INSECT PARASITISM

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"Parasitism in its broadest sense means degeneration." The first phase of parasitism appears when an insect loses the power to use some particular organ, upon which its maintenance depends, and a gradual modification of this organ, with others, makes the parasite wholly dependent on its host for survival.

Parasitism may be considered under two heads: periodical, and permanent parasitism. We have an example of periodical parasitism when the insect is a parasite for only a part of its life, and an example of permanent parasitism when the insect is a parasite during its entire life. We have an example of true parasitism when the parasite receives the benefit and the host the injury, if any. In nearly every case of insect parasitism the parasite is injurious to the host. Parasitism is a law of nature, and in order to preserve a balance among insects, nature has done so through the agency of parasitism. When there is an unusual number of insects present in a community, according to the law of nature, parasites will appear in greater or less number, checking their increase, and in some cases nearly destroying them entirely.

Parasites that belong to the Mallophaga, Pediculidae, and Sarcoptidae, which do not come strictly under the subject of insect parasitism, have obtained their parasitic habit through degeneration. The insect parasites, which nearly all come in the orders Hymenoptera and diptera, as a rule do practically all the injury to other insects while in the larval stage. The adult parasite deposits its eggs in the cocoon of a host insect, and in performing this operation the insect within the cocoon is usually killed. When the eggs hatch, the larvae feed upon the dead insect until they pupate, when they issue from the cocoon and in turn deposit eggs with their ovipositor in other cocoons.

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Hymenopterous parasites.

L. O. Howard, in his paper entitled "A study in Insect Parasitism," treats of the primary parasites and hyperparasites belonging to the orders Hymenoptera and Diptera, a few of the species of economic importance which I will consider. The white marked tussock moth, Orgyia leucostigma, was preyed upon by these parasites, hymenopterous and dipterous, and in a couple of years the parasites had entirely checked the ravages of this insect in Washington, where it had caused much injury to the shade trees. The White tussock moth began to increase in numbers about the time the English sparrow was introduced, for the purpose of destroying the canker worm, which it did to a great extent. The extermination of the canker worm left a more favorable condition for the white tussock moth to develop, and increased rapidly as the sparrow did not eat the larvae from the fact that it was hairy. It was noticed that this larva was causing great destruction to the shade trees in Washington in 1895, but by the time the third generation appeared in September, it was also noticed that many parasitic insects were found to be preying upon the cocoons.

Prior to the beginning of these observations seven species of probable primary parasites of the white tussock moth had been recorded, but after the close observations made during 1895-96 2,122 individual parasites were reared, of which 185 were Diptera and 1,937 Hymenoptera. A large number of secondary parasites was also reared. Some of the important parasites which Howard discussed in bulletin No. 5, are as follows:

Pimpla inquisitor. Say:

This is an important and wide spread parasite of lepidopterous larvae occuring in nearly all parts of the United States. It is not only parasitic upon Orgyia, but on other lepidopterous larvae, as

Clisiocampa, certain Phycitids, Tortricids, and large sized Tineids. The larvae when full grown measures 9.5 m.m. long and 3.2 m.m. wide. It is yellowish white in color, possessing no markings. After hatching, the larvae were found to feed externally on the body of the caterpillar, sucking the blood for nourishment. Seven eggs which were found on August 31st, had hatched the following day and by September 3d the larvae appeared to be full grown and on September 6th were spinning their cocoons. On September 8th they changed into the pupa stage. All the adults issued together on September 14th, leaving fifteen days as the duration of the life cycle.

In the course of observations made by Howard on this parasite, he found that the adult would examine the cocoon carefully as if to ascertain the exact condition of affairs, when it would suddenly insert its ovipositor into the body of the caterpillar, which would commence to struggle violently. The wasp remained in this position for several minutes, after which, on examining the caterpillar, it was found to contain an egg.

Pimpla annulipes. Say:

This species occurs in California, Missouri, Michigan, New York, Maryland, Illinois, and District of Columbia, and is an important and wide spread parasite of lepidopterous larvae. It is noted more for its efficient attacks on the Codling moth than its attacks on the white tussock moth. It is parasitic upon about the same lepidopterous larvae as the Pimpla inquisitor, though somewhat larger in size and readily distinguished by the remarkably distinct and complete black bands on the tarsi and tibiae.

Pimpla conquisitor. Say.

