Art. XXXV.—*Rabbit-disease in the South Wairarapa.*

By Coleman Phillips.

[*Read before the Wellington Philosophical Society, 2nd October, 1889.*]

Professor Thomas has finished his full report upon the parasitic diseases affecting rabbits in the Wairarapa district, and it has been presented to Parliament. It is to be regretted that the paper cannot be included in the "Transactions" of this Institute. As a zoological paper it is an excellent one, and had Professor Thomas confined himself to that aspect of the question I should have been the last person to take exception to it. But his analogies, deductions, and summaries are quite wrong and misleading. It is to prevent the harm that they must do that I venture to criticize his report. He must kindly excuse my doing so.

In the beginning of the report and at its conclusion Professor Thomas emphatically says that "the most valuable measures taken to reduce the pest have been winter poisoning and trapping," &c. All I can say in reply is that in the North Wairarapa, where poisoning and trapping have been relied upon, the rabbits are worse now than ever they were. Trapping, indeed, is a most fatal mistake. We never resorted to it, but carefully avoided it, in the South Wairarapa when we conquered the pest during the years 1884–87.

With regard to bladder-worm, Professor Thomas regards it only as a "minor and auxiliary means of destruction," "although it may be usefully employed against the rabbit-pest."* "The employment of liver-coccidea for the destruction of rabbits cannot be advocated;" "but the disease may be of further use in killing rabbits." (There is a confusion here which can only result from Professor Thomas's non-acquaintance with the practical working of rabbit-suppression.) Rabbit-scab (the louse-mite—*Sarcoptes cuniculi*) and the rabbit-louse (*Hæmatopinus ventricosus*)—two diseases—are dismissed as of no practical importance whatever. Yet each one of these four diseases was upon my run and in my district, and to them as much as to any other of the remedies used I ascribe the magical disappearance of rabbits in South Wairarapa in 1885–86 and the conquest of the pest. The other remedies we used were—(1) simultaneous action through a voluntary Local Board of Government; (2) winter poisoning; (3) the turning-out of the natural enemy (cats, ferrets, stoats, and

* I must say that I found this disease most useful in enabling me to conquer the pest and keep it at its minimum, as I shall show later on.

weasels; hawks being also most useful); (4) the steady hunting with dogs.

I am glad to note that Professor Thomas makes no mention of rabbit-fencing whatever in his report. This remedy, which captivates superficial minds, I never used, and have no faith in. It affords a temporary stop against the rabbit, but it is most harmful in causing settlers to rely upon its efficacy in place of taking proper and active measures against the pest. Whenever a settler resorts to rabbit-fencing I know that the rabbits are to be preserved in his district. It is no remedy whatever against the pest. All the good it affords is a selfish and temporary protection. Hundreds of thousands of pounds are being expended upon it throughout the Australasian Colonies, whereas one-tenth of the money properly applied would give far more effectual relief. I mean by this the introduction of the natural enemy and spread of the diseases above named.

I cannot add much to Professor Thomas's zoological work. That I think excellent, except in the one thing—viz., his experiments with the ferret. My opinion is that the ferret is a wormy animal, and I should like to see further experiments tried in the direction of feeding it with the proglottides (tapeworm-ends).

Professor Thomas takes exception to Sir James Hector's statement ("Trans.," vol. xx., p. 457) that "in America he had seen large tracts of country cleared of rabbits in a few months by the propagation of this disease—bladder-worm," and in support of his view he says that "the statements made by Mr. C. N. Bell, of Winnipeg, do not bear out any such idea." I should feel favoured by Sir James Hector stating now what he actually did say. I believe our worthy Director furnished our Government with a paper upon the rabbit question many years ago. I should be glad to see it included in the "Transactions" of this society.

With regard to the bladder-worm disease, I may be allowed to add here my own practical observations to Professor Thomas's scientific work. The disease certainly appears to be worse during the summer and autumn months. In winter not many bladdery rabbits are caught; but the men then are generally poisoning. As I write now, in the spring, the first small bladders are appearing attached to the liver and the big paunch of the stomach, like a little set of pendants, usually where the liver touches the stomach. They are rather pretty little pendants, like drops of cloudy water containing a worm or two—at least, that is their present appearance, although I must say that this is the first time I have noticed the bladder-worm in this form. I am not quite certain about these little sacs, but I have brought with me a specimen for members to

see this evening. The bladders subsequently come everywhere upon the muscles, some external and some internal, about 50 per cent. being internal bladders. If internal, or part internal and part external, *every other organ has to give place to them, even the genital organs totally disappearing*. Professor Thomas appears to quite overlook the fact that this disease positively stops the breeding-powers of the rabbits, *the most important desideratum for us to aim at in dealing with the rabbit difficulty*. All other measures are absolutely futile. We can sweep off the rabbits by the million with poison; but our time and money are thrown away unless we can stop the rabbits left after the poisoning from breeding up again. My rabbiter never remembers catching a doe in young afflicted with bladder-worm. I do not say that such a rabbit may not be caught so afflicted—in fact, I have heard of rabbits being so caught; but the disease certainly checks their breeding-powers. I should be sorry to be the embryo rabbit contesting existence with an internal developing bladder-worm. It is generally the buck-rabbits we catch afflicted with the bladders.

