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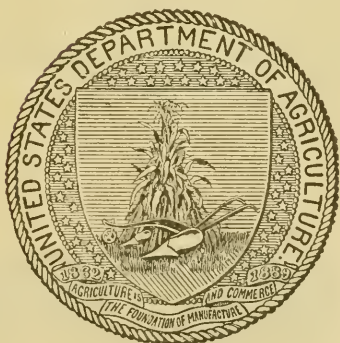
TECHNICAL PAPERS ON MISCELLANEOUS
FOREST INSECTS.

VI. CHALCIDIDS INJURIOUS TO
FOREST-TREE SEEDS.

BY

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VI. CHALCIDIDS INJURIOUS TO FOREST-TREE SEEDS.¹

By S. A. ROHWER,
Entomological Assistant.

INTRODUCTION.

For a long time entomologists were loath to give up the theory that all chalcidids were parasitic, and most of the species which attacked the seeds of forest trees were originally described as being parasitic on some other insect which either lived within the seeds of the trees or lived within the cones, but in 1893 Wachtl recorded definitely that *Megastigmus spermotrophus* lives within the seeds of Douglas fir and is phytophagous. Even after this statement entomologists were loath to believe that any chalcidids are not parasitic, and many of the foremost authorities on these insects believed up to the time of their death that some day it would be proven that all chalcidids, with the exception of certain few belonging to the genus *Isosoma* and its allies, are parasitic. Of late years, however, most entomologists have come to believe that the phytophagous habit in many of the chalcidids is not uncommon. We know at present phytophagous species of the family Collimanidæ (*olim* Torymidæ), of the subfamilies Collimaninæ and Megastigminæ, and of the family Eurytomidæ, the phytophagous species being in the tribes Isosomini and Eurytomini. To these also may be added certain genera which have been assigned to the family Perilampidæ.

The species that attack seeds of forest trees are confined to the Collimanidæ, and most of them belong to the subfamily Megastigminæ. Summing up the literature on phytophagous Chalcidoidea belonging to this family, it is possible to outline the life history of every species which may live within the seeds of forest trees. This would be as follows: The egg is laid in the early summer or late spring,

¹ Although certain hymenopterous insects belonging to the superfamily Chalcidoidea have been shown to be very injurious to the seeds of certain forest trees, very little work has been done on these insects in America. The present paper is a résumé of the literature which deals with these insects, with a bibliography of the literature. It is prepared to facilitate the work of field men and to call the attention of entomologists in general to the damage done by these insects.

the larva feeding within the seed until it reaches maturity, passing the winter within the seed as a prepupal larva, transforming into a pupa early in the spring, and emerging as an adult in time to oviposit in the rather young seeds of the trees. The egg-laying habit of some of the chalcidids which attack the seeds of shrubs or vines differs in a measure from that of those attacking the seeds of trees; for instance, the grape-seed chalcidid (*Evoxysona vitis* Saund.) oviposits in the seeds that are quite hard, and the only way that the female is able to deposit eggs within the seed of the grape is by finding a soft portion of the shell which is known as the chalaza. This is also the case with the seed chalcidid of Virginia creeper (*Prodecatoma phytophaga* Crosby). The oviposition of species of *Megastigmus* which live within the seeds of coniferous trees has never been observed, but owing to the heavy, leathery texture of the cones it is possible that oviposition occurs when the cones are very small.

Species of chalcidids feeding within the seeds of various plants have proven in some cases to be of much economic importance. A few examples will suffice to show this. Forty pounds of apple seed planted at Budapest failed to give even a good standing of apple seedlings, the seeds having been destroyed by the apple-seed chalcidid (*Syntomaspis druparum*). The seeds of the Douglas fir usually gathered in Aberdeenshire, Scotland, and amounting to over 300 bushels were, according to a letter from Mr. John Crosier published by MacDougall in 1906, not worth gathering, owing to the attack of the Douglas fir seed chalcidid (*Megastigmus spermotrophus*). According to a letter published by Riley in 1893, the seeds of the silver fir (*Abies pectinata*) in the forests of Denmark were so completely destroyed during the years 1886 and 1888 by species of the genus *Megastigmus* that not a single healthy seed could be found. As a great many of the species of *Megastigmus* which are troublesome in Europe come from the seed of the American conifers it is very likely that difficulty will be found in North America on account of the attacks of these insects. No parasite of the species of the genus *Megastigmus* is as yet known.

