COMPARISON OF THE INJURY TO APPLE CAUSED BY SCALES AND APHIDS (Homoptera: Aphididae & Coccidae)[1]

A. D. HERIOT
Dominion Entomological Laboratory, Vernon, B. C.

Both scales and aphids build up heavy infestations on apple and pear and both derive nourishment by piercing deeply into the plant tissues with their stylets and sucking up the plant juices. Although many differences connected with feeding exist between the fixed armoured scales and the more mobile aphids, it is generally assumed in the literature that injury to the tree is due in both cases to the loss of sap incurred by the mass feeding of these insects. Yet for some unexplained reason, scale infestation is much more injurious than aphid infestation.

Prior to the development of effective control measures, the ravages of the San Jose scale (*Aspidiotus perniciosus* Comstock) were notorious. Newcomer as recently as 1941 regards this scale, by reason of its rapid increase, "as potentially capable of doing more damage than any other insect occurring in the orchards of the Pacific Northwest."

A rapid increase in scale population without further qualification might imply a rapid depletion of the host plant. It is true that the San Jose scale with its 3 to 4 generations a season is the most prolific scale attacking apples and pear, but with its dependence on sexual reproduction involving a considerable proportion of males among its progeny, the scale cannot vie in potential reproductive power with the parthenogenetic apple aphid (*Aphis pomi* Degeer) which Newcomer credits with 9 to 17 generations in a single season.

Greater protection against natural enemies and adverse climatic conditions, may nevertheless sometimes enable the San Jose scale to outstrip the apple aphid in self-multiplication. This is less likely to occur in the case of the oyster shell scale (*Lepidosaphes ulmi* L.) which has only a single annual brood of 40 to 80 individuals that require 6 weeks to attain maturity. The eggs hatch several weeks later than those of the apple aphid and the adults after ovipositing die some weeks before cold weather puts a stop to aphid feeding. Moreover the scale confines its attention almost exclusively to the woody growth of the stems, while the apple aphid attacks both the leaves and stems. Yet in spite of slower development, inferior reproductive power and a much shorter feeding period, oyster shell scale infestation is definitely more injurious to the tree than aphid infestation. The outright killing of twigs and branches frequently occurs in neglected scale infested orchards and the same scale is capable of causing the death of the hardy native thorns and dogwoods of the Interior of British Columbia.

By comparison, the harm done by the apple aphid is insignificant and perhaps the worst feature of this orchard pest is the dense smutting of the foliage and fruit, indirectly due to the gross feeding of the aphid and the quantity of honey-dew excreted. The armoured scales on the other hand, utilize their comparatively small amount of waste material in the manufacture of their shells. It is possible that young trees encrusted with this scurfy material may suffer from an interference with the respiratory functions of the lenticels.

Be this as it may, it will be as well to look for other causes than the extraction of sap to account for the severity of scale injury, for it is hardly reasonable to assume that the slowly developing oyster shell scale is a greater drain on the plant than the more prolific aphid. In fact the question arises as to whether any insect can cause the death of a tree by the extraction of sap alone.

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It would seem in the case of the aphid that a state of equilibrium must inevitably be established between the ability of the plant to maintain the aphid and the ability of the aphid to reproduce on a diminishing food supply. In the case of the scale, this equilibrium, if ever reached, may be upset by some entirely different cause. It is therefore suggested that the severity of scale injury may be due, not as is generally assumed by what is taken out, but by what is actually put into the plant by the armoured scales. In this connection, the belief has sometimes been expressed that the San Jose scale injects a toxic substance into the plant when feeding. The red blotches on fruit and stems generally associated with the presence of this species, seems to be the foundation for this supposition. A less vivid discolouration occurs around the punctures of the oyster shell scale. Although it is quite possible that this scale spotting is indeed caused by the injection of a toxic secretion, it seems just as reasonable to suppose that it may be accounted for by something inserted that is more substantial and more readily demonstrated than a chemical agency. Perhaps the discolouration of the fruit known as "pansy spot" which has been traced by Newcomer to the insertion of a thrip's egg in the growing tissue may be an analagous injury.

In both scale and aphid infestations the presence of a multitude of stylets invading the tissues may conceivably be an encumbrance harmful to the plant. In heavy infestations, two or three young scales or aphids may settle on an area only a millimeter in diameter. As demonstrated by Weber (1930), each instar of the Hemiptera and Homoptera acquires a new set of stylets at each moult, a fact incidentally, that does not appear to have been accorded recognition in either British or American literature except by the author (1931 and 1934).

