

APPLIED ENTOMOLOGY IN THE ORCHARDS OF BRITISH COLUMBIA, 1900-1951¹

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Writing in the *Proceedings of the Entomological Society of British Columbia*, Winslow (1913) estimated that in 1912 the total return of the fruit crops of the interior of British Columbia had been \$500,000, the actual returns to growers \$250,000, and the cost of pest control \$53,670. Pest control, therefore, took 20 per cent. of the net returns and that, said Mr. Winslow, was too much.

By 1946 the gross value of the fruit crops had reached about \$25,000,000 and the net return may have been about \$12,000,000. Cost of pest control had been in the neighbourhood of \$1,500,000, or over 12 per cent. of the net returns. Hence the ratio of crop value to cost of pest control remained high, and 34 years later growers throughout the interior fruit-growing areas echoed Mr. Winslow's remark—it was too much. This was particularly so because, despite the drudgery and high cost of pest control, upwards of 10 per cent. of the apple crop was being lost to the codling moth.

Then came DDT and the synthetic organic acaricides. The number of codling moth sprays dropped from 6 or 7 to 4, then to 2 or 3. Cullage from insect infestation became negligible. And because of these new compounds, it became possible to develop the automatic concentrate sprayer, a device, largely British Columbian, that has further reduced the cost of pest control by at least a third and brought to the growers emancipation from one of the most unpleasant jobs in agriculture. Today, pest control is undoubtedly less costly, inconvenient and unpleasant to the fruit growers of British Columbia than at any other time since fruit growing became a sizable industry.

The history of the Entomological Society of British Columbia goes back nearly as far as that of the British Columbia Fruit Growers' Association. Because the affairs of the two organizations have often been closely associated, it is interesting to recall some conditions that were of concern to both and to compare them with conditions in 1951. In the early days of British Columbia fruit culture, Cunningham (1907) wrote as follows: "The standard sprays for the fruit growers may be reduced in number to lime, sulphur and salt for winter, Bordeaux mixture for both winter and summer, and arsenate of lead for summer. With these three sprays the whole line of successful orchard work and destruction of pests and disease may be accomplished." When, in the mid-'40's, the control of orchard pests had become a much more complex problem, the fruit industry no longer relied on Bordeaux mixture and lead arsenate; salt, believed to be an adhesive by Cunningham, had long since been omitted from the lime-sulphur mixture. Dormant-spray materials were high-viscosity dormant oil, distillate oil, dinitrocresol, and lime-sulphur. Summer sprays included the monoethanolamine salt of dinitrocyclohexylphenol, summer oil of medium viscosity and low unsulphonated residue, cryolite, nicotine sulphate, fixed nicotine, micronized phenothiazine, kerosene, rotenone, lime-sulphur, zinc sulphate, elemental sulphur, xanthone, DDT and BHC. Nowadays the trend is to the simple spray schedule, and most growers use heavy dormant oil-lime-sulphur mixture, or heavy dormant oil-dinitrocresol mixture for the early spray and DDT and parathion, or monoethanolamine dinitrocyclohexylphenolate (mono DNP) in summer applications.

There has been a great change in orchard spray machinery since the appearance of Cunningham's spray

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bulletin in 1907. At that time the power sprayer was unknown and the height of mechanization was the hand-operated barrel pump with vertical cylinders. It was superseded by the double-acting horizontal pump. But that did little to relieve the back and arms of the man who supplied the energy. Treherne (1914:67-71) records that the first barrel-type spray pump in British Columbia was purchased by Thomas Cunningham in 1885 for use in the coastal areas. The first of such pumps in the interior of the Province appears to have been in use in Vernon at the Coldstream Ranch in 1895. In 1910 the first gasoline-powered sprayer was imported into the Province; and by 1914 the Provincial government, in the course of its suppressive measures against the codling moth and the San Jose scale, had nine such machines in use. At that time there were, in addition, about 25 privately owned power machines in the Okanagan Valley.

