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L. O. HOWARD, Chief of Division.

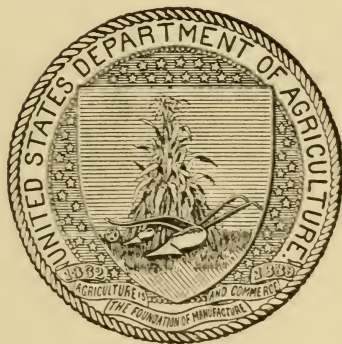
PROCEEDINGS

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY.

Washington, October 3, 1902.

SIR: I have the honor to transmit herewith the manuscript of the Proceedings of the Fourteenth Annual Meeting of the Association of Economic Entomologists, which was held at Pittsburg, Pa., June 27 and 28, 1902. The papers presented at these meetings are always of the highest economic importance, and the present series is of an unusually practical nature. The Department of Agriculture has hitherto published the secretary's reports as bulletins of this Division, and I therefore recommend the publication of the manuscript here presented as Bulletin No. 37 (new series).

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

by present conditions in portions of California. Mr. Craw reports in a recent letter that the San Jose scale is now exterminated in Santa Clara County, Cal., where it first appeared in this country.

PREDATORY INSECTS WHICH AFFECT THE USEFULNESS OF SCALE-FEEDING COCCINELLIDÆ.

By C. L. MARLATT, *Washington, D. C.*

When the breeding experiments out of doors were commenced with the imported Asiatic ladybird (*Chilocorus similis*), fears were early aroused for the success of the experiment on account of the abundance of predaceous insects^a in the small grove of pear, plum, and peach trees attached to the insectary of the Department, which it was proposed to use as a breeding ground, inasmuch as it was thickly stocked with San Jose scale.

A great many egg clusters of the wheel bug (*Prionidus cristatus*) and egg masses of our native praying mantis (*Mantis carolina*) were found attached to the trunks and limbs of these trees. Furthermore, a large lot of the egg masses of the European praying mantis (*Mantis religiosa*) had been shipped to us by Mr. Slingerland of Cornell, and these had been placed in an open cage in the midst of this grove, so that the young could escape. The hatching of these egg masses had already begun. Later developments established the fact that both the wheel bug and these two species of praying mantis would feed on the larvæ of *Chilocorus* and other ladybirds. In addition to this, as the season advanced, the larvæ of the plant-lice-feeding ladybird, *Adalia bipunctata*, were also found to eat the larvæ of *Chilocorus* when their normal food was not readily available.

The larvæ of the lace-winged fly (*Chrysopa* sp.) preyed more or less upon the *Chilocorus* larvæ in the breeding cages, eggs of the former insect being deposited on the outside of the wires in bunches in several instances, and the larvæ entering in some numbers. Perhaps some of the parent insects also hatched directly in the cage. A very careful search of the cage had to be made for these *Chrysopa* larvæ, and a great many of them were destroyed. Comparatively few were found in the grove, and at least they were not numerous enough to occasion any serious alarm.

The chief difficulty in the cage, however, arose from the presence of the *Adalia bipunctata*. This ladybird multiplies with astonishing rapidity, its eggs being laid in masses, and day after day 50 or 100 of its larvæ and pupæ were destroyed in this cage, and it was two or three weeks before a final clearance was effected. The cage tree was a fairly good-sized plum tree, and it seemed almost impossible to dis-

^a Relating to bird enemies of *Chilocorus*, I am assured by Messrs. Beal and Judd, experts on the food of birds, that Coccinellids are rarely found in bird stomachs, even in California, where such insects are very abundant.

cover and destroy all of the newly hatched and not very conspicuous *Adalia* larvæ on the leaves and twigs. The tree was badly infested with plant lice, and these furnished so much food for the *Adalia* larvæ that very little damage was done to the *Chilocorus*; but that the former would eat the latter was proved by observation in a few instances, and by inclosing them together in a jar: the smaller larvæ of *Chilocorus*, our native species, *bivulnerus*, being used for the experiment, were eaten, but nearly grown larvæ—big spiny fellows—were let alone.