In this way Nature works. She does not sweep off by the million, as people afflicted with the rabbit-pest expect her to do, but she sends a disease that quietly stops the breeding-power. Therein lies its great beauty. The rabbits absolutely thrive and fatten under a disease that all the time prevents their future increase. M. Pasteur's plan was therefore opposed to Nature's simple working. Why the rabbit thrives and fattens under the disease is easily answered. This animal affords a wonderful food-supply to man, and for that reason Nature will not allow it to be exterminated. Nothing we can do now will exterminate the rabbit in New Zealand or Australia.

Bladder-worm was not bad upon the Dry River Run when the rabbits were thick, and poisoning and hunting were relied upon (1883–84). Then I began turning out the natural enemy, and still continuing the use of dogs. Then the bladder-worm came as the rabbits were disappearing (towards the middle of 1885), and the run was fully infected with the disease (as also with liver-rot, scab, and louse) when Professor Thomas examined it in March, 1888; the height of the disease being a year and a half previous to that, about the end of 1886. The three other diseases named were not so bad with me as the bladder-worm, or as they were upon some of my neighbours' runs. I consider from what I heard that the liver-rot did better work upon Mr. Tully's run than the bladder-worm. (Still, I think these four diseases epidemic and endemic.)

Now, as I write—September, 1889, when the run is as clear as ever it will be—we do not catch many rabbits with bladder-worm. The disease may only be developing for the summer

and winter months. But, then, my rabbiter disagrees with Professor Thomas in the matter of the use of areca-nut. He says that for the past eight months, following Professor Thomas's instructions, he has desisted from giving his dogs areca-nut, and there is not nearly so much bladder-worm on the run now as when he used to give the dogs monthly doses of the medicine. He thinks that the disease did not appear at all upon Dry River until about six months after I had insisted upon his keeping the dogs in better condition than they were, and his using some kind of purgative to expel their worms. (That was early in 1885. See my paper, "Trans.," vol. xxi., p. 430 *et seq.*) It is difficult for me to be certain as to exact dates now, as we never kept a strict record of the appearance and course of these diseases. In my first paper I thought 1886 was the year when we first began using the medicine, but my rabbiter thinks now that it was in 1885.

As to the other natural diseases referred to, and discarded by Professor Thomas as being of no use, we have had, and still have, liver-rot, scab, and lice amongst the rabbits. And I should advise every other runholder to see to the spread of these diseases, just the same as, if he wished to reduce his sheep, he would not dip, and would so allow their scab to spread; not pare and use the arsenic-trough, and so allow foot-rot to spread; not shift and attend to his hoggets, and so allow lungworm to spread. These sheep and rabbit diseases I have mentioned are Nature's simple remedies against excessive increase, and our duty is to use and spread them if we desire to conquer the rabbit-pest. Therein lies our remedy, not in cholera-microbe solution. Nature never used cholera-microbes against the excessive increase of the rabbit. The Royal Commission in Sydney has made a capital blunder in overlooking these simple diseases which I pointed out, and seeking, with M. Pasteur's aid, for something new. There is nothing new under the sun. We shall not improve upon Nature's plan of decimation by disease. Slow, steady, and sure are these simple diseases. In this consists their great beauty. Let any runholder think for one moment of the state his sheep would get into if he allowed scab, lice, ticks, foot-rot, and lungworm to spread unchecked amongst them. His yearly increase would soon be at an end, and his flock would actually diminish in numbers.

Scabby rabbits can be spread from run to run. Bladder-worm is easily spread in the daily hunting which must be done. (For it is a complete mistake to suppose that even natural enemies will keep the rabbits down. They will not entirely do so.) Liver-rot can be spread. Professor Thomas or Sir James Hector can tell us how this can be best done. All these

diseases are most important and useful (not minor and auxiliary) in checking the breeding-powers of the rabbit. They act, as it were, as the last nail in the coffin. They do not sweep off their millions. I never claimed that they did. All they do is to keep the "minimum-of-safety stage" at its minimum.

I am told of an instance of a large runholder in the South Island who went to great expense in turning out ferrets, stoats, and weasels. These animals did not do the good he expected. He consequently resorted to trapping quite lately as a remedy. My opinion is that he had far better have resorted to the spread of my four diseases, as an aid to the natural enemy, and keeping the "minimum-of-safety stage" at its lowest. Of course I do not know *how* he turned out his ferrets, stoats, and weasels—whether he acted like a fellow-settler of mine (Mr. Riddiford), who turned out twelve hundred pounds' worth of stoats and weasels three or four years ago, and thought that that was all he had to do on 50,000 acres of land. Of course these stoats and weasels scattered themselves all over the country, and he should have imported more. I turn out the natural enemy *every year* (ferrets). There is a proper way to do even this. Settlers in New Zealand have only played with the question of turning out the natural enemy as yet. Every person afflicted with rabbits must turn out a certain proportion of ferrets, stoats, and weasels every year, until a balance of prey upon prey is attained. Nor must he act like a large runholder in North Wairarapa, who tells me that his men have trapped seventy ferrets within the last two years. Traps must not be used.