The stationary power sprayers, which reached its greatest development and use in the Wenatchee area of Washington, did not, to any great extent, displace the portable power sprayer in the British Columbia fruit industry. A considerable number of stationary units, however, were installed in the late '30's and early '40's. Portable power sprayers, most of which were eventually operated by tractor power take-offs, did not undergo any basic changes in design until the appearance of the huge "speed sprayer" in the mid-'forties; consequently, they had been made to a fairly fixed pattern for nearly 25 years.

In 1946 a new type of portable sprayer employing an air blast to boost spray fog generated by a hydraulic pump was purchased by the Fruit Insect Laboratory at Summerland. Although this machine proved unsatisfactory, it was, nevertheless, the forerunner of the Okanagan experimental sprayer, a hybrid device built by the joint efforts of the British Columbia and Canada departments of Agriculture and the Defence Research

Workshops. It has been described by Marshall (1948). The Okanagan experimental sprayer proved highly successful. It was the forerunner of four commercial models, which, in three years, have virtually revolutionized spraying in the orchards of this province. These automatic concentrate sprayers, as they are locally known, have put the British Columbia fruit industry in an outstanding position in the chemical control of pests. Already the spraying operations of the tree-fruits industry are about 90 per cent. mechanized.

It is a far cry from the laborious and messy business of hand spraying by barrel pump or even by conventional power sprayer to the simple but not unpleasant job of operating an automatic concentrate sprayer. And, fortunately, in addition to having practically eliminated the unpleasantness from spraying operations, the new machine has reduced the cost of labour by about 75 per cent. and the cost of spray materials by perhaps 20 per cent. Capital investment, too, has been greatly reduced. Although the new machines cost about one-third more than their predecessors, they are capable of spraying three times the acreage. Finally, they are operated by one man, the tractor driver, so that they release labour for other important cultural operations at the busiest time of the growing season.

Early in the century, there were few orchard pests in the Province and control of these was based largely on investigations that had been carried out in the United States. Treherne (1914:19-33) recorded the most important insects of the lower mainland: woolly apple aphid, *Eriosoma lanigerum* (Hausm.); green apple aphid, *Aphis pomi* Deg.; rosy apple aphid, *Anuraphis roseus* Baker; black cherry aphid, *Myzus cerasi* (F.); oystershell scale, *Lepidosaphes ulmi* (L.), pear-slug, *Caliroa cerasi* (L.); apple leafhopper, *Empoasca maligna* (Walsh); pear leaf blister mite, *Eriophyes pyri* (Pgst.).

The most serious orchard pests of today are orchard mites, which, in the

last five years, have replaced the codling moth in that category. Dash (1914) stated that the mites known to occur in the Okanagan Valley were two species of eriophyids; and the "red spider," *Tetranychus bimaculatus* Harvey; the brown mite, *Bryobia praetiosa* Koch; and the pear leaf blister mite, *Eriophyes pyri* (Pgst.). It is not known when the European red mite, *Metatetranychus ulmi* (Koch), first appeared in the orchards of British Columbia; but in the Okanagan Valley it was common in the 'thirties although not generally troublesome. By 1946 it had displaced the codling moth as the chief orchard pest and it maintains that distinction today. In 1939 the Pacific mite, *Eotetranychus pacificus* (McG.), was discovered at Oliver; it now occurs throughout the Okanagan Valley. Another troublesome orchard mite, the Willamette mite, *Eotetranychus flavus* (Ewing) was recorded at Summerland in 1949 and by the end of the 1950 season it was general throughout the south Okanagan. The brown mite, mentioned by Dash, has persisted, and in 1950 became injurious in a few orchards. The pear leaf blister mite, perhaps the first of the mites to be noticed in the Province, continues to cause trouble sporadically, but only where dormant spraying has not been done for several years. Two other species, the rust mite, *Callyntrotus schlechtendali* Nal., and the silver leaf mite, *Phyllocoptes cornutus* Banks, are also known to occur in the orchards of the interior but, so far, they have not caused measurable loss. In 1950 the two-spotted spider mite, *Tetranychus bimaculatus* Harvey, caused more injury in the orchards than at any other time since it was reported by Dash 36 years before. Still other species of orchard mites are being discovered as an intensive study of the biology of orchard mites gets under way at the Fruit Insect Laboratory at Summerland. Whether there is any connection between the use of DDT and parathion and the rise of the orchard mite problem remains to be seen, but C. V. G. Morgan of the Summerland laboratory

has demonstrated a relationship between the use of parathion and the abundance of the most effective predator of orchard mites, the coccinellid beetle, *Stethorus picipes* Csy.

