gave excellent control of the two-spotted spider mite and the Pacific mite.

(3) EPN 300 has a high human toxicity rating and a medium phytotoxicity rating. When applied in the pink stage at 0.75 pounds it gave good control of the European red mite although it was somewhat inferior to 1 pound of parathion. At 1.5 pounds it gave considerably better control of the Willamette mite than 1 pound of parathion.

(4) KARATHANE applied at the rate of 1.5 pounds was not so effective as 1 pound of 15 per cent parathion when used as a pink application for control of the European red mite, or when used in summer applications for control of the two-spotted spider mite and the Pacific mite. When applied in the summer by an automatic sprayer at 12 pounds per acre, however, it gave excellent control of the Willamette mite. Although it caused a very slight amount of damage to Newtown apple trees in August, it has a low phytotoxicity rating.

(5) R-242 has a low human toxicity rating and a low phytotoxicity rating. At 1.5 pounds, it was slightly less effective than 1 pound of parathion (15 per cent) when used as a pink application for control of the European red mite. When used in the summer at 2 pounds it was not so effective as 1 pound of parathion for control of the two-spotted spider mite and the Pacific mite. When used at 12 pounds per acre in a concentrate sprayer, however, it was slightly more effective against the Willamette mite than 8 pounds of parathion.

(6) ARAMITE has a low human toxicity rating and low phytotoxicity rating. When applied in the summer at 2 pounds, it gave excellent control of the two-spotted spider mite and the Pacific mite. Also, when applied by a concentrate sprayer at 12 pounds per acre, it gave excellent control of the Willamette mite.

NOTES ON THE SPRING ACTIVITY OF THE ROCKY MOUNTAIN WOOD TICK, DERMACENTOR ANDERSONI STILES (ACARINI: IXODIAE)[1]

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One of the remarkable features in the life-cycle of the Rocky Mountain wood tick, *Dermacentor andersoni* Stiles, in British Columbia is the annual appearance of adults at the beginning of spring and their regular disappearance about the middle of May. Such seasonal periodicity is natural for most insects, of which the adult stage is generally of short duration. However, ticks usually live longer than insects, and it would be expected that adults of the Rocky Mountain wood tick, which are herewith shown to be capable of living for at least 1 year, which continue to be active as long as the weather remained favourable. Such is not the case, however, and though in Alberta and in the damper regions of British Columbia adults of this species may be active as late as June, in the British Columbia dry-belt they disappear regularly in May, regardless of how moist or cool the prevailing atmospheric conditions are. It is suggested that some form of diapause must take effect, releasing its hold only after another winter has passed.

In the Interior of British Columbia the Rocky Mountain wood tick is distributed throughout the greater part of the dry bunch-grass open-land. Its peak abundance may vary, depending on the locality, from sparse populations to heavy concentrations. The latter occur in scattered parts of the Province where host and climatic conditions are apparently particularly ideal for tick development and survival. One such site is at Rayleigh, 10 miles north of Kamloops, B. C., where there is an extensive talus slope backed by a rocky bluff 200 feet high. The narrow belt of vegetation at the base of the cliff, besides harbouring a variety of rodent life, seems regu-

1 Contribution No. 2717, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

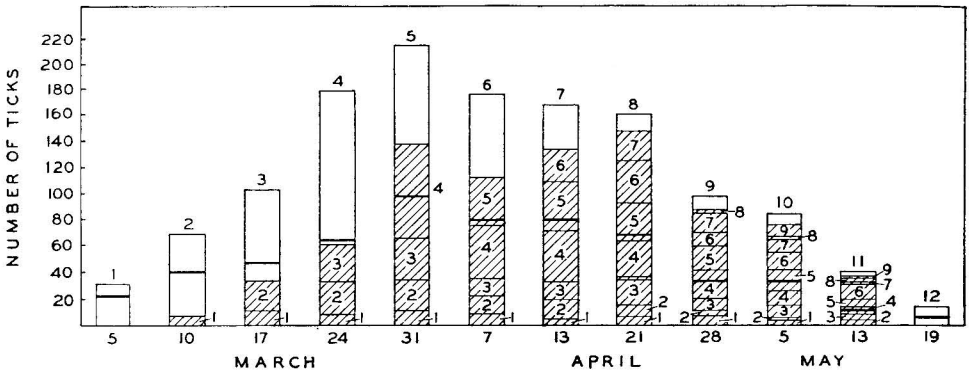

Fig. 1. Weekly collections of the Rocky Mountain wood tick, **Dermacentor andersoni** Stiles, at Rayleigh, B. C., during the spring of 1949. The hatched portions represent the numbers of marked ticks recaptured, the numerals indicating those of the various weeks. The dark horizontal lines indicate the numbers of males.

larly to have a copious supply of adults of *andersoni*, despite large annual collections for laboratory use. For the past 6 years their earliest appearance has been recorded on the following dates: 1945, Feb. 24; 1946, Feb. 26; 1947, Feb. 19; 1948, Mar. 17; 1949, Feb. 25; 1950, Feb. 27.