Natural enemies are therefore most useful. So are hunting, poisoning, the digging-out of burrows, &c. The harmful things are trapping, fumigating, and relying solely upon poisoning and rabbit-fencing. These things will never reduce the pest; and yet Professor Thomas thinks that winter poisoning and trapping will do so.

Trapping, of course, is fatal to reduction. That should be made a penal offence in these colonies. I would much rather see a bad piece of bush country rabbity than cleared by traps. Far better is it to leave it until the next poisoning, and after that remedy has been applied to turn out a greater number of natural enemies in that particular spot. For there is a right way and a wrong way to kill rabbits. The object to be aimed at is not mere killing and visible reduction, but so killing that the numbers will not breed up quickly again. No worse mistake could be committed, in the present condition of the Australasian Colonies, when we desire to breed up the natural enemy, than the visible reduction of rabbits caused by laying traps in a piece of country covered with logs, or near old warrens or watercourses. The ground-vermin which are

certain to be there, if they have been turned out, are greatly injured, if not killed outright, by the traps, and then there is no check to the rabbits breeding up again in that particular spot. Will any person in his senses say that a doe-ferret in young is not greatly injured by being caught in a trap? It is the increase of these natural enemies that we must aim at.

Poison certainly does great good and injures very little. But certain rabbits go through the poisoning, and come out harder and stronger than ever. This is always the case; so that more than one sharp winter poisoning in a year is highly injudicious. Summer poisoning is a wrong way to kill rabbits, as this method simply doubles the number of rabbits that become poison-proof. This only shows Nature's wonderful law of preservation—that it is impossible for us to exterminate the rabbit now that it is here. With all the density of their populations, neither Europe, Asia, Africa, nor America has been able to exterminate the rabbit. Professor Thomas is quite wrong, therefore, I regret to say, when he says that population will reduce the pest. A great population is the friend of the rabbit, strange to say, and the rabbit in return affords that population a great food-supply. In densely-populated Belgium the rabbits are numerous, also in England, Prussia, France. There is a far greater chance of rabbits being swept off, say, in North or South America, where there is little population, and wolves, lynxes, and foxes roam about and scatter their virulent tapeworms—far more fatal than the dog-worm. But population clears off the wolves, lynxes, and foxes, and the rabbit flourishes and skips about, and rather defies the stoat, ferret, and weasel. At all events he is a match for these three latter animals, and a very even balance is preserved. But the rabbit is no match, as Sir James Hector points out, against the tapeworm of the wolf, fox, or lynx of North or South America. Every now and again, as the Indians say, the rabbits are decimated by the bladder-worm disease: their dead bodies strew the whole face of the country, none even being left for food; so that even good Dame Nature can be sharp enough if the occasion demands it.

Poison, of course, does good work, and no one need fear that the natural enemies suffer from it—a few may die, but not many. The great use of the natural enemy is, of course, *after* the poisoning, when they eat up the young rabbits. No dog or ferret can possibly resist a three-or-four-days-old rabbit. This is a very toothsome and delicate morsel, and is usually swallowed whole. Trapping, of course, ignores the young rabbit, and allows it to breed up again; and it assists the rabbit in doing so when it kills or injures the natural enemy. In England, if the owner of an estate wishes to preserve his rabbits he gives his gamekeeper orders to "trap off the

ground-vermin." If he wishes to reduce his rabbits the man puts away the traps, and the ground-vermin flock in from the neighbouring lands and eat up the young ones.

Australia, Tasmania, and New Zealand must be placed in an exactly similar position to England in this respect: there must be so many ground-vermin against so many rabbits. The balance of prey upon prey must be obtained, and we can keep this balance at its minimum by the use of the four diseases which assisted us to conquer the pest in South Wairarapa. Professor Aldis estimates that one dog can distribute 900,000 tapeworm-eggs in one day—ten dogs 9,000,000, twenty dogs 18,000,000. How totally different a remedy this! how far removed from the rabbit-netting remedy so strongly advocated just at present!

Referring for a moment to this rabbit-netting remedy, which, certainly, Professor Thomas takes no notice of, I am told that the leaders of the fencing movement in Canterbury and Hawke's Bay say that they expect to keep the rabbits entirely out of their provinces by its means. Let me tell the settlers there that every acre of their lands, sooner or later, must pass under the rabbits' feet. I advise them as strongly as I can to trust not to their fences.

