THE BROADER IMPLICATIONS OF THE DEVELOPMENT OF ENTOMOLOGY IN THE PACIFIC NORTHWEST

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For some years the writer has been interested in the history of entomology in the Pacific Northwest. In 1949 the University of Washington Press issued the result of his studies under the title, "A Century of Entomology in the Pacific Northwest", and since then he has published a number of shorter historical studies. Moreover, the 1952 issue of the Proceedings of the Entomological Society of British Columbia contained a number of papers on the development of entomology in that portion of the Northwest. At the present time, accordingly, there seems no point in merely summarizing again what has been said before. Rather it seems more challenging at this juncture to carry the enquiry to the stage where the attempt is made to extract from the history something of its general significance. I propose to proceed by asking a series of questions about the development of entomology in this region in the hope that light will be shed on the subject by thus considering it from diverse points of view.

My basic assumption is that a science like entomology does not develop in a vacuum but is a part of a complex social process related to a complex array of factors in the environment in which it develops. As entomologists, we are well aware that the insects that we study are complexly related to the environment in which they occur. It is similarly true that the very fact that we are studying insects rather than, for instance, debating how many angels can dance on the head of a pin, is the result of complex factors in the sociological environment.

(An address given at the Annual Meeting of the Entomological Society of Canada, Victoria, B.C., October 19, 1953; in part based on an address given in a Symposium on the Development of Entomology in the West at the Pacific Coast Branch Meeting of the Entomological Society of America at Lake Tahoe, Calif., June 24, 1953.)

First, then, I ask: What is the over all position of the Pacific Northwest in regard to the development of entomology?

Entomology arose as part of that awakening interest in nature that occurred in Western Europe in the sixteenth century. The first insects were not taken in the Pacific Northwest until the beginning of the second third of the nineteenth century, and it was another forty or fifty years before an indigenous study of insects began to appear in our region. As regards both time and geography, then, entomology in the Pacific Northwest occupied a peripheral position, far removed from the central mainsprings of our western European culture.

The Pacific Northwest was one of the last portions of the North American continent to be claimed by men of European descent. California and Alaska had been occupied by Spain and Russia in the eighteenth century, but the first trading posts were not established in the intervening region until about 1808.

Modern natural history, as has been said, arose in Western Europe in the sixteenth century. The first studies were concerned with the more conspicuous plants and vertebrates, but by the end of the century a manuscript on the less conspicuous insects was being put together by a series of English naturalists, and Ulysses Aldrovandus, Professor of Natural History at the University of Bologna in northern Italy, was at work on his vast compendium, *de Animalibus Insectis*, which saw publication in 1603. A small but increasing number of books on insects appeared in the seventeenth and early eighteenth centuries, laying one of the bases for the *Systema Naturae*, in the middle of the eighteenth century, of the great Swedish Naturalist, Carolus Linnaeus, in the 1758 edition of which its

author gave relatively precise descriptions of some 4400 species of animals, including about 2100 insects. Thus, seventy-five years before the first insects were collected in the Pacific Northwest, Linnaeus had created a mature science of insects and had devised the method whereby, eventually, the million or so different species of insects may be classified.

Meanwhile, Linnaeus' pupil, the Dane, Johan Christian Fabricius, had specialized on the insects and had thus become the first strict entomologist. In eastern North America, Thomas Say had described some 1575 new species of insects between 1818 and 1834, and Dr. T. W. Harris, the librarian of Harvard, had published a catalogue of 2350 species of insects from Massachusetts in 1833 and would in 1841 publish the first American book on harmful insects, "A Report on the Insects of Massachusetts Injurious to Vegetation."

It was, accordingly, against the background of a mature but rapidly growing entomology that the first insects were collected in the lower Columbia River Valley about 1835. And it is not surprising to realize that the history of entomology in the Northwest has consisted in the main of a series of reactions to cultural influences of western European and eastern North America origin.

My second question is: What are the general features of Northwestern entomology as it actually developed?

