

## **RABIES IN CANADA, WITH SPECIAL REFERENCE TO WILDLIFE RESERVOIRS**

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### SYNOPSIS

The course of known outbreaks of rabies in Canada in the 20th century is sketched, and the present extensive enzootic described. Its spread throughout the North West Territories, and in the Provinces of Alberta, British Columbia, Manitoba, Quebec, and Saskatchewan, is attributed to the vast potential reservoirs of infection offered by the density of fauna in these areas—in particular, of foxes and wolves. Control and eradication is being attempted—with some success—chiefly by reducing the wildlife population and restricting the movement of dogs.

The most extensive enzootic of rabies ever known in Canada is in existence at the present time. It involves the North West Territories, practically all the Province of Alberta and certain northern districts of British Columbia, Saskatchewan, Manitoba, and Quebec. The infection was recognized first in 1947 almost simultaneously in three widely separated parts of the North West Territories. The important features of the initial discovery were that foxes and wolves were infected, and that the disease was present in the newer, unsettled parts of the country. Previously, all outbreaks had been in the older, populated areas of Canada, and infection was confined to domesticated animals.

This presented an entirely new situation. In the Territories and the northern parts of the Provinces, wildlife is present in great numbers. Certain species by their natural instincts are ideally equipped to transmit and disseminate rabies, and it is impossible to control their movements. From the onset, two species, foxes and wolves, were found to be infected. Later, the infection appeared in the coyote, lynx, bear, rabbit, mouse, beaver, and moose. Each additional species involved enlarges the reservoir and correspondingly adds to the difficulty of eradication.

The scope and magnitude of the problem may best be realized by examining a map of Canada. The 60th parallel divides the country into two parts. The section north of the parallel constitutes the North West Territories and the Yukon, comprising approximately 1,551,030 square miles

(nearly four million km<sup>2</sup>) of land and salt-water. In some parts the water is frozen for many months of the year ; in others it is always frozen, and represents a solid area. South of the parallel are situated the major portions of the Provinces. Here there are 2,294,114 square miles (approximately six and a half million km<sup>2</sup>) of land and fresh-water. The North West Territories and the first few hundred miles of the country south of the 60th parallel are sparsely populated and uncultivated. In contrast to the small human population, there is a large fauna of many species. The older, thickly-populated part of the country is south of the 54th parallel. This wide strip of land borders on the United States of America for a distance of some 3,000 miles (4,800 km). It was in this region that all previous outbreaks occurred. Canada, except upon a few occasions, has been free of rabies. This is remarkable when one considers its prevalence in the USA, and the fact that only an imaginary line separates the two countries.

In the older section of Canada the disease was first shown to occur in 1906, when two outbreaks were noted. One of these was in the southern part of Alberta and Saskatchewan, and involved only a limited number of animals; it was eliminated quickly. The other outbreak occurred in the Niagara peninsula in Ontario. Here, the dog population was large, and ten years elapsed before the infection was stamped out. Not until 1926 did rabies occur again. This time it made its way to the lower and eastern townships of Quebec, and several years were required to bring it under control. The infection spread to Montreal and in 1929 was carried by dogs along the St. Lawrence River and up the Ottawa valley, again crossing into the Province of Quebec. It was finally eradicated in 1931. The next outbreak occurred during the years 1944-7, and centred around Windsor, Ontario. In addition to these outbreaks, there have been sporadic minor foci involving only a few animals. In every instance the disease was confined to domesticated animals, principally dogs; wildlife was never known to be involved.

The history of the present outbreak probably goes back to late in the 19th century, although precise information did not become available until the 1930's. At that time, reports started to reach Ottawa relating to a condition of sleigh-dogs and wild animals in the North West Territories. These reports were received at irregular intervals and from widely separated districts, but there was a common denominator in the majority—a description of a disease affecting the central nervous system. Speculation arose as to its nature, but in the absence of specimens a diagnosis was not made. Occasionally, tissue was submitted, but invariably on arrival it was either putrid or preserved in a manner that precluded examination. Owing to the great distance and the difficulty of transportation, specimens generally failed to arrive within a year of submission.