Let me here explain fully my opposition to rabbit-fencing as a remedy against the rabbit-pest. As I have said above, directly I hear of a settler resorting to rabbit-netting I know at once that the rabbits will be preserved in his district; for rabbit-netting means his own sefish protection. For how can the netting be any remedy against the rabbits swarming upon the other side of the fence? Of course it is none. As a temporary stop it is useful, but it is no remedy. What the Royal Commission in Australia asked for was some remedy against the rabbit-pest. What the Royal Commission arrived at in their report was that rabbit-netting was the proper remedy. I immediately, in New Zealand, took up arms against that report, and have steadily tried to expose its fallacy; but the task is almost herculean. The most intelligent of my neighbours, to protect one year's grass, will resort to this rabbit-netting, and totally neglect the turning-out of the natural enemy or the spread of disease. Then he proceeds to poison, hunt, and trap, and reduce the rabbit-pest upon his own land, leaving it *worse than ever upon his neighbour's*, and utterly failing to reduce the future breeding-powers of his own rabbits (the natural enemies and disease alone doing that). Of course, the doe-rabbits that he catches and kills do not breed; but he puts nothing upon his run to check the future increase of those doe-rabbits which he does not catch and kill. In 1884, in my own mind, I condemned the use of rabbit-netting as far as my own run was concerned. I would

have nothing to do with it, preferring to turn out the natural enemy, and so assist in clearing my neighbours' lands, against which I had thought of erecting the fencing. Of course, I can say nothing if any settler chooses to adopt both the fencing and the turning-out of a sufficient number of the natural enemy and the spread of disease. All I should say then was that he did not rely upon his fencing as the remedy. I would also say that, were I living in a badly-infested rabbit district, with all the neighbours pulling against each other, in place of acting together and turning out the natural enemy and spreading these diseases, then in self-defence I might be compelled to erect rabbit-netting to save myself from ruin; but that would be no remedy against the rabbit-pest, which would flourish just as badly as ever on the other side of the fence. In South Wairarapa we never thought of this fencing at all, but took the wide measure of relieving the whole district at once by turning out ferrets, stoats, and weasels.

Strange to say, fencing was the only remedy recommended by the late Royal Commission in Australia. The Commission thought that bladder-worm might be useful, but fencing was chiefly relied upon. I have little experience of its use or effect in the dry central lands of the Australian Continent. All I know is that Nature never made use of this netting in reducing the rabbit-pest in the dry central desert-lands of Africa. She may have done so; but there is no record of these fences, or of the size of the mesh used. Practically, the Sydney Commission leaves the work of rabbit-extermination to drought in Central Australia. I should think that the dingo would be the best animal to cope with the rabbit difficulty in the uninhabited parts of the Australian Continent. That animal is well adapted to spread the bladder-worm disease, and it most certainly will do so. Professor Thomas thinks that the disease will be found more useful in New Zealand than in Australia, owing to the fact that the tape-worm-eggs must have moisture, dry winds and hot sunny days, in his opinion, being fatal to it. Here, again, from practical experience, I differ. The disease is worse with us in the dry, hot weather. In dry, hot Queensland there are occasional outbreaks of sheep-fluke—a very similar disease. In frozen Canada the bladder-worm thrives. There is a vitality of resistance, both against heat and cold, in these small forms of life which often surprises the zoologist, and I am rather astonished at Professor Thomas's statement. It is somewhat venturesome upon my part crossing swords with so able a man as Professor Thomas; but when he grasps the whole course of my argument, when he thinks of the money that is being wasted in wrong directions, then he will excuse me for writing so plainly as I am doing. Had he lived as long as I have

amongst the rabbits, had his fate depended upon their suppression, then he would have viewed the matter in a different light. But he was only ten days in our district; and, whilst I thank him sincerely for his able paper, still must I take exception to his deductions. I hope he will reply, through the Auckland Institute, to everything I say. The ball has only just opened in the matter of this rabbit difficulty. There will be scores of commissions, committees, and inquiries sitting upon it before a proper solution is arrived at. I can but tell how we succeeded in reducing the rabbits in my own district. I can but point to the similarity of the measures we adopted to the natural remedies happening in other parts of the world.

Professor Thomas points out the great difficulty of sending bladdery rabbits by sea. That is true enough. I tried to send a dozen shipments to Sydney: they nearly all died.

