L. hoodi Ross. June 10; Nanaimo (Departure Bay). Known from B.C. and Ore.

L. jewetti Ross. Sept. 25; Wellington. Known from B.C., Ore. and Calif.

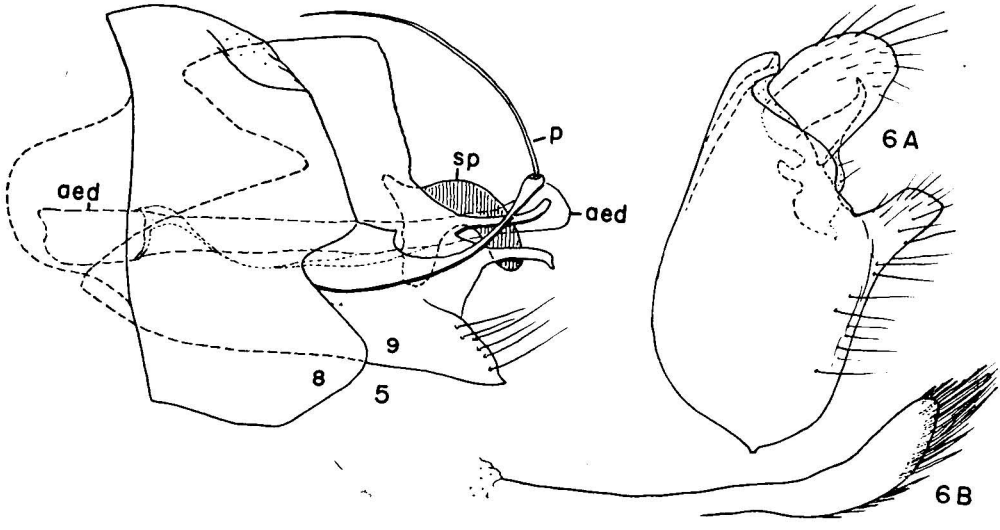
L. pluvialis (Milne). June 28; 100 Mile House. Widespread through eastern ranges of the western montane region.

L. rayneri Ross. July 16-18; Cultus L., Lillooet, Rosedale (Fraser R.), N. Vancouver. Apparently restricted to the Sierra Nevada and Cascade range from Calif. to B.C.

L. roafi (Milne). Vancouver, Vernon, Transcontinental, northern.

L. strophis Ross. June 5 to Oct. 16; Cultus Lake, N. of Ft. St. James (Middle R. at Takla L.), Vernon. Transcontinental, northern.

L. unicolor (Banks). July 15 to Sept. 13; Duncan, Vancouver (along Stream I). Transcontinental, northern.



Figs. 5-6. Genitalia of caddisflies. 5, *Oxyethira sodalis*: genital capsule, lateral aspect. 6, *Limnephilus cerus*: *A*, lateral aspect of capsule; *B*, lateral arm of aedeagus, lateral aspect.

A PRELIMINARY REPORT ON ACARICIDES TESTED FOR PROTECTION AGAINST THE TICK DERMACENTOR ANDERSONI STILES ON CATTLE[1]

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Economic considerations, which necessarily play an important role in the acceptance and use of any recommended insecticide, are particularly critical factors in the schedule of ranchers, whose products do not give them as high a return on their investments of property, care, and, notably, labour as do those of other agriculturists. In view of the nature of range practices in the British Columbia interior, a spray, if it is to be accepted by the ranchers, should be such that it might be applied only once: when the cattle are concentrated near spray chutes before being dispersed over the spring and summer grazing grounds. To advocate a compound of low residual properties for use against ticks will necessitate the rounding up of

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scattered cattle for a second treatment and result in the ultimate breakdown of the control program.

The dangerous portion of the tick season generally lasts but two or three weeks. However, two factors contribute to the need for a chemical that can remain toxic for longer periods:

(a) in an occasional year, such as the 1951 season, the dangerous period extends to four or five weeks;

(b) for the convenience of the rancher, the acaricide should be compatible for mixing with warble spray, which is usually applied two or more weeks prior to the tick season.