SYNTOMASPIS DRUPARUM (Boheman).

This species, which normally attacks the apple but is known to attack the seeds of mountain ash (*Sorbus scandica*, and probably *Sorbus latifolia*) and hawthorn (*Crataegus*), is very elaborately treated by Crosby in his paper entitled "Certain seed-infesting chalcid flies," where an account is given of practically the entire life history of this insect. The egg is deposited by the female within the seed of an apple when the apple is about three-fourths of an inch in diameter. The young larva feeds within the seed and develops until it hibernates as a larva within the seed, pupating early in the spring and emerging as an adult in June. As this species is not of any economic importance

so far as forest trees are concerned, no more details concerning it need be given, but any one wishing to obtain information regarding this insect may consult the above-mentioned paper by Crosby.

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MEGASTIGMUS SP.

A species of *Megastigmus* is recorded by Riley through rearings conducted by Borries, from the Japanese *Abies mariesii*. Nothing more is known about this species.

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MEGASTIGMUS BREVICAUDIS Ratzeburg.

This insect is considered by its original describer as probably a parasite of a gall fly inhabiting the fruit of mountain ash (*Sorbus scandica*), but Crosby has proven the species as entirely phytophagous in habit, and has reared it from seeds of *Sorbus aucuparia*. Crosby describes the larva as white, smaller than the larva of *Syntomaspis druparum*, from which it may be distinguished by the mandibles having four teeth on their inner margin and by the absence of brown tubercules on the face. The oviposition habit and the egg of this species are unknown, but it may be presumed that they are similar to those of the foregoing species.

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MEGASTIGMUS STROBILOBIUS Ratzburg.

The original describer of this insect considered it to be parasitic on *Tortrix strobilotina*, but since then it has been shown by Judeich and Nitsche that this species lives, as do other species of *Megastigmus*, within the seeds of plants, this species choosing the amabilis fir (*Abies*

amabilis). They also state that this species is distinct from *Megastigmus spermotrophus*, and that the larva is about 4 millimeters long, whitish in color, and that the mandibles have three inner teeth. Crosby records this species in *Abies pectinata*. Riley records it from Hooker hemlock (*Tsuga mertensiana hookeriana*) and from *Abies excelsa*.

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- Megastigmus pictus* (Foerster) Mayr, 1874, p. 138.
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MEGASTIGMUS PINUS Parfitt.

This species was considered by its original describer to be a parasite on some species of *Cynips* which infested the seeds of the bristle-cone fir (*Abies venusta*) (according to the original describer this was considered as *Picea bracteata*), of a new species of *Tsuga*, and of the noble fir (*Abies nobilis*). In the original account "etc." is added after the foregoing list, which implies that other coniferous seeds are attacked by this insect. Riley, in referring to material reared by Mr. Borries, of Copenhagen, Denmark, adds that this species has been reared from the seeds of Shasta fir (*Abies magnifica*), from the white fir (*Abies concolor*), from the grand fir (*Abies grandis*), and from the amabilis fir (*Abies amabilis*), but as Riley allows great variation within this species it may be that some of these rearings actually contained some of the other species of *Megastigmus*. Other than the above mentioned list of food plants nothing is published concerning the biology of this species.

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 Dalla Torre, 1898, p. 287.
 Riley, 1893, p. 360.
 Crosby, 1909, p. 368.

MEGASTIGMUS SPERMOTROPHUS Wachtl.