I am glad Professor Thomas says emphatically that bladder-worm does not affect sheep, but sheep-fluke may attack the rabbit. I must say that we have had no case as yet of a single sheep being attacked by bladder-worm—no sturdy or gid. We catch the bladdery rabbits all over the run, and there are usually 10,000 to 14,000 sheep running in the paddocks. There are also about 1,000 cattle, and 50 horses. (Seven out of ten rabbits we catch even now, as I write, are more or less afflicted with bladder-worm and liver-rot.) Neither have the horses or cattle suffered in the slightest way from these rabbit-diseases. A slight touch of sturdy did appear upon a neighbour's run (Mr. Bidwill's); but there were very few rabbits there at the time, and not a bladdery rabbit that I know of had been caught there. In Hawke's Bay Province, near Hastings, *where as yet no rabbits have been seen*, I saw in May last Mr. Ormond's sheepyards full of sturdied sheep. But this disease was accounted for by the excessive drought then raging, and the stock living upon tall fescue. There had been four years of drought there, and not much grass left, except tall fescue, the cattle living upon hay and willows cut down for them. I did not account for the sturdy in this way at all, but rather to the warm, dry weather then prevailing bringing to life the minute eggs from the sheep-sick lands—eggs of worms that had been deposited there year after year by the sheep themselves. Professor Thomas must kindly say how it happened that this disease only sprang into life in the driest and hottest season known there for years. But I must say that the sheep appeared to get worse after a small shower of rain.

Mr. Bidwill attributed his attack of sturdy to the ergot on the rye-grass. Again, if I remember rightly, this was in the hottest and driest month of the year. I rather think that it was

due neither to the tall fescue nor the rye-grass, but to the minute worms from the seed-eggs from the sheep-sick lands crawling up the long grass left, and so being eaten by the sheep. In both cases it happened upon ploughed ground, and in Mr. Bidwill's case on newly-ploughed land. This is only a supposition upon my part, which Professor Thomas can kindly consider.

The latest information I have received from a most trustworthy source is that the cattle near Hastings have also been attacked apparently by a foot-and-mouth disease, and that Mr. Ormond is now having the tall fescue grubbed up. I also faintly remember seeing a draught mare with the staggers in that district. I think it will be found that it is a worm (or worms) that is doing all this mischief, and not ergot. But it may be ergot. All I wish is to emphasize the fact that these diseases are attacking the stock near Hastings before any rabbits have been seen there.

With regard to bladdery rabbits being strong and healthy, I need only say that sheep fatten on fluke disease. Sheep-fluke runs a course of three or four months, and then, if the sheep affected is not killed, it rapidly dwindles away. We used to find scores of weak skeletons of rabbits upon the Dry River when the bladder-worm was bad, which could not run away from the dogs.

I should like to note the fact now, so that it may be afterwards referred to when the rabbit-pest has been reduced there, that the bladder-worm disease is among the rabbits over the whole of the North Wairarapa. I have heard of it personally from the owners of the following runs: Brancepeth (Mr. Beetham), Abbotsford (Mr. Whatman), Riversdale (Mr. Meredith), Matahiwi (Mr. Holmes), Bowlands (from Mr. McCrea, the manager). These runs are fairly wide apart, so that the disease is well distributed. In fact, it has a thorough hold upon the whole of the Wairarapa. Directly proper measures are taken to reduce the pest, similar to those we adopted in South Wairarapa, the disease will play its part, and keep the nuisance down to its minimum.

Professor Thomas says that the expense of distributing the remedy is not at all proportionate to the benefit to be derived from it. This, too, is quite a mistake. No expense to speak of is incurred in its distribution: therein lies its great beauty. Two shillings a year will provide any runholder with enough areca-nut to dose all his dogs, and so distribute the worm. These dogs must be used in the daily hunting. Feed them constantly upon raw rabbit, and they will get mangy and wormy. Each one of them, then, as Professor Thomas himself admits, will spread 900,000 eggs in a day. Wherein lies the expense?

Or, take rabbit scab or lice. It is quite easy to catch a couple of rabbits so afflicted. Shut them up with some healthy ones for a time after the poisoning, and then let them all go out upon the run. Wherein lies that expense?

Liver-rot I know little about. This disease was and is still upon the Dry River, and it was upon my neighbours' lands, especially Mr. Tully's.

To it as much as to the bladder-worm I ascribe our success in reducing the pest. I would point out that rabbit-fences check the free spread of these diseases, especially the fencing off the marshy damp spots from the dry uplands.

Professor Thomas's remarks upon Nature's method of check upon check are admirable. I have always revered Nature's wisdom in this respect. But the same checks appear to me to apply all over the globe to the same things. Thus the diseases or checks incidental to the rabbit apply just as well in Australia as in New Zealand, in North America as in Africa. Nature will give us no new check here, and the mistake we make is trying to seek for something new. Thus, if we wish to clear out any "bad spots" upon a run, the best plan is not to trap or fumigate, but to use tame ferrets and nets. My opinion is that natural enemies, as well as these diseases, will live just as well in Australia as in New Zealand. Stoats and weasels are perhaps more useful in the high snowy lands of the South Island of New Zealand than ferrets, the latter animal being the more delicate of the three. I am building little earth homes, and covering them with scrub, in various parts of my run, to afford warm shelter to the natural enemy. But all three animals will be found most useful in Australia, and the proper things to at once introduce there. Cats are useful everywhere.