Benzene hexachloride was investigated by Gregson (1946) and found very effective for the purpose, but the multiplicity of new synthetic insecticides that have appeared on the market in recent years required that a measure be taken of their effectiveness in controlling *Dermacentor andersoni* Stiles. This report deals with investigations preliminary to thorough future comparison of the compounds.

Materials and Procedures

The following materials were used:

Wettable powders: C-854 (p-chlorophenyl p-chlorobenzenesulphonate), Neotran (bis(p-chlorophenoxy) methane), chlordane, and gamma isomer of BHC.

Emulsions: aldrin, dieldrin, chlordane, and gamma isomer of BHC. The emulsifier employed in the formulations was Atlox 1045.

A concentration of 0.5 per cent. of active ingredient was chosen primarily on the basis that it was well within the effective limits for control of the tick by BHC (Gregson, 1946). This chemical, therefore, was used as a basis of comparison for the others before devoting time for a more complete examination of their properties.

The number of cattle which could be maintained on the laboratory premises was limited; hence one litre of a formulation was applied to the head, neck, and shoulders of each of four yearling steers and four heifers. One other steer was untreated and served as a control.

Ticks were collected at approximately weekly intervals and placed on the hosts' backs. The attached ticks were counted and removed at the end of each feeding period, before a new batch was placed on each animal. Occasional checks showed that the feeding ticks were not completing their development and leaving the host before they could be counted.

The mortality recorded in Table I was based only on female ticks, since the male tended to wander and drop from the host.

Results and Discussion

Three classes of ticks were noted, on the basis of their response to the effects of the acaricides:

The ticks unaffected by acaricidal contact, and those placed on the control, attached and proceeded to feed until repletion.

Most of the ticks affected by the acaricides died before they could become attached. This observation was substantiated by recovery of dead, flat ticks tangled in the hairs of treated hosts.

The third class consisted of ticks which attached on treated cattle but which died before becoming replete. Their bodies were collected, still attached by their mouth parts, where they had been feeding.

The variable reactions of the ticks to acaricides suggested a variable resistance of the individuals to the chemicals, even among those ticks which succumbed. Unfortunately, at the levels of acaricide concentrations used, the proportions of ticks of the third class were so low that a quantitative comparison of the types was not justified. However, in this preliminary study the totals of dead ticks were of primary concern; consequently, the last two classes were added and the sum was used to provide the data for the mortalities recorded in Table I.

Table I indicates that Neotran and dieldrin can be ruled out for future tests. Neotran had been tested on *D. albipictus* (Pack.) (unpublished data) as a dust at one, three, and five per cent. concentrations, and found ineffective in controlling that species.

TABLE I.

MORTALITIES OF *DERMACENTOR ANDERSONI* FEMALES EXPOSED TO VARIOUS ACARICIDES SPRAYED ON CATTLE

Chemical	Numbers of Female Ticks Placed on each Host Animal and Percentage Mortalities‡ (in parentheses) after Six to Nine Days							
	Number of Days After Treatment							
	5	12	21	27	33	41	50	57
Emulsions								
gamma BHC, 0.5%	50	25 (86)	25 (80)	25 (86)	25 (67)	25 (67)	0 (67)	-
chlordane, 0.8%†	50	25(100)	25(100)	25(100)	25(100)	0 (96)	-	-
aldrin, 0.5%	50	25(100)	25(100)	25 (71)	25 (33)	0 (70)	-	-
dieldrin, 0.5%	50	25 (0)	25 (0)	0 (0)	Discontinued			-
Wettable Powders								
gamma BHC, 0.5%	25	25(100)	25(100)	25(100)	9 (67)	0 (0)	10 (-)	0 (0)
chlordane, 0.5%	25	25(100)	25(100)	25(100)	22 (67)	0 (40)	10 (-)	0 (0)
Neotran, 0.5%	25	25 (2)	25 (5)	25 (-)	16 (3)	0 (0)	10 (-)	0 (0)
C-854, 0.5%	25	25 (82)	25 (85)	25 (90)	19 (40)	0 (23)	10 (-)	0 (0)

‡ Corrected by Abbot's formula (Shepard, 1946 p. 33) so that the controls show zero percentage mortality.