In 1947 the condition was reported at Baker Lake, a small outpost situated approximately 400 miles (640 km) north of Fort Churchill and in

the centre of the Territories. Arrangements were made for the author to go there by air. The disease, unfortunately, had subsided, but the carcasses of three dogs and a fox were available for study. Negri bodies were found in the brain of the fox, and also indefinite bodies in one dog. Subsequent laboratory-animal inoculations confirmed the field diagnosis, viable virus of rabies being found in the fox and in two of the three dogs. Shortly after, the brain of a mouse was received at the Animal Diseases Research Institute from the Provincial Bacteriologist of Alberta. It was one of several that had succumbed to inoculation of wolf-brain material from the district of Aklavik, a town in the extreme western part of the Territories. Microscopic study and animal inoculations both revealed evidence of rabies virus. Three months later the disease was found in Frobisher Bay, Baffin Island, when the brain of a sleigh-dog sent to the Institute was found to contain the virus of rabies. Thus, the presence of rabies was established in the eastern, central, and western areas of the North West Territories, and its existence confirmed in the fox and the wolf. As soon as the nature of the disease was disclosed, and the seriousness of the situation became apparent, a more concentrated effort was made to obtain specimens. Air travel had largely overcome earlier difficulties, and specimens became available.

In 1948, positive material was received from Cambridge Bay; in 1951, from Lake Harbour, Fort Smith, and also Fort Churchill in Manitoba. In 1952, more areas of the North West Territories were found to be involved. These included Toktoyaktuk, Yellowknife, Fort Rae, Fort Smith, Fort Macpherson, and Fort Resolution; also Summit Lake in the Yukon. In every instance, wildlife was infected—either foxes or wolves. It became obvious that the disease was enzootic throughout the entire North West Territories and that the reservoir of infection was wildlife.

The greatest invasion into a Province has been in Alberta. The disease was first discovered in June 1952, when positive dogs were found at Fort Fitzgerald, just south of the 50th parallel. In September, a positive fox was found at Peace River and a dog, a fox, and two pigs at Fort Vermilion, some 100 miles (160 km) south of the North West Territories. From then on the tempo increased. Positive animals have been submitted from one new community after another, with the general direction of spread towards the south. By the middle of 1953, the enzootic was considered to affect all parts of the Province except a narrow strip of land 35 miles (56 km) wide along the international border.

To the west of Alberta and in the Province of British Columbia the first cases were found in January 1953, when a positive wolf and two foxes were discovered. These animals came from around the district of Fort Nelson, approximately 100 miles (160 km) south of the northern border and 75 miles (120 km) from Alberta. The next specimen was a fox from an area known as Mile 110, on the Alaska highway; this was in February. In March, there were three foxes and a coyote from the district of Monteny and Rose

prairie, about 175 miles (280 km) south of Fort Nelson. In April, there were two positive specimens—a coyote from Montenev and a dog from East Pine; the latter is the most southern area involved and is a few miles south of Dawson Creek but 35 miles (56 km) west. If distances are considered, it would appear that the disease in British Columbia was brought in from Alberta rather than from the North West Territories.

As far as is known, in Saskatchewan only one district has been affected; that is Lake Loche, midway between the 56th and 57th parallels and close to the Alberta border. The first specimens were found in December 1952, the last in March 1953. Only dogs have been found to be infected. Again, it would appear that the disease was carried from Alberta.

In Manitoba, the first specimen was a fox from Fort Churchill in September 1951. Fort Churchill is at the eastern boundary of Manitoba on Hudson Bay and approximately 85 miles (137 km) south of the 50th parallel. The second specimen was another fox from the same district in May 1952. The last received was a dog from Nelson House, a few miles south of the 56th parallel and approximately 150 miles (240 km) east of Saskatchewan.

In January and February 1953, four dogs and three foxes were received at the laboratory from Eastmain, Quebec. These proved to have been infected with rabies. This district is on the eastern shore of James Bay, approximately 150 miles (240 km) north of the 50th parallel. There have been no further specimens from Quebec.

Two features of the outbreak would appear to be of special interest. The first relates to the period of incubation in the Territories. Evidence which appears overwhelming has accumulated to indicate that in this colder part of the country the period of incubation is from 4 to 5 days. At first it was thought that this was an error, and that the animals had experienced a previous exposure. The accumulated data, however, are such that we must for the present accept this interpretation of the period of incubation in the north. Whether it results from the extremely cold climate, or from an unusual susceptibility in the native dog, has not been determined. When the virus is brought to the laboratory and inoculated into experimental animals the usual incubation period follows. We are arranging to hold experimental dogs at low temperatures after inoculation to determine whether the shorter period found in the north is the result of low temperature or of the especial breed of animal there.