During 1949 and 1950 an attempt was made to show their rise, peak and decline of activity by counting and releasing all specimens as soon as they were collected on the drag, i.e., a square yard of flannelette that is swept over the vegetation in the manner of a flag. In addition, to determine whether the earliest ticks would be the first to disappear, each week's collections in 1949 were marked with a different colour of Fleet-X automobile enamel, a slow-drying Duco-like paint. The results of these observations are illustrated in Fig. 1, in which the number of marked ticks for each week is indicated. The activity of the ticks is shown to be equally late, regardless of when they appeared.

It must be noted that the data for the weekly periods of activity cannot be entirely accurate, for only a fraction of each week's marked specimens was recaptured. The recoverable portion appeared to be rather constant and in the neighbourhood of 40 per cent. Accordingly it is reasonable to assume that some 60 per cent of each week's active ticks, both old and new, are not recovered, and that the following week's unmarked specimens have not all recently hatched or emerged from hibernation. This incomplete recovery is explained by the fact that the ticks do not constantly present themselves in favourable positions for transference to a host or may have already attached themselves to hosts. Casual observations during sunny days have revealed that they very actively run about on the ground, and climb up twigs, only to descend again. Such individuals would not be readily available for capture on the drag and would account for the fact that often when one sits for a few minutes he or his drag picks up several specimens not otherwise detectable. This activity, which is contrary to the impression gained from the usual appearance of ticks waiting motionless at the tops of grass stems, leads to a certain amount of dispersal, and marked specimens were recovered nearly 20 feet from their point of liberation 2 weeks previously. Other individuals showed no tendency to roam, and week after week were observed at the same clump of grass.

Collections of ticks in the same area the following spring (Fig. 2) have shown nearly 8 per cent of the previous season's marked ticks still active, this figure being the percentage for the greatest number (40) of marked ticks taken at one time (April 17, 1950) of the total number (530) of ticks marked in the previous year. Since no attempt was made to re-mark the 1950 captures, it is not known how many others were collected on other days and it is likely that this percentage is even higher. The

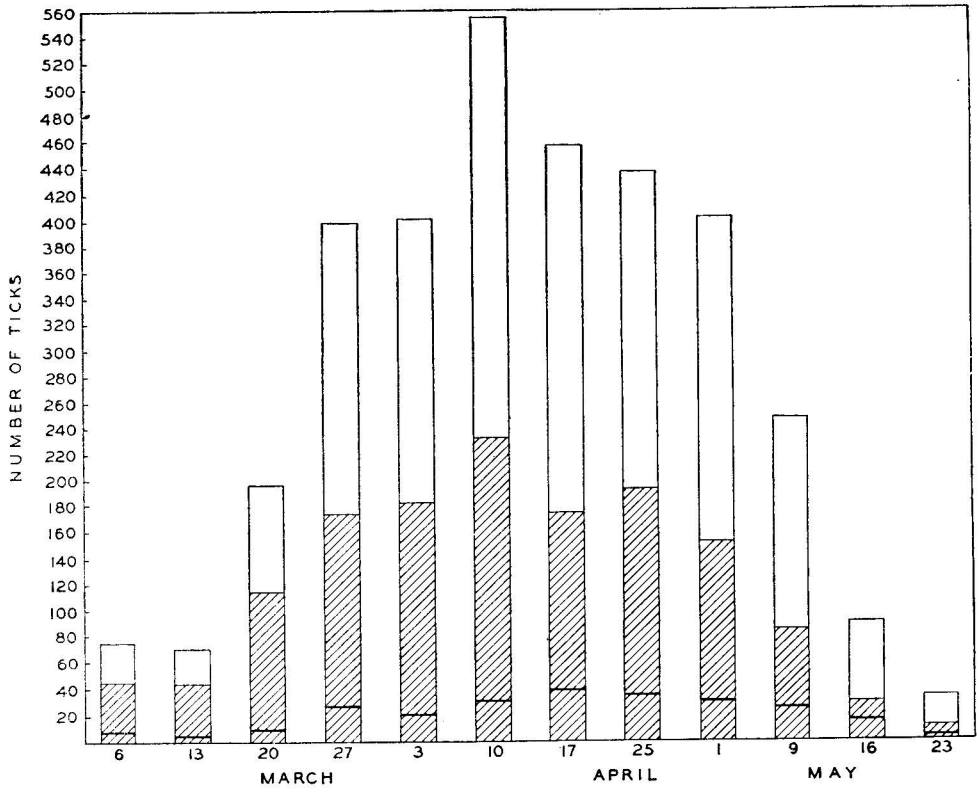

Fig 2. Weekly collections of the Rocky Mountain wood tick at Rayleigh, B. C., during the spring of 1950. The dark horizontal lines indicate the numbers of 1949 marked ticks recaptured. The hatched areas represent the numbers of males.

year-old ticks were virile enough to persist to the end of the tick season. That the remaining 1950 adults were new stock moulted from nymphs that had fed during the previous summer is suggested by the early appearance of the males, a phenomenon common in the first appearance of various species of insects.