This species is parasitic upon several lepidopterous larvae, being one of the most important parasites of the cotton worm

(Aletia argillacea). Other larvae upon which it is parasitic are the bag worm of New Jersey, Phryganidea in California and the tent caterpillar. The territory in which this species exists extends from California to New Jersey and as far south as the Gulf of Mexico. As far as is yet known, the cotton worm is parasitized only in the pupa state, while in the case of the Tussock moth it is the larva which is paratized.

Meteorus communis Cresson.

This species belongs to the family Braconidae, and is recorded by Cresson from Canada, Connecticut, and New Jersey. This species which is common and wide spread was a more or less important factor in reducing the number of tussock moth caterpillars in the early autumn of 1895, but in 1896 its economic importance was of little value on account of being attacked by secondary parasites. It has been reared from Tineids, Botids, Bombycids, and Orgyia leucostigma. Upon issuing from the caterpillar, which immediately thereafter dies, the parasitic larva spins a tough parchment like brown silk, an oval cocoon, which is attached with coarse thread to a leaf or a piece of bark. The larval development takes place in less than ten days and the pupal stage varies from ten to twenty days. The parasite issues by cutting a lid at the smaller end of the cocoon.

Chalcis ovata. Say.

This species is a general parasite of Lepidoptera, issuing as a rule when the host is in the pupae stage. It is very common and wide spread species, being found in all parts of the United States and Canada, and extending into the West Indies. It is parasitic upon the pupae of Thyridopteryx ephemeraefornis, Apatura clyton, Aletia argillacea, Desmia maculalis, Cacoecia rosaceana, Gelechia gallae-solidaginis, and Botis almialis, and is also the most impor-

tant primary parasite of the tussock moth caterpillar, next to pimpla inquisitor.

On September 7th, 1895, Howard observed a number of Chalcis-flies ovipositing in the tussock moth cocoons. Particular notice was taken of the actions of a female while ovipositing, and these were found to be similar to those of Pimplainquisitor. The length of the life round of this parasite can only be surmised owing to the failure to rear parasites from the pupae or larvae in which adults were observed to oviposite, but it is probable that during the fall the life round occupies on an average from three to four weeks. Next to pimpla inquisitor, this species is the most important parasite of the tussock moth caterpillar.

Hemiteles townsendi. Ashim.

This species is a hyperparasite and is reared from all sorts of lepidopterous larvae, pupae, oak galls, and spider cocoons. So far as known all the species of Hemiteles are hyperparasites.

Allocota thyridopterigis.

A single specimen of this insect was seen in 1895 crawling around on the poplar trees investigating Orgyia cocoons, and observations of this insect showed that it was a hyperparisite of Pimpla conquisitor. This species is commonly reared from the bags of the bag-worm.

Dipterous parasites.

The dipterous parasites rank next to the hymenopterous parasites in destructiveness to insects of other orders, the tachinidae being the most important parasitic family of this order. The female tachina fly lays her eggs upon the skin of caterpillars, the eggs hatching into footless maggots which bore into the caterpillar and live concealed until full grown, when they issue and transform

(generally in the ground near by) into ovoid, brownish puparia, from which come forth the adult flies. Some of the Tachinids which prey upon wasps deposit their eggs on the food which the wasps have stored in their chambers for their young and after hatching, the larvae of the Tachinidae eat up the food stored for the young wasps, leaving them to starve.

Frontina aletiae. Riley.

This species, a primary dipterous parasite, is an important enemy of the cotton caterpillar of the South and parasitic on a number of other injurious insects. It is distributed over several states, Georgia, Alabama, Mississippi, Florida, and Texas, and it is estimated that at different times, the proportion of caterpillars killed by this species has reached forty per cent.

Euphorocera claripennis Macq.

This is a widely distributed species which occurs practically all over the country and was the most abundant of the dipterous parasites. It has been reared from twenty-seven different species of Lepidoptera, among which a few of the species of greatest economic importance are Agrotis ypsilon, Aletia argillacea, Anarsia lineatella, Hyphantria cunea, and Mamestra trifolii.

Many hymenopterous parasites have been imported to the United States from foreign countries for the purpose of determining their economic value. Since some of these parasites proved to be beneficial in destroying injurious insects in other countries, why under similar climatic conditions and circumstances should they not do so in this country/ Experiments and investigations along this line were carried out in different parts of the country , one especially, in Illinois, where the Chalcid parasites of the Hessian fly were introduced from Europe.

