course is not being advocated blindly. Increasing thought is being given to the effects of spray chemicals on the biological balance and on orchard soils in recent years pest control problems have become more involved; and because of their complexity they are, as a rule, being studied not by individuals but by investigator groups that may include entomologists, chemists, horticulturists, zoologists and bacteriologists.

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THE DOMINION FIELD CROP INSECT LABORATORY AND ITS WORK, VERNON, 1918-1938, AND KAMLOOPS, 1939-1950

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ESTABLISHMENT AND STAFF

Comparatively little research work concerning field crop and garden insects had been done in the interior of British Columbia prior to 1918. On April 1 of that year, R. C. Treherne moved his headquarters from Agassiz to Vernon. E. R. Buckell, who had spent four years in the provincial service, was employed by the Dominion Entomological Branch April 22, 1922, and took charge of the Vernon laboratory following Treherne's transfer to Ottawa in that year.*

The Kamloops laboratory was established on May 1, 1939, with E. R. Buckell in charge, I. J. Ward as Insect Pest Investigator, and G. J. Spencer, University of British Columbia, employed as Entomologist during the summer months. The fruit insect investigations were continued by the staff remaining at Vernon. Buckell retired April 30, 1949, and R. H. Handford was placed in charge. C. L. Neilson was transferred to this staff from Lethbridge in 1947; D. Finlayson and H. R. MacCarthy joined the staff in 1948, and F. L. Banham in 1950.

CONTRIBUTIONS FROM RESEARCH

Grasshoppers. Grasshopper investigations were begun by E. R. Buckell before he joined the Dominion service in 1922 and have been carried on by one or more members of the staff since that date. The main contributions have been as follows:

Grasshopper outbreaks have been charted and described back to 1888; since 1922 these were based on the personal observations of E. R. Buckell and staff. Records of distribution

*The first Government Entomologist appointed in British Columbia was Dr. W. H. Brittain, who held the dual position of Provincial Entomologist and Plant Pathologist from 1912 to 1913 at Vernon. On the appointment of R. C. Treherne, under the Dominion Government in 1912, the entomological work of the Province was divided between them, Brittain taking the interior and Treherne the coast. M. H. Ruhmann was appointed assistant to Brittain in 1912, and after Brittain's departure for Nova Scotia in 1913, he continued in the position of Assistant Provincial Entomologist at Vernon until his death in 1943.—Editor.

and notes on ecology, and life history, are available for all known species of Orthoptera in British Columbia. The behaviour patterns of the more important species have also been recorded. While the distribution records were being obtained, series of all the species found in British Columbia were collected and deposited in the laboratory collection. The collection also includes representatives of nearly all other Canadian species. Intensive studies have been made of natural enemies and their effect on grasshopper abundance. The dipterous parasites have received special consideration and annotated lists of the many species have been published. Especially valuable have been the studies involving the relationship between range management and grasshopper abundance. These studies have resulted in much more general attention being paid to the rotation of cattle over grazing areas.

Bait investigations have resulted in a progressive reduction of baiting costs without loss of efficiency. The use of dried apple waste as a carrier with bran, was developed by the Kamloops laboratory. Diesel fuel oil for grasshopper control has been in use many years in British Columbia. More recently the value of chlordane and aldrin sprays has been demonstrated, as well as the more modern methods of application. A motor-driven bait spreader, especially adapted to the rough terrain of British Columbia range lands, was designed and tested by the Kamloops staff, and subsequently came into general use.

A world-famous type of grasshopper control organization, Grasshopper Control Zones, arose from the studies conducted soon after the establishment of the Vernon laboratory. In these zones, control is directed by a committee of ranchers, and the cost of bait materials and of hiring control crews, is collected as part of the land tax on all land within the boundaries of the organized "zone." This is of particular value in that it ensures control operations whenever and wherever needed. The Nicola Grasshopper Control Zone is a widely known, almost classic, example. In that zone, poisoning has been carried on annually for nearly 30 years with the result that no serious outbreak of grasshoppers has occurred there during that time.