As already noted, insects are relatively inconspicuous and their study tends to follow on that of the plants and vertebrates. Thus, the first scientific observations on Northwestern natural history were those made by Archibald Menzies, surgeon accompanying the Vancouver Expedition, in the 1790's, followed by additional observations by Lewis and Clark and others. Similarly at the present time, Northwestern plants and vertebrates are described in numerous detailed manuals, whereas the insects have so far been only rather sketchily listed, with only the barest beginning of descriptive works.

The beginning of the study of insects in the region dates from the first scientific collection of specimens in the lower Columbia River Valley about 1835. For thirty years all the insects taken in the region were by itinerant collectors who were not themselves entomologists, but transmitted their materials to specialists in Northwest Europe and Northeastern United States. Only with the seventies did two or three entomologists pass through the region, and the same decade saw O. B. Johnson living in the Willamette River Valley and G. W. Taylor on southern Vancouver Island. These were the pioneer resident entomologists of the region. The eighties saw O. B. Johnson commencing the teaching of entomology at the University of Washington in Seattle. The nineties saw the establishment of agricultural experiment stations at Pullman, Washington; Moscow, Idaho, and Corvallis, Oregon, with the beginning of investigational work in applied entomology.

The turn of the century witnessed the beginning of original work in insect taxonomy by J. M. Aldrich at Moscow and Trevor Kincaid at Seattle, joined later by G. W. Taylor at Nanaimo and A. L. Melander at Pullman. The nineteen tens witnessed the establishment by the federal governments of both the United States and Canada of permanent laboratories for investigations in applied entomology. In the United States these laboratories supplement the work of the states, but in British Columbia they have preempted nearly the entire field. Finally, by the 1920's the economic work in the region was so well established that occasional discoveries of national significance began to appear. After ninety years, Northwestern entomology had begun to come of age!

What have been the economic and cultural bases of Northwestern entomology? For no sort of science flourishes in a vacuum, but is related to other aspects of the culture.

The first Northwestern insects were collected as a by-product of the unsuccessful attempt of a business man

of Boston to break into the Northwestern fur trade. The next insects to be gathered—those taken in 1841 by Dr. Charles Pickering and Titian R. Peale—were an outcome of the New England whaling industry. At least, I suggest that whaling was an important factor in inducing Congress to send the Wilkes Exploring Expedition to the Antarctic and the Pacific, and Pickering and Peale were among the naturalists on this expedition. From 1853 to 1856, insects were taken by the Railway Surveys, which the American Government organized in order to keep the communities of an expanding western frontier integrated with the life of the rest of the country. And specimens secured between 1857 and 1864 were taken by the parties surveying the international boundary between the United States and Canada.

Of course, the very fact that the fur trade, the whaling industry, and the railroad and boundary surveys produced insects for scientific study was itself the result of cultural tendencies then long at work in the Atlantic community. The awakening interest in nature to which the 16th century had given birth came to permeate the highest circles of European society. To this the Royal Society of England and the Academies supported by the French, Prussian, and Russian governments bore witness. Moreover, in the persons of Benjamin Franklin and Thomas Jefferson, the new American republic had come into contact with the best continental traditions. The result was that, as the United States felt its way westward and as the Anglo-Canadian governments joined with it, scientific exploration became an integral part of geographical and commercial exploration.

With the early seventies, amateurism entered the picture—the industrial wealth of Great Britain made it possible for a Lord Walsingham to spend a year in northern California and Oregon collecting microlepidoptera and the Anglo-American coleopterist, George Robert Crotch, to collect beetles. By the seventies, moreover, life in the pioneer communities had become sufficiently established so that an occasional immigrant in very ordinary economic circumstances, like O. B. Johnson and G. W. Taylor, took up the study of insects. A decade later academic entomology became established at the as yet very tiny University of Washington.

The intrusion of applied entomology on the Northwestern scene had diverse roots. The sort of insect study that up to this time had operated in our area was the working out of the spirit and genius of Linnaeus in seeking to subject the works of the Creator to a rational ordering. But not the Swede, Linnaeus, but the Frenchman, Antoine Lavoisier, was the greatest scientist of the eighteenth century, and not Linnaeus, again, but the great Englishman, Charles Darwin, who was the biologist who was destined to leave the most indelible stamp on the modern world. It was the experimental techniques employed by Lavoisier in virtually founding the science of chemistry that in the course of two or three generations began to make an effective science of agriculture possible. And it was the evolutionist Darwin who showed that insects were something more than jewels fresh from the hand of the Creator, that they were veritable parts of the processes of nature, to be understood and controlled. Moreover, an advancing agriculture was intensifying its entomological problems, gradually bringing in additional pests from distant parts of the world and, by growing crops in ever more extensive continuous stands, producing ideal conditions for the multiplication of insects.