The living adults were exposed to some wheat infested by the Hessian fly, and in time a generation of the foreign parasite was bred. These bred insects were successfully distributed to fields infested by the fly, but on account of the unfavorable conditions for introducing this parasite, no marked results were obtained that season. On account of the great injury caused by scales to the fruit trees in California, investigations were made for the purpose of discovering parasites and praedaceous insects that would prey on these scales and thus destroy them. These investigations led to the importation of several parasites from Australia. A few of the important ones are Pachyneuron, reared from Scymuns flavifrous, Comys, reared from Lecanium hesperidium, Dipophogaster californica, reared from Lecanium Oleoe, and Vedalia cardinalis. Observations indicated that the fluted scale (also known as the white or cottony cushion scale) so injurious to the Californian orange trees, originated in Australia. As this scale was held in check in that country by natural enemies, it was decided to send Mr. Koebele to Australia for the purpose of obtaining and introducing such parasites to California. His effort was crowned with success as the results indicate. He obtained an insect Vedalia cardinalis, which was successfully introduced into California, and on account of its rapid increase, it practically destroyed the white scale throughout the infested region.

Many species of the Coleoptera are subject to the attacks of hymenopterous parasites, the most important of which are Ephialtes irritator (Fabs) reared from a larva found living externally on the larva of a Cerambycid, Bracon simplex (Crisson), found in the nests of Rhagum lineatum, and Bracon erythrogaster, found in hickory wood infested exclusively with Cyllenpicta.

Although the greater number of insect parasites belong to the orders Hymenoptera and Diptera, a few families of the order Coleoptera contain insect parasites.

Stylopidae.-

These insects, excepting for the independent life of the male, are just as confined and dependent upon their host for survival, in all stages of development, as the Pediculidae and Mallophaga. The males have large fan shaped wings, lacking elytra, and more or less rudimentary mouth parts, while the females are wingless and worm like in form. They live just under the skin in the abdomen of bees, wasps, and even ants. There are two genera that occur in this country; Stylops, which is parasitic on bees of the genus, Andrena, and Xenos, which is parasitic on the wasps of the genus Polistes.

Rhipiphoridae.-

Little is known of the life history of the beetles of this family. They are parasitic upon Lachnosterna larvae and cockroaches.

Meloidae.-

This family includes the oil-beetles and blister beetles which in the early stages are partially parasitic in the cells of bees, and egg masses of locusts.

In the genera Epicanta, Macrobasis, Henous, the eggs are laid on the ground, not necessarily near the locust eggs, as the larva is active and having great vitality, can live long without food, until it finds an egg mass on which to live. In other genera, as Meloe and Hornia, the triungulins, after hatching, congregate on certain flowers, and when occasion permits, they attach themselves to some female bee, and are carried to the cell of a bee where they destroy the eggs or eat the bee bread, stored up for the bee larvae.

As to the economic bearing of insect parasitism, it is difficult to estimate the economic importance of some of the insect parasites to agriculture. Many crops could not be grown successfully if parasites did not exist, yet at the same time their economic importance has been somewhat overestimated. According to the views of some entomologists "Nature tends to preserve a balance among her creatures and a balance only." A farmer does not generally commence to combat an injurious insect until it has reached the zenith of its increase and done considerable harm. Then nature as a rule brings about some check upon the multiplication of the injurious insects, but in many cases this check is not brought about until the crops are nearly ruined.

Some of our noted entomologists differ broadly in their estimation of the economic importance of insect parasites. J. B. Smith, of New Jersey, in an article on "The economic value of parasites and predaceous insects" says that in nearly all cases, the parasite checks the injurious insects only after they have done practically as much harm as they could. He gives an example of one of the species of the Tortricids infesting cranberries, which is very subuect to attacks of parasites. The larvae in the spring have very few parasites, in the second brood a larger number, and in the third brood about seventy-five per cent are parasitized, the check thus arriving too late to save the plants. This check does not appear to affect the increase of the injurious species for the next year.

Ashmead endorses the economic value of parasites more strongly. He thinks that many crops could not be successfully grown if it were not for parasites. The apple, peach, grape, etc. and the more important crops, as cotton, wheat, corn, etc. have distinct species of Aphides which would cause much damage to these crops were they not

kept under control by parasites and predaceous insects.

Other results, as the destruction of the cotton worm egg by parasites, the checking of the army worm by the Jachinid (Nemorea leucaniae) and the successful attacks of Vedalia cardinalis on the fluted scale, should encourage the transportation of parasites from one country to another for the purpose of destroying injurious insects, and should show the advantage of developing this important method in Economic Entomology.