cocoons between the rocks under the double layer of fabric. On April 16 a pupa could be seen in the cocoon under the curtain fabric. It was 27 mm long, black and shiny. A female emerged on June 1, after six weeks pupation. A male emerged from a cocoon between the rocks on June 11. The third pupa was killed by mildew. The moths emerged 10 days earlier than those observed in nature, a sign that the hibernation place was too warm and the ambient air too dry. None of the larvae reared was parasitised.

Reference

Jones, J. R. J. L. 1951. An annotated check list of the Macrolepidoptera of British Columbia. Entomol. Soc. Brit. Columbia Occasional Paper No. 1.

RECORDS OF TICK PARALYSIS IN LIVESTOCK IN BRITISH COLUMBIA

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ABSTRACT

Reports of 189 outbreaks of tick paralysis in livestock in British Columbia are tabulated with regard to distribution, the kind and number of animals involved, the annual incidence of paralysis, and the dates and sizes of the major outbreaks. The disease is most prevalent in the western half of the interior dry belt where there have been apparent peak years of cases. The recorded totals are in excess of 2010, 1849, 9, and 13 for cattle, sheep, horses, and dogs, respectively. Most of the loss from the disease results from the extra manpower needed to care for affected animals, reduced animal condition, and disuse of otherwise valuable pasture.

Almost every year since its inception in 1928, the entomology laboratory at Kamloops, B.C., has received word of cases of tick paralysis in livestock and humans in this province. Since the published records refer only to 11 out of some 190 outbreaks of the disease in livestock, it is felt that more information should be made available from data in this laboratory's files.

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Tick paralysis was first recognized as a disease in North America when Todd, in 1912, accumulated case histories of the effects associated with tick bites in humans and differentiated the symptoms from those of Rocky Mountain spotted fever. Hadwen (1913) associated the disease with a condition observed in the vicinity of Keremeos, where for three years a farmer had up to 300 of his sheep affected by a form of paralysis. Hadwen proved experimentally that the disease was caused by the bite of *Dermacentor venustus* Banks (=*D. andersoni* Stiles). His theory that a toxin caused the symptoms remains unchallenged.

Other than Bruce's (1920) warning to ranchers of tick paralysis, there are no further references to outbreaks until Bruce's publication in 1922. In this, he records witnessing an outbreak at Vavenby where Moilliet had 300 sheep affected out of a band of 400. Subsequent unpublished references to this rancher indicate that up to 1928 as many as 10% of his flock of 1300 were sometimes paralysed.

In 1928, at the request of the B.C. ranching industry, a laboratory was established at Kamloops for the study

of insects affecting livestock. After this date all records of tick paralysis appear in the laboratory's files and unpublished monthly reports. These have been the source of most of the figures presented here.

Concerning the validity of these records, it must be noted that only occasionally have instances of paralysis in livestock been fully and officially verified. The symptoms are so well known to the stockman that his first thought is for his animals, and only after they have been "de-ticked" does he trouble to report the occurrence, and not always then. Frequently the information trickles in second-hand a year or more later. Nevertheless, because the symptoms are not likely to be confused with other illnesses, there is usually little doubt of the authenticity of cases witnessed and reported by ranchers.

The size of an outbreak is often more questionable; a distraught rancher tends to exaggerate his losses. Compensating this in the overall picture is the fact that many instances of tick paralysis never are recorded. Indeed, herders have frequently been reticent in reporting their troubles even to their employers for fear of reprisals for negligence.

TABLE 1—Number of livestock and humans paralysed annually in British Columbia by ticks as reported to the Kamloops laboratory since 1900.

Year	Cattle	Sheep	Horses	Dogs	Totals	Reports	Humans
to 20	13	385*			398*	6	±80
20-28	22	375	2		399	7	±80
28	*	130			130*	2	6
29	4	26*			30*	6	9
30	101	24			125	5	11
31	2	20	1	1	24	5	
32	2	20*			22*	3	5
33	2*	22			24*	5	1
34	29	1*			30*	5	4
35	200	13		5	218	12	4
36	15	103	1		119	7	
37	22	2*			24*	5	1
38	10	211			221	8	4
39	20	2*			22*	4	7
40	32			2	34	4	1
41		1	1		2	2	1
42	25	16*			41*	4	2
43	16	*	1		17*	4	
44	491*		3		494*	11	2
45	34				34	4	3
46					0	0	
47	3	*			3*	2	2
48	70				70	2	4
49	1				1	1	4
50	58*	50			108*	7	
51	103	341			444	21	
52					0	0	1
53	*				0	1	8
54	1	100			101	2	7
55	30				30	1	2
56					0	0	2
57	385*				385*	10	2
58	1				1	1	1
59	23				23	3	1
60					0	0	3
61					0	0	1
62	1	3		2	6	4	7
63	1				1	1	5
64	263*	4			267*	19	3
65	30			3	33	5	2
Totals	2010	1849	9	13	3881	189	276

* "several" cases. These are not entered in the totals.