The greatest menace to the safety of the *Chilocorus* larvæ is the wheel bug. It was comparatively easy to keep the outdoor cages free from this predaceous bug, but had no steps been taken to destroy the wheel bugs in the grove the success of the introduction of the *Chilocorus* would have been very much jeopardized when the time came for their general liberation. These wheel bugs were observed feeding on the larvæ of *Adalia* and on the larvæ of *Chilocorus*. They did not feed on the scale insects, the latter being much too small for their notice, and it may be that the almost complete absence of our native *Chilocorus* in this grove is due to the very great abundance of the wheel bug. When our fears relative to the wheel bug were fully aroused, Mr. Kotinsky, of the Entomological Office, spent a day going through this little grove, destroying egg masses and killing the wheel bugs that had already hatched. He estimated that he killed 9,000 wheel bugs in this grove of not less than one-eighth of an acre, and subsequent results indicated that even with that number destroyed a good many had escaped, and several later inspections had to be made to fairly free the trees. This wheel bug has become extraordinarily abundant in the vicinity of Washington in the last few years, and has been increasing in numbers very considerably in its northern range, which has already been pushed as far as New York and New England.

All the egg masses of our native Mantis that could be found were collected and destroyed. Hatching, however, had already begun. The egg masses of the European Mantis were taken indoors and kept inclosed, and those that had not already hatched were allowed to come out and devour each other until the final extermination was effected by this natural means. The hatched and escaped mantides are with difficulty detected; they are of a dull grayish color, harmonizing with the bark and leaves, and their quick movements and their habit of keeping out of sight under leaves or running around to the other side of twigs when approached render their discovery difficult. All that were found in the grove, however, were destroyed.

Of the five insects mentioned above, four are dangerous enemies of the larvæ of the scale-feeding ladybirds; and, in proportion to their numbers, the benefits from such ladybirds will be decreased.^a

^aA single instance was noted by Mr. Kotinsky, in late July, of the feeding of a larva of a *Telephorus* on a *Chilocorus* larva.

The observations and experience of this spring have brought into question the real value, as aids to the fruit grower, of the four predaceous insects mentioned and others of the same class which have general feeding habits. The evidence points very strongly to the conclusion that such insects do more harm by destroying beneficial species like the ladybirds feeding on scale and plant-lice than they will ever do good by eating larvæ or other soft-bodied plant-feeding insects. In other words, the injurious insects which they may feed upon to a greater or less extent are almost without exception species which are very easily controlled by other means, viz, by insecticides or methods of cropping. On the other hand, the beneficial insects which they destroy, as notably the larvæ of ladybirds, which feed on plant-lice and scale insects, include a group of insects of special importance and value to the horticulturist, for the reason that they feed on insects which are not easily controlled by other means, and which, if kept in control by natural enemies, may never require the expensive and, to the plants, dangerous treatment necessary to effect their artificial destruction. As a general proposition, therefore, I am inclined to rank all general-feeding predaceous insects as injurious and distinctly prejudicial to the interests of the horticulturist and farmer. The introduction, therefore, of any such insect, as, for example, the European *Mantis religiosa*, or efforts at their wider dissemination, are mistakes, which, in my opinion, will come to be regretted very keenly in the future. Instead of protecting these insects, I believe it will be much more to the general advantage to destroy all egg masses of mantids and the wheel bug; and to view the lace-winged flies with suspicion, if not to class them as absolute foes.

ADDENDUM.

A very important hymenopterous parasite must be added to the list of natural enemies of the Asiatic ladybird. To our very great disappointment and astonishment, early in September it was found that the pupæ of the last brood were much parasitized, causing a loss of more than 10 per cent of this brood. As many as could be of these parasitized pupæ have been collected, and from them has been reared a little Chalcidid fly, *Syntomosphyrum esurus* Riley, from five to seven parasites coming from each pupa. This insect belongs with a group of secondary parasites, but no trace of the primary parasite could be found in any of the pupæ examined, although later breeding may develop the primary parasite during the winter or next spring. The larvæ were found free in the abdominal cavity of the Chilocorus pupa, and ultimately all of the substance of the pupa disappears. In one or two cases where parasitism had only just begun to make itself evident, half-grown larvæ were found. These were filled with the yellow fluid contents of the Chrysomelid, and were orange yellow in color. The

older larvæ in the nearly empty shells of the pupæ were whitish in color. That all of these larvæ are of the parasite mentioned above can not be definitely said. Dr. Howard, who examined the material with the writer, is of the belief that the primary parasite will prove to be *Honalotylus obscurus* How., the common coccinellid parasite of this country. If the parasite bred proves to be a true secondary parasite, as believed, its presence in such numbers in the pupæ of *Chilocorus* is a matter for gratification. If, on the contrary, it be a primary parasite, it seriously threatens the success of the imported *Chilocorus* and all allied ladybirds. The status of this parasite is given in the appended note by Dr. Howard:

All of the Tetrastichinæ known and whose exact host relations have been determined are hyperparasites. *Syntomosphyrum esurus* Riley has never been proved to be either secondary or primary. It is or was a common parasite of *Aletia argillacea* in the cotton fields of the South late in the summer. It issued frequently and in great numbers from old chrysalids left hanging bare upon the cotton stalks. The chrysalids on being opened were found full of this parasite, and no trace of a primary parasite was ever found. Hence this insect was considered in Bulletin 3 of the United States Entomological Commission, and in the Report on Cotton Insects, by J. H. Comstock, published by the Department of Agriculture in 1879, to be a primary parasite. The question as to whether it might not be a secondary parasite was raised by me in the Fourth Report of the United States Entomological Commission. It was reared, as recorded in Bulletin 5 (Technical Series), of this Division, by Dr. A. D. Hopkins, at Morgantown, W. Va., from *Orygia leucostigma*. It was reared abundantly in 1896, in the late winter and early spring, at Washington, D. C., from the chrysalids of *Hyphantria cunea*. Moreover, it was reared by F. M. Webster, in 1889, on May 3, according to the notes of the Division, from the galls of *Trypeta gibba* Loew on *Ambrosia artemisiifolia*. But these *Trypeta* galls, especially late in the season, are apt to contain several different kinds of insects, not only primary parasites, but frequently lepidopterous, coleopterous, and dipterous larvæ, so that the rearing from the gall means nothing at all; the presumption, however, being that the insect came from the *Trypeta* either as a primary or a secondary parasite.

Summing this evidence all up, we have the insect reared undoubtedly from lepidopterous chrysalids and from coleopterous chrysalids—that is to say, the Coccinellids under consideration—and also possibly from dipterous insects. Unity of habit—that is to say, unity of host relation—is so marked among the Chalcididæ that wherever such a diversity in the apparent hosts occurs it has become my rule to place such parasites as undoubtedly secondary or tertiary parasites. The primary parasites of a given group of insects belong to certain definite groups. Examples are so numerous that they need not be mentioned. In no case in the whole family, to my knowledge, are the parasites of a single genus parasitic upon more than one order of hosts, and in some instances they are confined even to individual families of hosts, and the assumption that a single species of Chalcidid may be reared from Coleoptera, from Lepidoptera, as well as possibly from Diptera, is almost an absurdity. These are the principal reasons upon which I base my belief that *Syntomosphyrum esurus* is a hyperparasite.

After the reading of these papers they were opened for discussion. Mr. Webster commented on the value of what Mr. Marlatt had accomplished, and felt that the least the Association could do was to

extend to him a vote of thanks. He then made a motion to that effect. Mr. Webster, continuing, stated that it would have been exceedingly interesting if Mr. Marlatt could have gone to Korea, but doubtless this was not possible. The main object, however, was accomplished. He wondered if Mr. Marlatt would not have had as good success with material gathered from Europe instead of Japan and China. He did not consider that there was quite so much danger from our native predaceous insects as Mr. Marlatt had suggested, and called attention to the value of the twice-stabbed ladybird in clearing maple trees badly infested with the common maple *Pulvinaria*. The occurrence of *Chilocorus similis* in Europe would indicate that it had a variety of host insects, and that it would feed on almost any species of scale. The insect, however, seemed to have acquired a greater taste for the San Jose scale than any other of the scale insects, and he thought that it would gain about the same status of importance and abundance as other native species, but that it would probably be a little more fond of *Aspidiotus* and *Diaspis* species than is *C. bivulnerus*. Mr. Webster was very glad that the studies in Japan and China had been made, and thought American entomologists had a great deal to thank Mr. Marlatt for.

Mr. Scott rose to second the motion made by Mr. Webster. He considered this one of the most important attempts in experimental entomology, and thought Mr. Marlatt was to be congratulated as contributing such valuable work along this line.

The president then put the motion, and it was heartily carried.

Mr. Smith stated that Mr. Marlatt's paper had interested him greatly, and he considered that the most important feature of the work was that Mr. Marlatt had shown that China was the native home of the San Jose scale, and that it was there kept in check by native insects. The question had always been, however, whether the enemy which kept it in check in its home would do the same in the eastern United States. He felt satisfied from investigation in California that our native species was there one of the most active enemies of the San Jose scale. He had found there, quite early in the season, that not only had there been a brood of the ladybird larvæ before the scale began to breed, but that eggs were already scattered over the trees for a second brood. He had seen larvæ as well as adults feeding on the dormant scale. He felt quite certain that this was the insect doing most good in keeping the scale in check in that State. Just why the beetle would not breed with us in the East as continuously he was at a loss to explain. He had watched it for several years, and was convinced that it did not have more than two broods a year in New Jersey. He stated that the beetles were eating on his trees at present, but not at the same rate as in California. He had found them on trees that had never been treated as well as on those which had been treated.