In conclusion, I ask my hearers to excuse this long paper. In criticizing the work of so able a man as Professor Thomas I can only say that I do so from the practical-experience point of view. I know that practical experience is generally ignorant experience; but then, my measures having succeeded, my words should be listened to. I know also that it is difficult for one man to try and persuade a thousand, and the longer I live the more I doubt my own ability so to do. Each person holds a different opinion upon the rabbit question: I can only leave good Father Time to say which is right.

Sir James Hector has shown me the official correspondence on the occurrence of this disease in Canada, and permits me to append it as having an important bearing on the matter.

1st September, 1886.

Diseases for Rabbits.

MEMORANDUM by Sir JAMES HECTOR for the Hon. Sir JULIUS VOGEL, K.C.M.G.

THE suggestion of Mr. Stroever, to introduce the disease called red measle in the pig with the view of its destroying rabbits, would, as he himself admits, require very careful investigation before its adoption. I think there must be some mistake as to the nature of the disease alluded to. The pig is affected with two kinds of measles, one of which is a hydatid fluke which is the larval condition of the common tapeworm in man, and the other of the tapeworm of the dog. Both of these produce the measles in the pig, but I do not think they would be communicable to the rabbit.

Most probably, by the "red measle" is meant a very formidable disease known as the "swine plague," which is due to the presence of a minute organism known as *Bacilli suis*. This disease caused a loss in 1877 in the United States of £2,000,000. A Committee was appointed to investigate this disease, and, from their report, it can be communicated to several other animals, among which is the rabbit, and also the sheep. This was effected by artificial inoculation, but it does not appear that there is any evidence of its ever having spread naturally to either of these animals in the United States.

I think it would be well to ask the Agent-General to confer with some of the officers of the Canadian Government, now in London, with the view of ascertaining what is known as to the nature of a disease that periodically destroys the rabbits in the Canadian backwoods. In 1857–58 the Saskatchewan swarmed with rabbits, and Indians depended there on rabbits, largely, for their food in the winter-time; but during the winter of 1858–59 the rabbits almost entirely disappeared, and I found the Thickwood Indians starving to death in consequence. I was nearly starved myself with my party, travelling on the snow between Jasper House and Fort Edmonton, a distance of 230 miles. We had relied on finding rabbits plentiful for the whole distance, but only got one, and were several days without food. I was told by the hunters and officers of the Hudson Bay Company that about every seven to ten years the rabbits were attacked by a murrain that destroyed them. There was nothing unusual in the severity of the season on this occasion to account for their destruction.

My impression at the time was that the disease was a fluke or hydatid that attacked the liver, but soon spread to the muscles and other tissues of the rabbit. I have seen several instances of such a disease among the rabbits in the Waira-

rapa district; but it does not seem to spread—most probably owing to the absence of other carnivorous animals in which the hydatid exists in the tapeworm stage. The animals that prey on the rabbit in the country I speak of are the wolf, the kit-fox, and the common fox; so that if it is due to the fluke it is probable that it is from one of these animals that the disease is derived.

JAMES HECTOR.

Colonial Museum, 30th December, 1887.

The Hon. the Minister of Mines.

I HAVE already reported on these papers to the Joint Rabbit Committee.

The disease described by Mr. McBeath (p. 11) as so fatal to rabbits is the same that I referred to in evidence given on the subject in 1872. It is not a constitutional disease, as Mr. McBeath states, nor one affected by climate, as Mr. Bayley suggests, but is due to some form of an internal parasite (probably the *Cœnurus*) that gives rise to what are known among the warreners of Norfolk as "bladdery rabbits."

As I previously reported, in 1857–59 I have seen the rabbits wholly destroyed by disease over large districts of western Canada, and have in consequence been myself nearly starved along with the Indians, just as described by Mr. McBeath. There is reason to believe that this "bladder-worm" is one stage in the development of a kind of tapeworm that infests the lynx, fox, and perhaps other carnivorous animals that prey on rabbits. This double form of existence explains the periodicity of the murrain.

The chain of circumstances is somewhat as follows:—First period: Rabbits increase greatly until they are in swarms. Second period: Lynxes and foxes are attracted to, and thrive in, the district, and infect the rabbits. Third period: The rabbits die off, and the lynxes and foxes clear out to other districts in search of food. Fourth period: A few remaining rabbits commence to breed, and the first period recurs.

As the rabbit is much shorter-lived, more rapidly matured, and greatly more prolific than the fox or lynx, the latter can only be saved from destruction by migration. The fox and lynx do not therefore keep the rabbit in check merely by preying on them, but in a far greater degree by the conveyance of the disease that causes the murrain among the rabbits. In a somewhat similar manner the scab-insect of the cat is the same that infests the rabbit with fatal results—attention to which as a means of checking the rabbit-pest has been lately recalled by Professor Watson, of Adelaide; but it would be well to await the result of experiments that are being made to ascertain if this scab-insect is specifically distinct from that of the sheep.

The suggestion of Mr. Broden (p. 15) to introduce the fishers and the marten is hardly suitable to the conditions. Both these animals are only forms of the polecat that are specially adapted for living in dense subarctic forests. I am afraid that in New Zealand they would not live in our open country, but take to the bush, where there are no rabbits, as in America; for the American rabbit is really a hare that lives in forest country without making burrows.