Harris' 1841 "Report on the Insects of Massachusetts Injurious to Vegetation" was a recognition of the problem. The 1854 appointment of Townsend Glover as federal entomologist by the United States government followed by the appointment by New York, Illinois, and Missouri, of state entomologist in 1856, 1867, and 1868, was acknowledgment by government that insects were of public concern. Finally, the spectacular control of the Colorado potato beetle by Paris Green in the sixties and the control of the

grape Phylloxera by the use of resistant hosts in the seventies showed what entomological research could accomplish. The result was an accumulation of pressures making for government participation in combating insects as part of the general promotion of applied agriculture.

In the late eighties, the American Congress was induced to pass the Hatch Act matching state with federal funds in maintaining an Agricultural Experimental Station in each of the states and territories. This led to the establishment of research and teaching in applied entomology in each of the Northwestern states. The pressure on the federal government to aid agriculture was not satisfied with this direct help to the states, however, so that from the early nineties special agents were sent into the states who worked in close conjunction with the several state entomologists on special entomological problems. By 1910 the federal agents were spending two or three years at a time in the region. The work of these agents continued to expand, until, with the second decade of the present century, semi-permanent federal laboratories were established on both sides of the border: at Agassiz, Victoria, and Vernon, in British Columbia, at Wenatchee and Ritzville in Washington, and at Ashland and Forest Grove in Oregon. In British Columbia the federal agency virtually supplanted the provincial entomological service, except for instructional work carried on at the University of British Columbia after 1919. South of the border, the federal and state services have coexisted and collaborated with each other closely. In these ways the economic resources of an entire continent have been brought to bear on the agricultural problems of one of the less densely populated portions.

Accordingly, since the nineties, the continuing importance of a knowledge of insects in the maintenance and development of agriculture and forestry has been the main factor in promoting the study of Northwestern entomology. Academic entomology remains at the University of Washington, where we have virtually the strongest entomological library in the Northwest and where there are no economic involvements except for some recently introduced very elementary instruction in the College of Forestry. Seven or eight amateur entomologists of importance reside at various localities in our territory, but in general, applied entomology has dominated the field.

Northwestern entomology acquires additional interest for the student of cultural history from the fact that the region in which it operates is traversed by an international boundary. Because of the different political affiliation of the two regions, the area south of the border was settled by persons from the eastern United States, a generation or several removed from their European ancestors. Moreover, the diversity of cultural traditions represented by the people of the eastern United States was reflected in the settlers in general and the entomologists in particular. North of the border, on the other hand, a preponderance of the settlers was of British birth and brought their British traditions with them to their new home. Paramount among these traditions, from an entomological point of view, was a more general interest in nature and a wide-spread amateurism characteristic of the older more settled society from which they came. It was, perhaps, the continuation of the eighteenth century tradition that had produced Gilbert White's "Natural History of Selborne," 1788, at a time when Americans were making homes for themselves in a primeval wilderness.

In line with this tradition, there were, among the early entomologists of British Columbia, three clergymen: on Vancouver Island, Henry Matthews in the sixties and G. W. Taylor in the eighties and later; on the Queen Charlotte Islands, J. H. Keen in the nineties. One looks almost in vain for clergymen pursuing entomology on the American scene!