Human cases are well documented in the Kamloops files since 1928, but prior to that date the records are obscure and there are possibilities of duplication.

In this paper the 189 single and multiple records of tick paralysis in livestock are tabulated in three ways. Fig. 1 illustrates their distribution and the kind and approximate numbers of animals involved. Table 1 lists, separately and together, the annual totals of paralysed cattle, sheep, horses and dogs, and also the annual incidence of paralysis as recorded from separate reports, either single or grouped cases. Human cases have been included to give an overall picture of tick activity. Table 2 lists those outbreaks which exceeded 20 paralysed animals.

Reference to these tabulations, with details in the original reports, permits some speculation regarding the frequency and distribution of tick paralysis as it affects livestock. However, in dealing with a disease as enigmatic as this one (Gregson, 1962) caution must be taken not to be misled by false interpretations for it will be apparent that to evaluate properly any one aspect, the whole picture must be considered. Since the main purpose of this paper is to list the incidence in livestock, other aspects of the disease will not be discussed.

The distribution of tick paralysis in livestock, with the exception of two known outbreaks, appears to be confined to the western half of the interior dry belt. The largest outbreaks

TABLE 2—Outbreaks of tick paralysis in B.C. since 1911, involving more than 20 head of livestock.

Date	Locality	Positions*		Cattle	Sheep	No. exposed to ticks	Paralysed	Died
1911	Keremeos	49°N	119°W		x	900	46+	46
1912	Keremeos	49	119		x	900	334	90
1920	Vavenby	51	119		x	400	300	—
1927	Similkameen	49	119		x	—	40+	40
1928	Vavenby	51	119		x	1300	10% yr	few
1929	Blackpines	50	120		x	350	20/day	few
1930	Douglas L.	50	120	x		900	100	65
1930	Stump Lake	50	120		x	—	10-15/day	—
1931	Copper Cr.	50	120		x	700	20+	20
1932	Falkland	50	119		x	180	35+	35
1935	Quilchena	50	120	x		638	200	26
1936	Wolf Cr.	49	120		x	1000	100	—
1938	Pinantan	50	120		x	1700	90	12
1938	Jaffray	49	115		x	—	100+	100
1940	Scheidam Fl.	50	120	x		200	26	5
1944	Merritt	50	120	x		—	40	12
1944	Quilchena	50	120	x		1230	400	50
1944	Douglas L.	50	120	x		—	42+	42
1948	Big Creek	51	122	x		2000	50	several
1950	Merritt	50	120	x		—	40	3
1950	Pritchard	50	119		x	300	50	1
1951	Quilchena	50	120	x		800	30	3
1951	Penticton	49	119		x	—	20+	--
1951	Barnhartvale	50	120		x	700	270	7
1954	Barnhartvale	50	120		x	—	100	--
1955	Douglas L.	50	120	x		400	30	2
1957	Stump Lake	50	120	x		118	32	7
1957	Douglas L.	50	120	x		700	320	30
1964	Alkali L.	51	122	x		300	22	7
1964	Dog Cr.	51	122	x		650	±90	3
1964	Farwell Can.	51	122	x		250	±60	13
1964	Copper Cr.	50	120	x		400	30	—
1965	Chimney Cr.	52	122	x		250	28	—

* According to 1953 Gazetteer of Canada; B.C. Co-ordinates given at S.E. corners of the geographical quadrilaterals.