† Chlordane emulsion contained 0.8% of active ingredient because of an error in formulation.

Aldrin and C-854 showed some promise. The former compound produced greater mortalities than the comparable strength of BHC for 21 days, but its effects diminished considerably during the subsequent period. C-854 produced consistently lower mortalities than the corresponding BHC formulation. However, the mortalities of 82, 85, and 90 per cent. obtained during the first three weeks may be sufficient for practical control of infestations in the field.

The wettable form of BHC appeared to be more effective than the emulsion. A similar comparison could not be made for chlordane because the emulsion form contained 0.8 per cent. as opposed to 0.5 per cent. of the wettable powder. BHC and chlordane wettable powders produced identical results for three days, after which chlordane emulsion killed all of the ticks for 33 days and 96 per cent. until 44 days. A performance of this type might very well answer the needs of ranchers even in the occasional years of extraordinarily prolonged tick activity.

Although there were no records of toxic effects among the cattle treated, the problem of danger to livestock is an apt one and deserves mention. At the present time published data are not available for effects of dermal doses of aldrin, dieldrin, Neotran, and C-854 when applied to cattle.

Bushland *et al* (1948) and Radeleff and Bushland (1950) have investigated chlordane and benzene hexachloride in this respect. Bushland and his co-workers reported that a wettable powder at 0.25 per cent of gamma benzene hexachloride caused no injury

when applied once as a drenching spray to three cows. However, when similarly applied at 0.75 and 1.5 per cent. of gamma isomer, benzene hexachloride did affect and kill the cows. Two Hereford heifers, thoroughly sprayed in eight treatments at four-day intervals with 1.5 per cent. chlordane emulsion, were not affected.

In the same paper the authors reported that of ten cattle sprayed with a two per cent. suspension of chlordane at two-week intervals, three cows died after 10-12 days following the fourth spraying. Other cattle sprayed similarly with two per cent. of benzene hexachloride (12 per cent. gamma isomer) showed no apparent injury.

Radeleff and Bushland (1950) found that suckling calves were particularly susceptible to benzene hexachloride, toxaphene, and chlordane at various levels from 8.0 per cent. to 0.025 per cent. of the toxic ingredients. In this experiment the calves were sprayed until thoroughly wet.

The meagre published results of work on this phase of the toxicity of the newer insecticides emphasizes a need for further investigation. To aggravate the situation, no standardized method of applying the insecticides has been attempted, for each group of workers has a different set of problems. For example, in the present experiment only one litre of insecticide was sprayed on each of the cattle, whereas Radeleff and Bushland and Bushland *et al* wet their cattle thoroughly. Each group was guided by the limits of its purpose in performing one experiment.

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FURTHER STUDIES ON TICK PARALYSIS[1]

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Tick paralysis in British Columbia and adjacent territories, as in South Africa and Australia, has long remained a disease of baffling origin. Though it is generally conceded that the symptoms produced in the host are brought on by the injection of a toxin by the tick, the reason why ticks of the same species vary in potency is still a puzzle. The solution to this mystery has been complicated by a series of factors which have included such nebulous conditions as are involved in different host and tick species, host susceptibility, and host immunity. Zumpt (1950) even questions whether these factors are the only ones, and as he suggests, the physiological condition of the individual tick seems to be of considerable significance, a factor which has resulted in studies too frequently containing so many unknowns that no logical pattern is apparent. This, together with the shortness of the annual period of natural tick activity, has rendered progress in the etiology of the disease slow. Nevertheless, each year some advance has been made and considerable data gained toward the understanding of this interesting phenomenon.

In British Columbia tick paralysis is caused by the female of the Rocky

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