An event of some concern to pear growers of the Province was the discovery of the pear psylla, *Psylla pyricola* Foerst., at Oliver in 1942. Since that time the insect has spread throughout the Okanagan Valley, although it does not yet occur in the Kootenay fruit districts. Parathion has proved to be exceedingly effective against this species.

An unexpected pest, the apple mealybug, *Phenacoccus aceris* Sign., was reported from Nelson in 1927. Previously this insect was known to occur in Canada only in Nova Scotia. Until the introduction of the parasite *Alloctropa utilis* Mues., through the Insect Parasite Laboratory, Belleville, Ontario, the mealybug caused some loss of fruit in the Kootenay Valley. The growth of the sooty fungus on fruit coated with the excretion that is copiously shed by these insects rendered the fruit unsaleable.

This year it appears that Okanagan fruit growers may have two additional insects to contend with. A leafhopper, *Erythroneura* sp., has occurred in outbreak numbers on grape at Osoyoos; and the black cherry fruit fly, *Rhagoletis fausta* (O.S.), has been taken in an orchard near Westbank Ferry. These insects may have been present in the Valley for some time.

Treherne (1916) reported the rise of the San Jose scale, *Aspidiotus perniciosus* Comst., as a serious orchard pest, but it was not until some 20 years later that it obtained such a strong foothold in the Oliver, Osoyoos, and Keremeos districts as to be a menace. The pear thrips, *Taeniothrips inconsequens* (Uzel), had been found on Vancouver Island; and the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), which had first been noticed on the lower mainland in 1892, followed the expansion of fruit growing until by 1912 it was general in the interior fruit districts. Later, the relationship between the woolly apple aphid and perennial canker established

the aphid as a major pest in the Okanagan Valley. The eye-spotted bud moth, *Spilonota ocellana* (D. & S.), occurred at Vernon in 1894 but was not common until 1915. Venables (1924) described four leaf rollers attacking fruit trees in the Okanagan Valley; referring to the fruit tree leaf roller, *Archips argyrospila* (Wlkr.), he wrote, "The control of this insect may at present be considered the most serious problem facing orchardists in the interior fruit growing section of the Province"; he recommended for its control the application of 8 per cent. miscible dormant oil. This insect became a minor pest after codling moth spraying with lead arsenate became general. Perhaps its decline may be ascribed to that arsenical.

As mentioned by Hoy (1942), the codling moth has been associated with the British Columbia fruit industry from the early days. Infestations were reported at Victoria in 1900 and at Kaslo in 1905. Referring to the codling moth regulations in force early in the century, the first Provincial fruit pests inspector, T. Cunningham (1907), wrote: "The duty of enforcing these regulations is exceedingly unpleasant, but after all, it is only kindness to the fruit grower to compel him to protect his own interests and those of the country in which it is his good fortune to have his home." Cunningham's words bear out the opinion, still heard, that he was a staunch patriot with a strong sense of duty. Eventually it was found that spraying regulations could not be adequately enforced.

The codling moth did not menace the Okanagan fruit industry until 1916; and, because of vigorous eradication measures undertaken by the Provincial government, the insect was kept in check until 1925. After that, however, control measures were left with the grower, and the codling moth steadily increased in destructiveness until, 20 years later, it almost appeared that it had doomed the apple industry. As mentioned earlier, the situation was immensely improved by the introduction of DDT, an insecticide that appears to be at its best

under the climatic conditions of the Okanagan Valley.