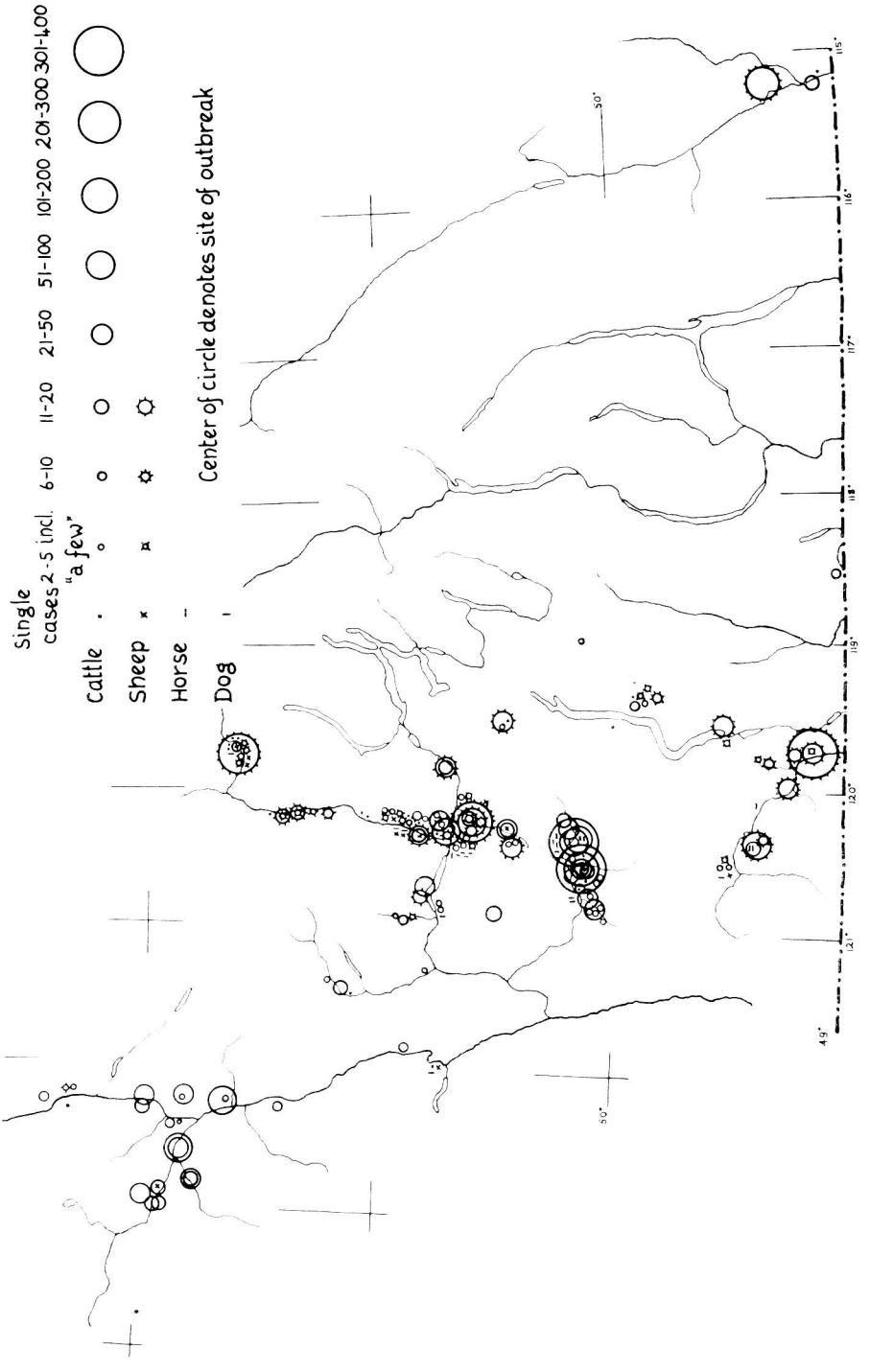

Fig. 1—Occurrences of tick paralysis in south-central British Columbia from 1900 to 1965.

occur in the best areas for ranching, in the vicinity of Keremeos, Princeton, Nicola, Kamloops and Vavenby (Hearle, 1933; Moilliet, 1937; Gregson, 1958). Smaller, more localized outbreaks have been recorded at points along the Fraser River trench from Lillooet to Macalister and up the Chilcotin River to Alexis Creek. Others have appeared at Mamette Lake, Upper Bonaparte, Chase, Falkland and Kelowna.

The paucity of cases in the Kootenay district may partly be due to the fact that only about 15% of the beef cattle industry is in that area. Nevertheless, there are enough animals and ticks for a paralysis potential. Of interest is the fact that since 1928, 25% of the human cases in B.C. have occurred in this region. Conversely, there is only one human record in the vicinity of Nicola Lake where a total of more than 1000 cattle have been paralysed. Host density is obviously a factor in the incidence of paralysis but presumably not the only one. Ticks east of the Rocky Mountains produce paralysis rarely, if at all.

Besides the apparent distributional variation in tick virulence, there is the possibility of seasonal variation, resulting either from tick activity or their feeding habits. Ranchers are often heard to say that there are "bad tick years." One sheepman believed that extremes in spring temperatures made the ticks "hungrier and deadlier." Whether or not there are such variations in tick virulence, Table 1 shows that some years such as 1935, 1944, 1951, 1957 and 1964 are worse than others for livestock infestations. Not only were there major outbreaks of paralysis during these years, but also there were more than the average number of separate outbreaks. A questionnaire solicited much of this information in 1951, but questionnaires were sent out also in 1939, 1955 and 1965. It is perhaps significant that the incidence of human paralysis is not appreciably higher during years of heavy livestock paralysis. Human exposure to ticks would be expected to be less variable than that of livestock and may thus indicate that variations in the livestock records are more or less determined by movements of the cattle. During years of hay shortage special advantage is taken of warm, tick-infested hillsides for early spring grazing; this might further coincide with a year of high tick activity. When conditions of a particular year force this practice upon many ranchers, there may be a high incidence of paralysis, often in new areas. Such was the situation in the Fraser River trench in 1964. Changing ranching practices such as the decline in sheep populations, or avoidance of tick-infested areas following an outbreak of paralysis, are also responsible for annual fluctuations of this disease.