It would be advisable to introduce the black-footed ferret which inhabits the prairies west of the Mississippi and lives on the gophers and prairie-dogs, which are rodents that have burrowing habits like our rabbits. Besides, the British martens have even a worse reputation than polecats as destroyers of lambs, one pair having been known to kill twenty-one lambs in a night.

The suggestion of Mr. Thaine, of Capetown, requires more definite information, founded on experience.

The civet-cat is not a cat, but a burrowing animal about 3½ft. long that inhabits subtropical Africa. As it is of great value on account of its musk-secretion, it would be a useful animal to introduce if it would thrive in this climate and live on rabbits.

The meer-cat is a small animal like a rat, being the African representative of the Indian mongoos, or ichneumon. It burrows in the dry arid plains of South Africa, and is very plentiful there. The Indian mongoos has already been turned out in New Zealand; but I have recommended the introduction of the kit-fox, a small species that lives in Oregon, and the Canadian lynx, as the most natural enemies of the rabbit.

JAMES HECTOR.

N.W. Mounted Police,
Battleford, 17th January, 1889.

To the Officer commanding C Division, N.W.M.P.

SIR,—In compliance with instructions received from you, I beg leave to report that last year and up to the present time there has been an unusual scarcity of rabbits in this part of the Saskatchewan district.

Every seven years the rabbits indigenous to this country become affected with a disease of the epizootic type, which, in my opinion, is malignant anthrax. The development of this disease may arise from contagion, mosquitoes and other insects with perforating apparatus to the mouth helping to communicate the disease; frequent inundations of banks of rivers; very warm, dry summers; extreme vicissitudes in temperature of either night or day.

During the summer of 1886 and the spring of 1887 an

immense number of rabbits died in this section of the country, many being found dead in the erect posture, which goes far to show that death must have been very sudden. In many cases diffused dropsical swellings were to be seen all over the body, the throat being much swollen, and a streaky bloody discharge oozing from the mouth. The *post-mortem* examination in most cases revealed the cellular tissues much congested with black tarry blood, the mucous membrane lining the trachea much congested, the liver enlarged and congested, likewise serous effusion into the thoracic viscera. There were also to be seen bloody exudations into all the internal organs.

I am, &c.,

J. L. Poett, Vet. Surgeon.

Extract of Letter from L. Clarke, Esq.

N. W. Territories, Regina.

In reply, I have to state that rabbits swarm throughout the country every seven years periodically.

For instance, in 1880 rabbits were found dead in scores under every bush; in 1881 but very few were snared; in 1882 they had almost totally disappeared; in 1883 the country was travelled for long distances without a rabbit-track appearing on the snow; in 1884 rabbit-tracks became common; in 1885 they became still more numerous; in 1886 they simply were swarming throughout the country; in the winter of 1887 they were still very numerous, but their numbers greatly diminished.

In 1885 lynx and foxes became numerous; in 1886 the same classes of fur-bearing animals were caught in great quantities; in 1887 the catch of these animals was very much larger than in the previous year. These two classes of fur-bearing animals prey entirely upon rabbits when the latter are plentiful, and destroy large numbers.

The rabbits, following the usual course of events, in 1888 will be attacked by a murrain or throat-disease, which will almost exterminate them.

I have an opinion that the rabbits, having eaten up all their natural food within their reach, are compelled to fall back upon other food-substance which proves the cause of the singular disease which kills them.

Scores of rabbits next year will be found under every bush, evidently choked to death, from the appearance of the neck and head.

I have, &c.,

L. Clarke, C.F.

EXTRACT of LETTER from A. MCBEATH, Esq., *re* DIMINUTION of RABBITS.

Fort Qu'appelle, 25th June, 1887.

MY experience of this subject covers a period of nearly sixty years, during which time, as an officer of the Hudson Bay Company, I have had opportunities of observing the periodical increase and decrease of the rabbits over the whole of the North-west Territories, from the Rocky Mountains to Hudson Bay, and from the shores of the Arctic Ocean to Red River. Although I never made any special investigation into the subject of the rabbit-disease, still, in the ordinary course of my duties a certain amount of attention had of necessity to be given to the question of rabbits, as at some of the Hudson Bay posts where I was stationed they, in conjunction with fish, formed the principal (sometimes the only) food of the company's servants, besides being fed to the hauling-dogs. In some parts the Indians depended almost entirely on rabbits for their existence, and I myself have known many Indians dying from starvation during those years when the rabbits were practically extinct.

With regard to the exact period at which the disease appears among the rabbits, my experience goes to prove that regularly every seven years they reach the limit of their increase. The disease then, without any apparent cause, appears among them, and during the following three years they rapidly decrease, and again at the seventh year they are at their height.