Treherne (1921) reviewed the status of applied entomology, noting that in 1915 he was the only professional economic entomologist at work in the Province. Until that time he was stationed at Agassiz and no investigational work had been done in the interior fruit-growing areas. In 1916, however, it appeared that the greatest need for investigations in applied entomology were pending in the Okanagan Valley and, that year, Treherne and M. H. Ruhmann commenced a study of the life-history and habits of the codling moth at Vernon.

In 1917 the Dominion Entomological Branch began to expand its work in the fruit industry of British Columbia by the appointment of W. Downes to work on insects of small fruits at Victoria. After the First World War Treherne was transferred to Ottawa; then, in 1919 and the next few years, E. R. Buckell, E. P. Venables, A. A. Dennys and, still later, A. D. Heriot were successively appointed. All worked from Vernon. Buckell did most of his work on range insects but Venables, Dennys and Heriot worked exclusively on fruit insects. This group of investigators was associated with entomological investigations in the interior of the Province until about 1945. They were a colourful company, and all who were familiar with these Englishmen regret their departure from active work and have a feeling of nostalgia for the old days of the S.S. *Okanagan*, the Model-T Ford, and the collecting trip.

In December, 1938, the Division of Entomology appointed the writer to the Vernon office to work on the control of pests of tree fruits in the Province. During the Second World War the staff at the Vernon office included Venables, Dennys, Heriot, and the writer and, in 1942, Harry Andison, transferred from the Victoria laboratory after the untimely death of Alec Dennys. In 1946, after the south Okanagan had replaced the north Okanagan as the chief tree

fruits area in British Columbia, the equipment of the old Vernon office on the third floor of the Provincial Court House was moved to Summerland. Harry Andison returned to Victoria to follow W. Downes as head of the investigations on insects of small fruits and greenhouses on the coast. Heriot and Venables had retired and were succeeded by C. V. G. Morgan (biology of orchard mites), M. D. Proverbs (insects of stone fruits), D. B. Waddell (spray equipment and chemical formulations), and R. S. Downing (chemical control of orchard mites). In the Fruit Insect Laboratory the naturalist with the modulated English voice had been replaced by the "spray bloke," with the flat Canadian monotone.

In checking back over the years the reader is impressed with the work in the control of fruit insects that has been done by the Provincial Fruit Branch. R. M. Winslow did good service in that field from 1909 to 1917. During the '30's and '40's, W. H. Robertson, then Provincial Horticulturist, now Deputy Minister of Agriculture for British Columbia, saw to it that, when help was needed for pest control, funds were provided as far as possible. The present Provincial Horticulturist, Ben Hoy, conducted eradication work in the early days of the codling moth in the Province and followed that by extensive investigations in the chemical control of a variety of fruit insects, particularly the codling moth, during the '30's and '40's. R. P. Murray, now District supervisor of Horticulture at Kelowna, has been keenly interested in the control of fruit insects and active in that field for 30 years. H. H. Evans, who served as Provincial District Horticulturist at Vernon, also helped a great deal in orchard pest control measures. E. C. Hunt, the Provincial District Horticulturist at Nelson, investigated the control of Kootenay orchard pests and diseases from about 1916 to 1951. From 1937 onward he received help from the investigators of the federal laboratory at Vernon and, later, Summerland. Hunt's work has been of great assistance to the

Kootenay fruit grower. At present the Provincial Fruit Branch operates two truck-mounted power sprayers for experimental work in the Okanagan Valley and an automatic concentrate sprayer in the Kootenay Valley.

An interesting feature of pest control investigations in the interests of the tree fruits industry of British Columbia is the close collaboration that has developed between the British Columbia Fruit Growers' Association, the Provincial Fruit Branch, and the Federal Fruit Insect Laboratory at Summerland. The growers' organization keeps in close touch with investigations in pest control and takes an active part in the necessary extension work. The B.C.F.G.A., as it is commonly known, supplied a considerable sum of money for the equipment of the Fruit Insect laboratory at Summerland, which was opened in 1948. On occasion the B.C.F.G.A. has guaranteed growers against loss from field experiments undertaken in their orchards by investigators. The federal entomological and Provincial horticultural services operate practically as one in carrying on field work in pest control for the tree fruits industry. Men and equipment are interchanged so freely that nearly all orchard experiments in applied entomology in this province are joint ones. Seldom in the field of agricultural investigations has this close association between government services been matched; that is a matter of pride for all concerned.