The second feature is the emphasis on the changed dispositions among wild animals following infection. Ordinarily, foxes and wolves fear their natural enemies and pay only surreptitious visits to settlements. When these animals develop the first stages of rabies they walk boldly into settlements and even into dwellings and mingle freely with sleigh-dogs, which ordinarily they avoid. In fact, it is not unusual for these infected animals to join a dog-team during travel. This has resulted in the colloquial term among

trappers and other northern people of "crazy animal". Less aggressive species, such as coyotes and rabbits, lose their fear of man and without hesitation will attack him or domestic animals.

Table I, which follows, indicates the number of specimens presented for examination and the results. It is necessary to point out that this does not represent the number of infected animals. When an infected animal is demonstrated in a district, this is looked upon as an infected area and very few other specimens are taken.

**TABLE I. WILD AND DOMESTIC ANIMALS IN WHICH RABIES WAS POSITIVELY DIAGNOSED, IN VARIOUS PARTS OF CANADA**

Animals	North West Territories	British Columbia	Alberta	Saskatchewan	Manitoba	Quebec	Total
<b>Wild</b>							
Bear . . . . .	.	.	1	.	.	.	1
Beaver . . . . .	.	.	2	.	.	.	2
Caribou . . . . .	1	.	.	.	.	.	1
Coyote . . . . .	.	1	17	.	.	.	18
Fox . . . . .	18	5	21	1	1	3	49
Lynx . . . . .	.	.	3	.	.	.	3
Moose . . . . .	.	1	1	.	.	.	2
Rabbit . . . . .	.	.	1	.	.	.	1
Weasel . . . . .	.	.	1	.	.	.	1
Wolf . . . . .	2	1	1	.	.	.	4
Total . . . . .	21	8	48	1	1	3	82
<b>Domestic</b>							
Cat . . . . .	.	.	6	1	.	.	7
Cow . . . . .	1	2	6	.	.	.	9
Dog . . . . .	25	3	30	4	1	4	67
Pig . . . . .	.	.	3	.	.	.	3
Sheep . . . . .	.	.	1	.	.	.	1
Total . . . . .	26	5	46	5	1	4	87

The present outbreak in Canada raises a number of questions which cannot be answered with precision. Looking back, and reading into many accounts coming out of the north, it seems reasonably certain that rabies has been present among wild animals in this vast territory for a great number of years. That the infection was brought into the country in the early days of the Hudson Bay trade, and has remained present there for

many years, is difficult to believe, and yet from time to time accounts would suggest that a central-nervous-system infection was found among dogs occasionally. Alaska is on the northern Canadian boundary, and since the USA has for many years contained infected animals the possibility arises that infection came in from this source. However, all this is mere speculation. The point is that within comparatively recent years there is evidence to indicate that rabies was present. The reason for its rapid expansion and the migration of the disease southward is likely to be found to be related to the density of the wild animal population. The pelts of the fox and the wolf possessed considerable economic value until recent years. Consequently, the trappers were seeking these animals and thereby reducing the population. A few years ago, the value of these pelts declined to a point where there was little inducement to capture foxes and wolves. This seems to have been the basic reason for an increase and concentration of this carnivorous population in the wilderness of the north. Some idea may be gathered of the likely number of animals to be found by considering that one man travelling along a highway in northern Alberta for a distance of 300 miles (480 km) was able to shoot 430 foxes without leaving the highway. It is said, too, that there has been a migration southward of some of the smaller animals which are prey for foxes and wolves, these, in turn, being followed by the predators.

The evidence suggests that the fox is the most dangerous reservoir. Like the wolf, it travels long distances, but, unlike the wolf, it fails to kill the larger animals which it attacks. In this way it serves, like the dog, as a travelling reservoir, snapping and infecting along the way and leaving in its wake a number of inoculated animals.