One often hears that ticks are on the increase, or that they were originally brought in on livestock. Dr. L. Guichon, pioneer rancher in the Nicola valley from before 1890, was of the latter opinion and did not become aware of ticks as a pest until after 1920. Parks, of Cache Creek, saw ticks for the first time in 40 years in 1928; Lees, at Hanceville since 1913, noticed ticks there first in 1916, then further west at Alexis Creek in 1937; Cotton, of Riske Creek, reported in 1941 that ticks were the worst in the 43 years of his ranching experience and that he had had no ticks at first; Collett, of Merritt, had his first tick trouble in 40 years during 1945; Davis, of Mamette Lake, had his first trouble in 13 years during 1957; Cordonier reported ticks in 1950 for the first time during his 30 years of ranching at Barnhartvale. Although the first published records of paralysis are those appearing along the B.C.-U.S. border, there is no reason to suppose that *D. andersoni* was introduced into Canada from the south. Indeed, correspondence from Moilliet of Vavenby and Johnson of Alkali Lake, report paralysis in cattle on their relatively northern ranches in 1907 and 1903 respectively. It is probable that tick

populations have merely increased following the introduction of livestock into already infested areas.

The incidence of paralysis in livestock is greatest between the 10th and 27th of April. Occasional cases occur two weeks on either side of these dates. The earliest case recorded was on February 9, 1962; the latest, June 15, 1965. Since paralysis occurs only after a tick has been feeding for 5 or more days the dates of the initial infestations would necessarily precede the recorded periods.

The ratio of paralysis in the two groups of livestock most affected has depended partly on which animals were being pastured on infested pastures. Until 1930, cases among sheep were more common; during recent years cattle have superseded sheep and have been more affected (Table 2). The recorded cases for the entire period are in excess of 2010 cattle, 1849 sheep, 9 horses and 13 dogs.

The economic aspect of tick paralysis is difficult to estimate. Definite, recorded deaths over the past 50 years are not greatly in excess of 361 cattle, 251 sheep and 6 horses, representing a value of only about $60,000 even at present prices. Greatly exceeding this figure are the combined losses of manpower required to handle cattle during week-long outbreaks, of animal condition during recovery, and of potential pasturage unused through fear of ticks. The use of BHC during the past 18 years has helped to alleviate the hazard of paralysis. Apart from this remedy, whenever untreated stock are pastured on tick-infested ranges, there still remains the threat of large outbreaks of tick paralysis with heavy animal losses.

References

Bruce, E. A. 1920. Tick paralysis in British Columbia. Dom. of Can. Dept. Agric. Bull. No. 133:7 pp.

Bruce, E. A. 1922. Fatalities in cattle due to the tick **Dermacentor venustus**. J. Amer. Vet. Med. Assoc. 61:537-539.

Gregson, J. D. 1958. Tick paralysis in cattle in British Columbia in 1957. Proc. Entomol. Soc. Brit. Columbia 55:6-7.

Gregson, J. D. 1962. The enigma of tick paralysis in North America. Proc. 11th Intern. Congr. Entomol., Vienna, 1960. 3:92-101.

Hadwen, S. 1913. On "tick paralysis" in sheep and man following bites of **Dermacentor venustus**. Parasitology 6:283-297.

Hearle, E. 1933. Notes on a serious outbreak of tick paralysis in cattle. Proc. Entomol. Soc. Brit. Columbia 30:11-16.

Moilliet, T. K. 1937. A review of tick paralysis in cattle in British Columbia. Proc. Entomol. Soc. Brit. Columbia 33:35-39.

Todd, J. L. 1912. Does a human tick-borne disease exist in British Columbia? Can. Med. Assoc. J. n. s. 2:686.

A RECORD OF THE BROWN-BANDED ROACH

In 1960 specimens of the brown-banded roach, *Supella supellectilium* (Serv.) were sent from a New Westminster home. The furniture in the newly-built house had been shipped from California in a moving van within the last year and the infestation had since developed. Arrangements were made to spray the house and the roach was controlled.

The roach has not been recorded from Canada west of Winnipeg. Mr. C. G. MacNay, Ottawa, has reported it from eastern Canadian cities.

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