As to the exact nature of the disease, I am unable to give any detailed information further than that every rabbit I ever found dead (and I have picked up thousands of them) showed the same symptoms of disease—viz., a lump like an enlarged gland on each side of the throat under the jaw-bones. In fact, it was from this sign that we decided as to whether they were fit for human food or only fit for the dogs. During all my experience I never heard of any other symptoms of disease being noticed. From the appearance of the dead rabbits I judged they must have suffered for a considerable time before they died, as they were hardly anything but skin and bone.

In my opinion, it is to this regularly-recurring disease that we must attribute the exemption of Canada from a rabbit-pest similar to that which has become such a serious evil in New Zealand. As a means of reducing the pest in New Zealand, I would respectfully suggest that a number of rabbits be exported from this country there, and, being turned loose among the native rabbits, would, in my opinion, by cross-breeding, introduce their disease, which I believe to be inherent in their blood.

A. MCBEATH.

Extract of Letter from W. Brodie, Esq., President Toronto Natural History Society.

Of the several agencies which operate in Ontario and the North-west Provinces in limiting the increase of the native rabbit (*Lepus americanus*, Erxl.), the three principal are—(1) The cryptoid parasites, the development of which requires an intermediate carnivorous animal preying on the rabbit, such as the wolf, fisher, and owl. (2.) The wood-tick, a large external parasite, not yet well separated from other species of the genus, which, though often found on other rodents and on carnivorous animals, is especially a parasite on the rabbit. (3.) Carnivorous animals, the principal of which are the wolf, fox, lynx, fisher, marten, and owl. Of these, the fisher, marten, and owl prey more exclusively on rabbits than any of the others.

From remote and various causes these vary in number from year to year, and when a maximum of their number occur in the same season the rabbits are brought down to zero. The parasites reduce the staying-powers of the rabbit, thus making it an easier prey to its carnivorous enemies, while these, in turn, force it from the best feeding-grounds.

To check the increase of the English rabbit in New Zealand, I would recommend the importation and protection of the fisher (*Mustela pennantii*), the marten (*Mustela americana*), and the horned owl (*Bubo virginiana*). The first two are amongst the largest and most insatiable of their race, breed freely, are hardy, have a wide geographical range, are swift runners, have good scent, and freely follow rabbits into their burrows. They are also good climbers, thus easily eluding the pursuit of dogs and other large animals. Neither of them are large enough to do injury to any domestic animals except fowls. The horned owl is a large, hardy, and powerful bird, having a wide geographical range, lives to an old age, and breeds freely. Where rabbits are abundant it feeds almost exclusively upon them, and as it is a nocturnal feeder it is easy to protect domestic fowls from its attack. From the fact that these animals thrive well in confinement, eating living or dead food, and from their generally hardy nature, it is believed they would endure a long ocean-voyage.

W. Brodie.

Canadian Rabbit-disease.

Inspector Mackay informs me that there is an island in Lake Wanaka which at one time swarmed with rabbits, but they were attacked by a disease, and nearly, if not quite, exterminated. A similar instance exists in the Motunau Island, on

the coast about forty miles north of Christchurch, which was stocked with rabbits some thirty years ago by Mr. Caverhill. About every seven years disease nearly exterminates the rabbits; but the fittest survive and breed up again. The reason is popularly supposed to be that the rabbits increase beyond their food-supply, and, becoming weakened in consequence, are attacked by disease. This Canadian disease may be similar.

R. Foster, Inspector,
Christchurch.

Art. XXXVI.—*The Soaring of the Hawk—A possible Reason for Notched Wing-feathers.*

By T. W. Kirk, F.R.M.S.

[*Read before the Wellington Philosophical Society, 31st July, 1889.*]

Plate XVIII.

The peculiar notched or cut-away shape of the primary feathers in the wings of many birds, more especially of the Raptores, or "birds of prey," has often attracted my attention, and the purpose of such emargination has been a source of curiosity to me for many years.

Before going further, however, allow me to direct your attention to this feather (Plate XVIII., fig. 1). You will observe that the outer portion of both the anterior and posterior vanes (I am speaking of the feather as though it were in position in the expanded wing) is cut away, the anterior for about half its length, the posterior for rather less. The form of these feathers has, of course, been frequently described, but I have never seen any explanation of why their shape should be as it is—indeed, I believe no such explanation has been published.

I recently stumbled, so to speak, upon what may perhaps prove to be a solution of the question. When up country a short time ago I saw a large hawk (*Circus gouldi*) shot while soaring. After receiving the charge it continued to soar although rapidly descending, and fell at some distance with both wings extended. On going to pick it up I was surprised to observe that, though quite dead, its wings were still expanded, and the primaries were locked by a partial reversal of their vanes, as shown in the specimen now on the table (fig. 2). Fig. 3 shows the under-side of the same wing.

The question arose, was this position of the feathers due to accident, or had the bird the power of placing them in this apparently unusual relationship? and, if the latter, with what object? After a careful examination, I replaced the vanes in