Much of the credit for the present favourable status of applied entomology in the orchards of British Columbia goes to the chemists, whether in the federal service or in industry. The Fruit Insect Laboratory at Summerland is jointly operated by the divisions of Entomology and Chemistry of Science Service, Canada Department of Agriculture, the two organizations being, for practical purposes, so closely integrated at Summerland as to be one. Their work is greatly aided by pesticide research in the chemical industry of the United States, Great Britain, and Canada. In fact,

without that research it is doubtful whether the apple business of this province could have survived. One must recall the ruinous and losing battle that was being waged against the codling moth only a few years ago to realize what the fruit growers owe to DDT, parathion, and the other synthetic organic pesticides in use today.

Although the tree fruits industry has come to place chief reliance on chemical control of orchard pests, it should not be concluded that biological control procedures have been, or are being, overlooked. In 1917, J. D. Tottill and R. C. Treherne of the Dominion Entomological Branch introduced into the Vernon district the mite *Hemisarcoptes malus* (Shimer) to aid in control of the oyster-shell scale, *Lepidosaphes ulmi* (L.). That predator, although slow in dissemination, has been doing good work ever since. In 1929, through the Insect Parasite Laboratory, Belleville, Ontario, the parasite *Aphelinus mali* (Hald.) was released in the Okanagan Valley because the woolly apple aphid, *Eriosoma lanigerum* (Hausm.), by reason of its connection with perennial canker of apple, had become a serious orchard pest of the interior fruit belt. Almost from the start *A. mali* was a complete success, and the woolly aphid-perennial canker problem soon subsided. Still later, when the apple mealybug, *Phenacoccus aceris* Sign., became troublesome, through the Parasite Laboratory the parasite *Allotropa utilis* Mues. was released in the infested areas; within five years the apple mealybug caused little concern. From time to time the codling moth parasites *Ascogaster quadridentata* Wesm., *Ephialtes caudatus* (Ratz.) and *Cryptus sexannulatus* Grav. have been released in the interior fruit districts. So far, they do not appear to have exerted any appreciable effect in controlling the codling moth, but *A. quadridentata*, at least, seems to be well established.

It is recognized that compounds such as DDT and parathion may be injurious to parasitic and predacious insects and mites. Consequently, growers are advised to use these insecticides

only when their application is clearly necessary. In the meantime, the Fruit Insect Laboratory at Summerland is devoting an increasing amount of time to a study of the effects of spray chemicals on biological control factors. In this work it is assisted by the Biological Control Investigations Unit of the Federal Division of Entomology, which, in 1951, stationed an investigator, D. A. Chant, at the Summerland laboratory.

The increasing complexity of pest control is further illustrated by the attention that is being paid to the effects of spray chemicals upon orchard soils and upon wild life. Experience in various orchard areas in the western United States has shown that serious poisoning of the soil can occur from an excessive concentration of lead arsenate. As the effects of most of today's synthetic organic insecticides in orchard soils are not well known, as investigation on the effects of spray chemicals on soils has been underway at Summerland for the last three years. These studies involve the Science Service divisions of Bacteriology, Chemistry, and Entomology. Effects of spray chemicals on birds and small mammals are being investigated by men representing the Department of Zoology of the University of British Columbia and the Wildlife Service of the Canada Department of Resources and Development. Their summer headquarters are at the Fruit Insect Laboratory, Summerland.

SUMMARY

The first 50 years of the Entomological Society of British Columbia have covered a great expansion in the fruit industry of the Province. Although the membership of the Society has not greatly increased since the early days, the status of its members has changed from predominantly amateur to predominantly professional. So far as control of tree-fruit pests is concerned, there is still a desirable diversification of methods. Chief reliance nowadays is being placed on mechanically efficient control of orchard pests with chemicals, but that

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 be-

cause 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.