He had in his experiment orchard a number of trees that had never been treated, which showed resisting qualities and did well. The scale never increased beyond a certain point, and then practically died off. He had never found any wheel bugs in this orchard, so that these could not be considered in accounting for the disappearance of the ladybirds. They should hardly rank as enemies, but might form an important factor in the destruction of the larvæ of this ladybird beetle if it really appeared in considerable numbers. He knew that many of our predaceous insects eat a great variety of food. The wheel bug will eat a webworm, the larvæ of the elm-leaf beetle, or anything else in its way with equal pleasure.

Mr. Smith had been able to determine positively that the larva of the two-spotted ladybird eats the young crawling scale larvæ. He thought, as a result of his observations in California, that there was a possibility that the California species of *Chilocorus* was different from our Eastern form, though they were quite similar in appearance. He had had a number in the early stages and could not make out any difference between them. One year 200 California specimens had been sent to him, and in comparison with the Japanese specimens and those from the eastern United States he was not able to tell which came from one place and which came from the other. To secure the lot that had been imported from Japan, he wrote to every entomologist in that country whose address could be secured. Individual letters were sent, with offers to pay all expenses, and in this way a considerable number of two species were secured, one a large form, the name of which was not remembered at that moment, and the other a smaller species, *Chilocorus similis*. These beetles were taken to a very scaly orchard and liberated on the trees at a season of the year when all stages of the scale were present, and when there was an abundance of time for the beetles to deposit eggs. So far as he knew there had been no survivors. He had not been able to find any larvæ and had not recognized the difference between those of the twice-stabbed ladybird and those of the *Chilocorus similis* until Mr. Marlatt had pointed it out in his paper. He considered that Mr. Marlatt was very conservative in his claims in regard to the imported beetles and thought his suggestions well worth the trial. He was in doubt as to the importance of the injury resulting from the wheel bug, but stated that this species did considerable good in controlling the fall webworm. In response to a query, Mr. Smith stated that the *Chilocorus similis* had been placed in the orchards referred to three or four years ago. He further stated that the orchard had been pretty well cleaned of scales by other means, but that he had never seen any descendants of the imported insects.

Mr. Sanderson observed that *C. bivulnerus* was very common in Delaware and that he knew of several orchards where it kept the

Forbes scale in check. The Forbes scale would sometimes become quite injurious and peach trees would often be killed. It was his observation that the *C. biculnerus* was largely instrumental in controlling this species, and while he had observed the wheel bug to be very common, yet he had never noticed that it fed on the larva of this beetle.

Mr. Felt stated that he desired to congratulate Mr. Marlatt on his efforts in searching for the native home of the San Jose scale and procuring its natural enemies. He stated that there were no wheel bugs in New York State, so that this insect could not have a hand in destroying parasites. He stated that there were very few of the *C. biculnerus*. So far as his observations went, he considered the ladybirds most valuable as enemies of plant-lice. Plant-lice were very abundant in Albany in 1897, and ladybird larvæ were so very numerous as to attract considerable attention.

Mr. Hopkins remarked that there was great difficulty in determining the different species of closely related scolytid beetles, and suggested the importance of a close study of closely related species in all stages to definitely determine their distinctness. As an example, two scolytids had been described from Germany as different species, but were afterwards considered the same. After a close study, however, he had found that the two European species belonged to two quite distinct genera. On close study he had found striking differences, not only in habits, but in structure.

The next paper was presented by Mr. Quaintance.

ON THE FEEDING HABITS OF ADULTS OF THE PERIODICAL CICADA.

(*Cicada septendecim* L.).

By A. L. QUAINANCE, *College Park, Md.*

But little accurate observation seems to have been made on the feeding habits of the adults of the periodical cicada, or so-called seventeen-year locusts. A review of the rather scant literature on the subject indicates also that considerable diversity of opinion prevails among entomologists and others as to the extent to which they feed, and, on the whole, the opinion probably prevails at the present time that the adults, particularly the males, feed but little, if at all, during their brief aerial life of about thirty days. The first note in reference to this point which I have seen is by Messrs. Walsh and Riley, in the *American Entomologist*, Vol. I, p. 67 (1868). It is here stated, under a general discussion relative to the sting of the periodical cicada, that "the beak is an organ which both sexes of the cicada possess, and by which they take their nourishment. We have