A vigorous amateurism, again, was involved in the organization and early years of the Entomological Society of British Columbia in Vancouver in 1902, and the consistency with which the

British Columbians have gotten their findings into print. The published proceedings of their Society gave them the vehicle and their amateur attitude gave them the drive for publishing their results. Many of these amateurs, it is true, later secured professional positions in the Dominion Entomological Service, but at a period in their lives too late to alter their basic attitudes. The outcome has been that, in the period since 1880, and virtually up to the present, a preponderance of the non-economic literature references to Northwestern insects refer to the British Columbia fauna. But the years effect changes. The amateur attitude does not apparently persist in the face of the increased efficiency of greater professionalism, and the time may soon be at hand when such differences as are referred to here may no longer distinguish the entomological work on the two sides of the border. Another influence of the border is seen in the personnel of the professional entomologists to the north and south of it. Because of the border and because of the control of the two federal services from Ottawa and Washington respectively, the movement of personnel tends to be east and west and not north and south. Moreover, the contacts with British entomology is far closer in British Columbia than in the states. The results are probably beneficial, tending to maintain a diversity of entomological outlook that otherwise might be absent.

Another way in which the international border has affected entomology is economic. The fact that Washington, Idaho, and Oregon are an integral part of the mid-twentieth century's greatest political, economic and military power, as well as the further circumstance that they are favorably situated with regard to agricultural, commercial and increasingly, to industrial wealth, means that, in the long run, tremendous economic resources are available for the study of entomological problems. The favorable present position of the University of Washington as regards library resources in entomology is one of the results of this economic power. The time will come, I suspect, when it will be regarded as strange that this Northwest country—one, as it is, in geography, in language, in flora, in fauna, and in basic economic relationships—should be divided, even to the extent that it is, by an invisible political boundary, and that its essentially similar entomological problems north and south of the 49th parallel should, in part, be administered separately from Ottawa and from Washington.

Another question that can be asked is: To what extent is the Pacific Northwest a natural unit for the consideration either of historical processes relative to the study of insects or to the study of insects themselves.

In my 1949 study of Northwestern entomology and in my forthcoming book on beetles, I have adopted British Columbia, Washington, Idaho, and Oregon as my unit for study. Faunistically, the area is only approximately natural, and southeastern Alaska and Montana west of the continental divide are integral parts of it, excluded for practical considerations. To the south, the area shades off gradually, especially in the mountains. In general, however, I suggest that the Arctic area to the north, the Great Plains east of the Rocky Mountains, and the Great American Desert to the south delimit the Pacific Northwest as a natural entomological region. In addition to these theoretical considerations, there is the following practical one for taking the Pacific Northwest as an area for study. Entomological problems, including those having to do with entomological history, are so complex that they must be broken down in various ways for analysis and study. Our primary political units, the United States and Canada, are too large and unwieldy for many types of studies. In Europe, regions like the British Isles, France, Italy, or Germany have repeatedly proven useful for detailed analysis. The Pacific Northwest represents a similar unit, one of the same order of size as the European area mentioned. The cultural effect of the international border has already been noted. I suggest,

however, that similar north and south extending climatic and faunal zones involving similar crops and similar entomological problems, unite far more effectively than the border separates.

What have been the principal organizations that Northwestern entomologists have set up in order to expedite the prosecution of their entomological activities? Oldest and most important is the Entomological Society of British Columbia. Founded in Vancouver, in 1902, revived in 1911 by R. C. Treherne, this society has by its annual meetings and long series of publications promoted the entire field of entomology in the more northern portions of the Pacific Northwest. Similar in scope, but much more recent in origin, is the Oregon Entomological Society. Founded in 1939, under the sponsorship of the Oregon State College, it meets four or five times a year at various places in the Willamette Valley, issues a mimeographed *Bulletin* of proceedings, and co-ordinates effectively the activities of both amateur and professional entomologists.

Since the 1900's economic entomologists have participated in the annual meetings and publications of the state horticultural societies of Washigton and Oregon, and since 1918 the Northwest Association of Horticulturists, Entomologists, and Plant Pathologists has met annually for the reading of papers and informal discussions. Since 1926 the Western Co-operative Oil Spray Project, for many years under the chairmanship of E. J. Newcomer, has held informal annual meetings in various Northwestern cities. No formal recommendations have emerged from these meetings, but their informal findings have constituted the basis of all official spray recommendations made in the Pacific Northwest, and it is the considered opinion of some that this conference has done more for applied entomology in the Northwest than any other single organization. Its success led to the formation along similar lines of a Pea Weevil Control Conference in 1936, reorganized six years later as the Pacific Northwest Truck Crop Insect Control Conference. An annual Pacific Northwest Pest Control Operators Conference, organized at Corvallis in 1950, may come to play a similar role in that field of applied entomology.