Besides the many research contributions made to an understanding of grasshoppers and grasshopper control, assistance has been given the Provincial Department of Agriculture since 1918 with the organizing of control zones and extension work in connection with control.

Crickets. During the severe outbreak of *Anabrus longipes* Caudell in the Okanagan Valley in 1926, officers of the Vernon laboratory introduced, and demonstrated the value of, various types of barriers.

Cutworms. The Kamloops laboratory made observations in 1946 on the value of DDT dusts for cutworm control. At that time a survey of injurious species was begun as a minor project and is still in progress.

Bertha Armyworm. During 1928 the most efficient dilutions of calcium arsenate for controlling young and mature larvae of *Mamestra* (*Barathra*) *configurata* (Walker) were determined experimentally.

Wireworms. Detailed surveys conducted in a few fields in 1930 suggested that grass permitted a greater increase in wireworms than did alfalfa. On December 5 of that year, at Summerland, B.C., wireworms were still relatively close to the surface of the soil indicating that vertical migrations were probably dependent on weather conditions rather than being an inherent part of wireworm behaviour.

Onion Maggot. From studies of life history and behaviour in 1919 and 1920 it was learned that volunteer onions were selected for oviposition in preference to seedling onions. From these observations and experiments based on them it was concluded that "the value of a trap crop in the control of the onion maggot is very

great." At the same time it was learned that off-type, short-necked onions were used very little for oviposition, suggesting possibilities for breeding resistant strains. During that period it was concluded that molasses-sodium arsenite baits were most effective in controlling adults of the species. Experiments during 1950 indicated that lindane surface treatments, aldrin surface treatments, chlordane trench treatments, and DDT seed treatments could be used to replace the more expensive calomel seed or surface treatment.

Cabbage Root Maggot. Extensive experiments in 1919 and 1920 proved that mercury bichloride surface treatments were superior to tarred felt discs.

Colorado Potato Beetle. As a result of the observations and advice of the Field Crop Insect Laboratory, Vernon, an intensive control programme was initiated by the Provincial Department of Agriculture in 1923 in an effort to prevent the spread of the species to other, non-infested districts. Although some spread has occurred since that time, the pest does not occur west of the Similkameen Valley, and in the Okanagan Valley it does not occur north of Penticton.

In addition to experimental work on control, and advice regarding control operations that might restrict the spread of the beetle, the staff of the Vernon laboratory co-operated with the Provincial Government to a considerable extent from 1922 to 1930 in the allocation of insecticides, extension work, and in making a survey of its distribution.

Potato Tuber Flea Beetle. Modifications of R. Glendenning's recommendations for control of the tuber flea beetle have been worked out experimentally, beginning in 1947, for the interior of the province. Differences in life history have also been determined. The 1950 experiments indicated that much time, and possibly considerable expense, could be saved without loss of efficiency by a single application of one of the newer synthetic insecticides to the soil.

Pollinators of Vegetable Seed Crops. During 1918 a study was made of insects observed visiting the flower heads of onion, carrot, beet, mangel, parsnip, and radish, and numerous species were listed.

Pests of Vegetable Seed Crops. A list of insects injurious to vegetable seed crops was prepared from field observations in 1918. Thirty years later the study was resumed. The amount of damage caused by a new pest, *Lygus campestris* (L), was determined experimentally and control methods demonstrated. A study of this pest is being continued and observations have begun on mites and plant lice.

During the years 1943 to 1948 an excellent collection of wild bees, especially leaf-cutter bees and bumblebees, was built up in the laboratory. This now serves as an index to possible pollinators of a wide variety of seed crops.

Collection of insects. An extensive collection of wasps was made during the years 1943 to 1948 and is now available in the laboratory for reference purposes.

During the period 1932 to 1944 dragon-flies were collected intensively and excellent series of all known B.C. species were placed in the laboratory museum.

In the course of work to determine the vector of witches' broom of potatoes an excellent collection of Cicadellidae of the northern Cariboo has been brought together.

Records of Insect Damage. Records of damage by insect pests have been kept since the inception of the field crop insect investigations in the interior of British Columbia 1918.