The replacement of the stylets at each moult means that the small area cited above will receive in the case of the scale with its three instars, three separate punctures from each of its occupants. The aphid with five instars, has an advantage over the scale in being able to move and distribute its more numerous punctures in less congested and probably more succulent areas of the growing stem. It is not however, in the number of punctures, but in the final disposal of the stylets when moulting that the scales differ so widely from the aphids. In the case of the free-moving aphids, the stylets are withdrawn from the tissues at ecdysis and are invariably found intact and attached to the cast skin. The scale cramped beneath its shell, is unable to withdraw its stylets. Instead, the old stylets are broken off at the base and left like tenuous rivets or stitches in the tissues of the bark and cambium. Longitudinal sections of scale-infested bark reveal the stylets of each instar in the positions they would be expected to assume when allowance is made for the slight movement permitted by the insect's confinement. The respective stylets are thus close together and are easily distinguishable by the their different diameters. Cross-sections of the infested bark show that the passage of the stylets is intra-cellular and the tips are frequently observed to extend beyond the cambium into the xylem.

Thus on a heavily scale-infested twig there are three sets of stylets implanted by every visible adult, but under conditions where the young frequently settle beneath the parent scale, the congestion of abandoned stylets may be much greater than might be estimated from the number of scale present at a given time.

The extraction of sap or the injection of a toxicant are only possible while the insect is living, but the disposal of stylets in the tissues by successive instars and generations evidently results in mechanical injury to the plant the year round.

It seems therefore reasonable to believe that this distinctive feature, namely the accumulation of abandoned stylets in the tissues hampering growth by a mat of chitinous stitches, may have much to do with the severity of scale injury in comparison to that inflicted by the aphid.

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FURTHER NOTES ON THE CERAMBYCIDAE OF VANCOUVER ISLAND (Coleoptera)

GEORGE A. HARDY
Provincial Museum, Victoria, B. C.

The object of these notes is to bring together scattered records that have accumulated from time to time since the 1925-26 Museum Reports (Hardy 1926-1927).

It is by no means claimed that all the data have been examined, as the Coleoptera of Vancouver Island have possibly been investigated by students and collectors who are at present unknown to the writer. In that event, should this article result in bringing hitherto unknown collectors to light, this effort will have achieved a definite purpose.

At the best, aside from the southern and eastern coastal areas of the island, information on the Cerambycidae is very meagre. This cannot altogether be due to the absence of many species, but to the fact that comparatively little intensive research has been undertaken. It is true that the habits of the members of this family are often such as to make them exceedingly elusive in relation to our affairs, so that they may be unseen yet numerous. Hot sunshine coupled with the fallen trees or newly-cut wood at just the right stage of attraction, the synchronization of favourite plant blossoms, and time of appearance, or nocturnal habits of the species, are only some of the limiting factors.

To the ardent collector, however, all the above factors add a spicy attraction, for perseverance often brings unexpected rewards. By being perennially beetle-conscious, "windfalls" occasionally occur at most unexpected moments.

The following annotated list includes only those species that seem to be of special interest either as new records, extensions of the known range, or from a biological viewpoint.

(1) *Eumichthus oedipus* LeC. New locality records: Colwood, two specimens in a collection formed during the years 1932-36, and presented to the Provincial Museum by Hedley Peake. This is the most westerly Vancouver Island record known. 10 Mile Point near Victoria, specimens taken by the writer on July 26 and August 9, 1935, as they were running over the trunk of a newly-felled Douglas fir, *Pseudotsuga taxifolia* (Lamb) Brit.

Most other specimens so far recorded were obtained on the flowers of the ocean spray, *Spiraea discolor* Pursh., during the month of June. It would appear that this beetle has a longer period of emergence than hitherto suspected.

(2) *Pidonia quadrata* Hopping. First described and recorded for Vancouver Island from Clayoquot by R. Hopping (1931). The Clayoquot specimen is designated as a paratype and was collected by G. J. Spencer. Two additional specimens were obtained by M. L. Prebble from the Great Central Lakes area on June 27 and 29, 1941.

This very distinctive little species closely resembles *P. scripta* LeC. one of our most abundant members of the genus, but of all the hundreds collected from the eastern and southern portion of the Island, none has so far been noted to include this species. It would seem therefore to favour the more humid regions of Vancouver Island.

(3) *Pachyta armata* LeC. New locality