The crucial question to be asked concerning Northwestern entomology pertains to the nature of its contributions to man's understanding of the insects. This is a question that the present author is able to answer only in part and imperfectly.

First, there is the matter of the Northwest insect fauna, the aspect of Northwestern entomology with which the speaker has been most concerned. During the first thirty or forty years of Northwestern entomology the insects collected and reported on were mostly Coleoptera, of which LeConte issued a list of 233 species in 1857 and of which perhaps as many, 500 or 600, were known from the region by 1880. By the nineties, however, the British Columbians were becoming especially interested in the Lepidoptera, resulting in 1904 in a catalogue of 1128 species that was issued by the Provincial Museum in Victoria. The same period saw less complete listings of groups of Hymenoptera, Diptera, Coleoptera, Trichoptera, Odonata, Neuroptera, and Orthoptera from British Columbia, so that by 1910 the Canadians were well on the way to a preliminary knowledge of their fauna.

This early work took the form largely of simple lists, in part, because the economic resources of these pioneer Northwestern entomologists did not permit them to assemble either the libraries or the collections necessary for descriptive work. They sent their specimens to specialists in the northeastern United States and eastern Canada, and frequently the extent of what they knew about them was represented by the names attached to the returned insects.

Not all the work, however, remained on this preliminary level. At the turn of the century the two most outstanding entomologists in the Northwest were probably Trevor Kincaid of the University of Washington and John Merton Aldrich of the University of Idaho. These men, to be

joined shortly by A. L. Melander of the Washington State College and the Rev. G. W. Taylor of the Nanaimo Biological Station, were the first to show that entomological work other than the mere listing of names assigned by others or the issuance of routine economic information was possible in this new country. Taylor in Geometridae and Aldrich and Melander and Kincaid in Diptera demonstrated beyond peradventure of doubt that entomological work of the most exacting sort was possible even in these far reaches of North America; and Aldrich's brusque dismissal from the University of Idaho in 1913 is a dark page in the history of Northwestern entomology. This northwest interest in Diptera spread to Oregon, where it resulted in Cole and Lovett's *List of the Diptera of Oregon* in 1921.

Somewhat analogous to the Aldrich-Melander Diptera studies was the Vernon "school' 'of Coleoptera studies at the Dominion Forest Insect Laboratory at Vernon, B.C., between 1919 and 1948. Here Ralph Hopping (1868-1941) and his son, George R. Hopping, produced a number of continent-wide studies of Cerambycidae, and Hugh B. Leech laid the foundations for his work on water beetles. I am informed that during this period Hopping's staff was encouraged to collect beetles in general and not just those of economic importance to the forest, with the result that, for better or for worse, a very fine collection was assembled, one that I am finding invaluable in my present studies. Now the pendulum swings in the other direction: not only does no general beetle collecting go on at the laboratory, but the forest beetles are being themselves neglected for other insect types such as the defoliators. In our own decade, the private studies of Kenneth and Dorothy Fender of McMinnville on the Lampyroid families of Coleoptera are likewise on a continent-wide scale. But such work has been scattered. The bulk of Northwestern taxonomic entomological activity has concerned the local fauna.

Whatever the administrators back in Ottawa and Washington, or in the presidents' or deans' chairs of the agricultural colleges may have intended to the contrary, the basic taxonomic problem as it relates to insects has come out; and there has been scarcely an entomological laboratory in the region that in one way or at one time or another has not made contributions —sometimes of an extensive nature— to the knowledge of the fauna. Large collections of Northwestern insects exist at the State College of Washington, the Oregon State College, the University of British Columbia, the University of Idaho, and, outside the Northwest, at the California Academy of Sciences, with an important collection of Coleoptera at the University of Washington—not to mention a number of collections in the hands of individuals and at certain of the experiment stations and federal laboratories.

