeping such sheep in health by means of curative treatment.

Prevention, therefore, had to be aimed at. The farmer's simplest method of prevention is to trek with his flock to healthy pastures, but this can only be considered as a temporary measure in time of distress, saving his flock by deserting his customary pasture, and other means of preventing the disease were accordingly looked for. The method to which many farmers had pinned their faith and which we also were inclined to regard as promising, was limited supplementary feeding. It was, therefore, a great disappointment when the experiments at Boetsap showed that even large quantities of supplementary foodstuffs would not prevent the disease. The possibility of eradicating the plant by mechanical means is out of the question in view of its extraordinary dominance in bad years, and the low value of the land concerned.

What then, it may be asked, are the prospects for the future? At the beginning of this article it was pointed out that *Geigeria passerinoides* had spread to an alarming extent over vast areas during the last few years. The question now is, will it continue to spread and if so will the disease become an increasingly serious menace to sheep farming in South Africa?

It should be mentioned here that even in 1923 and 1924 when the position was at its worst, the idea was expressed that Geigeria might perhaps disappear in the same way as it had appeared; in other words that the 1923-24 position was just a passing phase in the course of a plant succession. Conditions, it was assumed, had been particularly favourable for the propagation of Geigeria. It has already been mentioned that the drought and locusts had actually favoured its spread, and it was thought reasonable to suppose that those conditions would change and that with the changed conditions other plants would replace the Geigeria. Another possibility was that some pest might attack the Geigeria and destroy it, or, at any rate, stay its progress.

In reality reports began to reach us in 1925 from different districts indicating that the Geigeria plants were actually dying in great numbers. Most observers were inclined to incriminate an insect

larva which hatches and lives at the base of the stems. This explanation seemed hardly satisfactory since the same larva had been known for years to infest the plant, and never seemed to harm it in any way.

Dr. I. B. Pole Evans, the Chief of the Division of Botany, was accordingly requested to investigate the conditions, and the following is a quotation from his report:—

“ I visited Boetsap on the 8th October, 1925, and found that in the Veld Reserve which we have established there and on which there were at least one to two *Geigeria* plants per square foot, I found every one of these within the Reserve dead at the time of my visit. Also on my journey from Fourteen Streams to Boetsap and back I saw no living plants of *Geigeria*. There were, however, plenty of old dead plants and young ones at various stages. It was clear, however, that none of the plants had survived the frost. While at Boetsap I also made a careful examination of the old feeding camp established by the Veterinary Research Division. In this camp where the *Geigeria* had been stacked into heaps I found one or two *Geigeria* plants which had just managed to survive the winter and which were making new growth from the old shoots. I only found these plants where they were protected from frosts by the heavy deposit of dead plant remains and this was also probably responsible for preserving a certain amount of moisture in the soil. As a result of my last visit to Boetsap, I am quite satisfied that *Geigeria passerinoides* on the Kaap Plateau is an annual.”

The prospects for the future, therefore, do not appear to be quite so black. The plant is undoubtedly disappearing, whatever the various factors contributing towards this result may be. It is to be hoped, therefore, that the losses from Vomeersiekte during the coming years will be light. In the meantime, the researches which were begun at Donderbosfontein and Boetsap will be continued, and it is yet hoped that some means will be found of controlling the occurrence of this disease, which during the past fifty years must have killed hundreds of thousands of sheep over the various occasions upon which it flared into prominence.

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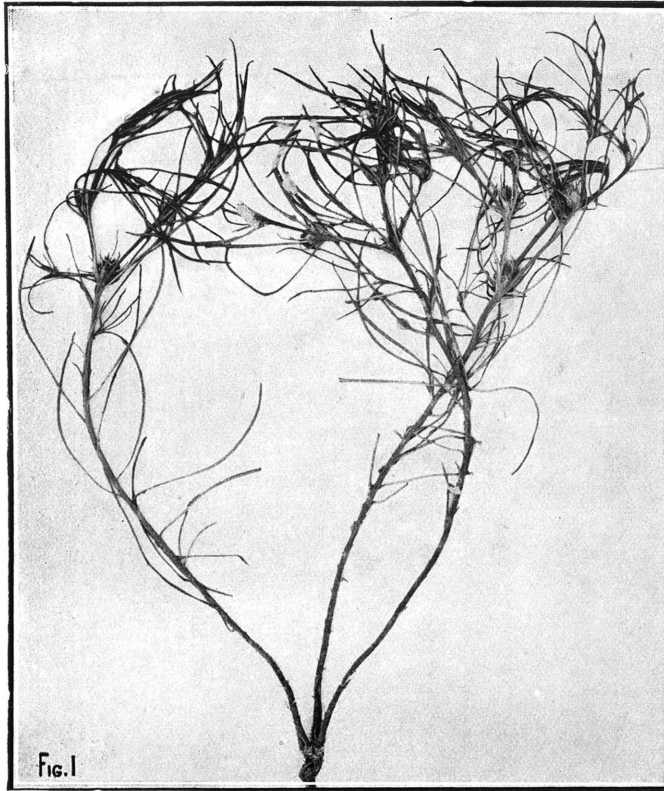


FIG. 1



FIG. 2

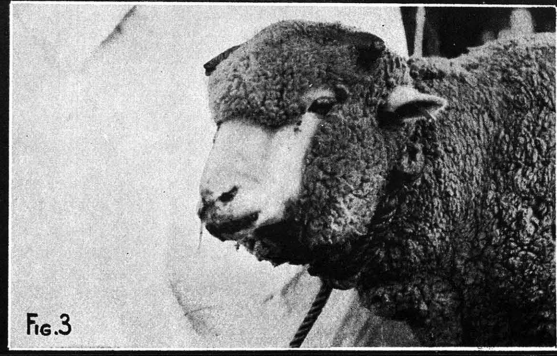


FIG. 3

EXPLANATION OF PLATE.

Fig. 1.—A dried specimen of *Geigeria passerinoides* in flower. Fig. 2.—Photograph of a sheep in the act of vomiting.

Fig. 3.—Head of a sheep suffering from Vomeersiekte. Evidence of vomiting on nose and mouth.

Vomeersiekte.]

[*Du Toit.*