The nearly equal ratio of the sexes and the earlier appearance and disappearance of the males are shown in Figs. 1 and 2. The peak of tick activity fell approximately at the end of March in 1949 and on April 10 in 1950. This is in keeping with the relative earliness of the two seasons, the spring of 1950, as indicated by phenological observations, being approximately a week later than that of 1949. The main period of tick activity lasted from the height of the flower season of the common dry-belt buttercup, *Ranunculus glaberrimus* and of the johnny-jump-up, *Fritillaria pudica*, to the appearance of blossoms of saskatoon, *Amelanchier* sp. and of Oregon-grape, *Mahonia nervosa*. Activity ceased with the blooming of the chokecherry, *Prunus demissa*. The reason for the apparent great increase in the tick population at Rayleigh in 1950 is unexplained.

What causes the ticks to disappear toward the middle of May is not known. A study of the temperature and humidity fluctuations recorded during their activity reveals no striking change that could account for their sudden decline. Disappearance due to a gradual aging or depletion of energy is ruled out by their reappearance the following year without having had a meal in the interim.

Observations were made to determine the fate of these ticks after activity. A number of adults were enclosed in a cage over talus 3 feet deep from the time they became active in 1949 until the following spring. All that were recovered (15 per cent) were found dead in

the upper inch of leaf mould, suggesting that the ticks do not seek protection from winter by descending to any depth in loose rock. Because of the presence of the cage, the ground surface was not protected by snow, with the result that it was exposed to a temperature of –40° F. However, temperature readings taken at a depth of 1 foot in the talus beneath the cage did not go below 32° F. The only adult found in its apparently natural site of hibernation was an unengorged female, located by accident in November under a small rock at ground level. Careful search during summer months in the areas where concentrations of ticks had been liberated the previous spring has, however, revealed specimens among the decaying roots of bunch grass, *Agropyron* sp., substantiating the theory that adult aestivation and hibernation are spent at shallow levels.

In conclusion, it has been shown that a portion of these ticks are capable of living more than 12 months as unfed adults, passing the winter under the protection of snow. The disappearance of all the ticks in late spring is apparently due not to normal aging but to some form of diapause, the cause of which is not known.

RECORDS OF BEES FROM BRITISH COLUMBIA: BOMBIDAE[1]

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This paper records 26 species, 14 named varieties, and 10 colour variants of *Bombus* and 4 species of *Psithyrus* from British Columbia. Of the 5326 specimens here recorded, 4641 belong to *Bombus*, and 685 to *Psithyrus*.

These records have been compiled from the collections in the Dominion Entomological Laboratory, Kamloops, B. C.; the University of British Columbia, Vancouver, B. C.; and the Provincial Museum, Victoria, B. C.; and from the Canadian National Collection, Ottawa, Canada, as well as from some records in publications by Franklin and Frison, and some unpublished notes by Frison. Almost all of the records obtained from the Canadian National Collection were from specimens determined by Frison.

These bumble bees were collected by 97 collectors during 50 years from 142 localities; except F. W. L. Sladen, E. R. Buckell, and G. J. Spencer, they paid little attention to taxonomy of bees, and their material was obtained in the course of general collecting. The localities are listed and their corresponding numbers placed on the accompanying map.

The collection points are mainly in the southern half of the Province, and vast areas in the north have not yet been visited by collectors. This, of course, is due to the fact that there are no roads, railways, or other ready means of entering these areas.

There are no collection records from the Queen Charlotte Islands, but several species must occur there as they have been taken on the adjacent mainland and on islands off the Alaskan coast.

After the name of each species the number of localities in which it has been taken, the number of each sex, and the total number of specimens recorded are indicated, e.g.: (26: 80♂ 39♀ 83♀—202).

The author wishes to thank all those who have helped in the preparation of this paper, either by the loan of material or in providing species determination or locality records. Thanks are particularly due to Mr. K. V. Krombein, Division of Insect Identification, Bureau of Entomology and Plant Quarantine, Washington, D. C., for the determination of material, and to Dr. O. Peck, Division of Entomology, Department of Agriculture, Ottawa, Canada, for the British Columbia records in the Canadian National Collection.

1 Contribution No. 2734, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

2 Retired November 1, 1949.