One is tempted to make a generalization. In the early decades on economic work there is a tendency to recruit personnel in important measure from men who were attracted into entomology by the aesthetic appeal of insects and who have insisted on continuing this interest along with their strictly practical studies. Aldrich, Melander, Hopping, and others are examples of such men. As economic entomology has matured, however, numerous factors have combined to end this tendency. The methods open for the investigation of economic problems become more extensive and more preoccupying. Students are attracted into the field primarily by the opportunity it offers for earning a living rather than because it is a chance to work with insects in which they are already interested. Finally there comes a time when the administrators themselves have become thoroughly conditioned to such a view point and regulations are effected to see that all the foolishness with insect collections and insect nets—the badge of the dreamy impractical enthusiast —is relegated to the limbo of forgotten things!

Applied entomology in the Northwest began with a short series of letters by O. B. Johnson on a number

of insect pests, in the Willamette Farmer between 1874 and 1877. It got underway in earnest with the establishment of the state experiment stations in the early nineties, but for three decades was largely occupied with applying in the Northwest discoveries that had been made elsewhere. C. L. Metcalf, for instance, in his 1940 survey of entomological progress between 1909 and 1919, cited 73 names on his "roll of honor" for the decade. The only Northwesterner on the list was Aldrich, listed for his taxonomic work on Diptera, and he had been discharged from the University of Idaho in 1913! With the 1920's, however, the picture began to change, and some ten Northwesterners are among the more than 300 names cited in the bibliography in a special study by E. O. Essig of entomological progress in this decade. Essig's list may be of interest: Leroy Childs, F. R. Cole, B. B. Fulton, Eric Hearle, A. L. Lovett, A. L. Melander, O. M. Morris, R. A. Muttkowski, E. J. Newcomer, and R. C. Treherne. I leave to someone more competent the task of a comprehensive chronicle of Northwestern achievement in applied entomology.

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NOTES ON THE LIFE HISTORY OF THE SHADED UMBER NEPHELODES EMMEDONIA CRAM. (F. PECTINATA SM.) LEPIDOPTERA: PHYLAENIDAE

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This moth often turns up at my porch light in Saanich, B.C. during the month of August and September. In 1951 a female was captured and placed in a box within which she laid a batch of eggs. The following life-history notes were taken.

Ova. On August 29, 1951, 200 eggs were deposited loosely in the box. No cementing material was used; they were free to roll about whenever the box was tilted. The egg is spherical, 1 mm. in diameter, slightly flattened on opposite sides, like an orange, finely ribbed and cross-ribbed, white to cream in colour, changing to a dull pink or leaden hue by September 15, 1951 As no signs of hatching were observable on October 17, to ascertain their condition one or two eggs were dissected. This disclosed the young larvae fully developed and lying curled up in a dormant condition. Head pale brown, body more or less translucent.

1st Instar. Some hatched about February 16, 1952. Length 1.5 mm. Head pale brown, body light grey in colour. The egg shell is not eaten. I had difficulty in getting the larvae to feed despite a variety of plants in leaf at this time of the year. Finally they reluctantly took to *Bromus* sp.

2nd Instar. February 29, 1952. Length 4 mm. Head pale brown, body green, darker above than beneath, slightly translucent; a white broad spiracular line, followed by two narrow ones and a medium dorsal line of the same colour.

3rd Instar. March 12, 1952. Length 7 mm. Head and body similar to the last instar, but the white lines edged with black. Spiracular line creamy, spiracles black.

4th Instar. March 25, 1952. Length 12 mm. Colour as before but body darker and stripes more creamy and more pronounced; in some larvae the creamy white of the spiraclar line is centred by a pinkish colour.

5th Instar. April 10, 1952. Length 18 mm. Head pale brown or greenish with dark freckles; body colour has changed from green to black, with a slight bronze reflection, in sharp contrast to the white black-bordered, longitudinal stripes, each of which has a delicate pink flush superimposed upon it.

6th Instar. April 26, 1952. Length 35 mm. Colour and marking as before, but the bronzy reflections more noticeable, and with the surface of the skin with many minute transverse wrinkles. Full fed about May 15. Length 45 mm. tapering a little towards each end. Width 6 mm. in middle of body. One larva burrowed beneath the soil on May 31, but failed to pupate.

Remarks. Of the 20 ova, the majority hatched, but the larvae rapidly died off. Only two finally reached maturity, but without the vitality to