This insect was originally described in 1893 by Wachtl, and at that time Wachtl stated with assurance that this species of *Megastigmus* was phytophagous and lived within the seeds of the Douglas fir (*Pseudotsuga taxifolia*). Since then two papers have treated this insect in some detail. The first of these was by MacDougall in 1906. MacDougall knew the larva and felt reasonably sure that this species was phytophagous. Some of his statements as to emergence are not without interest; he states that from a lot of seeds harvested in October, 1904, he found larvæ in May, June, July, August, September, Octo-

ber, and November, 1905, and seemed to be of the opinion that the great variation in the dates of emergence of this insect was due to the irregularity of the hatching of the eggs and the coming to maturity of the larvæ. It may be, however, that the females which had emerged in the receptacle containing the seeds oviposited within the seeds, thus accounting for the larvæ found in the months of July, August, September, October, and November, 1905, when the larvæ which would be adults in the spring of 1906 should be feeding within the seeds. MacDougall does not give sufficient information to make his statement concerning variation in emergence conclusive, while rearings by Crosby, Crosier, and Wachtl confirm this last supposition.

The egg has been obtained by Crosby by dissection of a female and is described by him as "white, smooth, and spindle-shaped with a very long pedicel at the anterior end and the vestige of one at the opposite end. Length of body of egg, .36 mm.; tail-like process, .9 to 1.2 mm." The larva described by Crosby is as follows: "The full-grown larva is yellowish white with brownish mouth parts; its length varies from 2.5 to 3.5 millimeters. The surface is smooth without apparent sculpture, and the hairs are very sparse and microscopic in size. The inner margin of the mandibles is provided with three sharp teeth." The pupa is described by Crosby as follows: "The pupa is yellowish white and in the female has the ovipositor curved over the back and reaching to about the middle of the thorax. Length of female pupa, 3 mm.; of male, 2.5 mm."

The oviposition of this species is unknown, and the shape of the egg after having been deposited is not known. Neither has this insect been recorded as having been reared from the seeds of any Douglas fir raised in the United States. All seeds from which it has been reared were collected in Aberdeenshire, Scotland, on the estate of Mr. John Crosier. In this statement we must except the seeds from which the species was reared by Wachtl, as it is presumed that these were collected somewhere in the northwestern United States. Crosby also records the larvæ within the seeds of Douglas fir in Colorado, but these seeds came from a nursery firm and definite locality could not be secured.

Up to the present time this is the most injurious chalcidid on forest trees which has received the attention of any entomologist. The attention which this insect has received in America, with the exception of the work done by Crosby, has been nil. MacDougall recommends as protection from this species that the cones be gathered as soon as ripe, and that, as soon as they will permit, the seed be thrashed from them, and that this be fumigated without delay with bisulphid of carbon. No experiments have been published concerning the results of such fumigation, but except for killing the larvæ within the seed and preventing another generation of adults this method can not be considered as valuable.

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 Crosby, 1909, pp. 379-380, figs. 85-89.

SUMMARY.

Up to the present time there are seven species of chalcidid flies which are known to attack the seeds of the following forest trees:

Mountain ash.....	{ <i>Sorbus scandica</i> . <i>Sorbus aucuparia</i> . <i>Sorbus latifolia</i> ?
Amabilis fir.....	<i>Abies amabilis</i> .
White fir.....	<i>Abies concolor</i> .
Great silver fir.....	<i>Abies grandis</i> .
Shasta fir.....	<i>Abies magnifica</i> .
Bristlecone fir.....	<i>Abies venusta</i> .
Noble fir.....	<i>Abies nobilis</i> .
Three exotic firs.....	{ <i>Abies excelsa</i> . <i>Abies pectinata</i> . <i>Abies mariesii</i> .
Hooker hemlock.....	<i>Tsuga mertensiana hookeriana</i> .
Unknown Tsuga.....	<i>Tsuga</i> sp. (?)
Douglas fir.....	<i>Pseudotsuga taxifolia</i> .

Of these seven species the eggs of two are known, the larvæ of four, the pupæ of two, the oviposition habit of one, and the emergence dates of three. The only species of which the life history has been completely traced is that of the apple-seed chalcidid (*Syntomaspis druparum*) which is also known to attack the seeds of mountain ash.

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