Having regard to the conditions only briefly outlined here, it will be realized that the whole matter of control is a most difficult one. Over the years, Canada has not taken kindly to control measures that are not aimed at stamping out a disease. As an example, vaccination against hog cholera in Canada has not been permitted. The whole policy has aimed at completely eliminating the disease from the country. This has been eminently successful and can be demonstrated to be the most economical of all policies. A similar system has been followed with the few outbreaks of rabies previously noted. These, however, have been in the south where wildlife is seldom found and where the reservoir is the dog. The control, by tying up and muzzling, has always resulted in the complete elimination of the disease from the country. In the north, however, a very different set of circumstances is to be found. Here, as indicated, the disease reservoir is not the dog but wildlife, such as wolves and foxes. Therefore the tried and successful method which has been followed in the south is totally inapplicable to the wilderness country. It is possible that a reduction of wild animal life, so that the concentration of population makes the transfer of infection from animal to animal in serial order more difficult, will be sufficient to reduce the incidence

of disease. An active campaign is going forward, supported by the Provinces, of reducing the wild animal population by various means, including poisoned baits. One might speculate on the effect of increasing the value of furs to encourage the destruction of these wild creatures. One might be inclined to wish that a vaccine which would be active by the oral route might be devised. For the present, however, the control of the infection in Canada is being attacked by (a) reducing the wildlife population, (b) controlling the movement of dogs, and (c) the vaccination of dogs and cats in the settled areas. Already there appears to have been a very definite decline in the incidence of infection. It may be added that, while vaccination is used, it is looked upon as subsidiary and of secondary importance to the first two measures named.

### RÉSUMÉ

L'enzoote rabique qui existe actuellement au Canada est la plus sérieuse que ce pays ait connue. Elle s'étend sur tous les territoires du Nord-Ouest, la province d'Alberta, certains districts du nord de la Colombie britannique, du Saskatchewan, du Manitoba et de Québec. On découvrit en 1947 que les renards et les loups étaient infectés et que la maladie existait dans les parties du pays le plus récemment habitées, alors que, autrefois, elle était confinée dans les régions les plus peuplées et limitée aux seuls animaux domestiques. Plus tard, on trouva la rage chez le coyote, le lynx, l'ours, le lapin, la souris et l'original. Ces animaux étant très répandus, le réservoir de l'infection est immense et la lutte d'autant plus difficile. L'enzoote présente deux caractères qu'il est utile de connaître : la période d'incubation n'est que de 4-5 jours chez les chiens vivant dans le nord. On ne sait s'il s'agit d'une sensibilité particulière des races en cause ou de l'influence du climat. D'autre part, l'attitude des animaux enragés vis-à-vis de leurs ennemis naturels se modifie. Les renards et les loups pénètrent dans les camps, les cabanes et les maisons, se mêlent librement aux chiens de traîneaux et accompagnent leurs attelages (ces « animaux fous » sont connus des trappeurs). Des animaux de nature moins agressive, tels que les coyotes, perdent leur crainte instinctive et attaquent l'homme ou les animaux domestiques.

Il est possible que la rage ait existé au Canada depuis fort longtemps. Sa brusque et récente invasion et son expansion vers le sud doit être en rapport avec la densité de la population des animaux sauvages. Il y a quelques années encore, les fourrures de renard et de loup avaient une grande valeur. La chasse intensive faite à ces animaux réduisait notablement leur nombre (un chasseur pouvait tuer 430 renards sur quelque 500 km sans quitter la grande route). La valeur de ces fourrures baissa et, la chasse n'étant plus d'un rendement intéressant, le nombre des carnivores augmenta à nouveau dans les régions désertiques du nord. Il semble aussi que les petits animaux qu'attaquaient le renard et le loup aient fui vers le sud, et que ces derniers aient suivi leurs proies.

La lutte est extrêmement difficile. Jusqu'à maintenant, les autorités sanitaires du Canada ont favorisé — avec grand succès — les mesures propres à éliminer une maladie plutôt que celles qui se bornaient à la tenir en échec. Le système appliqué lors de précédentes épizooties rabiques, dans des régions où les animaux sauvages étaient rares et où les chiens représentaient le réservoir de la maladie, ont donné d'excellents résultats. Dans l'enzoote actuelle, dont les animaux sauvages sont responsables, les mêmes

mesures (laisse et muselière) ne sont pas applicables. Aussi des campagnes sont-elles conduites très activement, avec l'appui des Provinces, visant à la réduction des populations d'animaux sauvages. On peut espérer que la revalorisation de certaines fourrures pourra y contribuer. La campagne antirabique au Canada revêt maintenant trois aspects : a) réduction du nombre des animaux sauvages; b) surveillance du mouvement des chiens; c) vaccination des chiens et chats dans les zones urbaines, cette dernière mesure étant considérée comme un complément des deux précédentes.

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