U. S. DEPARTMENT OF AGRICULTURE,

DIVISION OF ENTOMOLOGY—BULLETIN NO. 44.

L. O. HOWARD, Entomologist.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

VII.

PREPARED UNDER THE DIRECTION OF THE ENTOMOLOGIST.

WASHINGTON:

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1904.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., February 24, 1904.

SIR: I have the honor to transmit herewith the manuscript of a bulletin which contains several articles and notes similar in nature to those which have been presented in previous years under the title, "Some miscellaneous results of the work of the Division of Entomology," and recommend that the material here presented be published as Part VII of that series. The introductory article on aphides affecting grains and grasses is of special value to the economic entomologist, as the identity of many of these species has been in a state of confusion for a number of years, and the descriptions here furnished, together with the illustrations, will assist materially in simplifying this matter. For many years there has been great demand for a publication covering the subject of the weevils which affect chestnut, as also pecan and hickory, and the article presented on this subject will, in part, fill this want. The remaining articles are mostly shorter, and each has its special value.

Respectfully, L. O. HOWARD,
Entomologist.

HON. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

[a] Presented by title before the St. Louis Meeting of the Association of Economic Entomologists, Dec. 30 and 31, 1903.

ILLUSTRATIONS.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

VII.

ON SOME OF THE APHIDES AFFECTING GRAINS AND GRASSES OF THE UNITED STATES.

By Theo. Pergande.

THE EUROPEAN GRAIN LOUSE.

(*Siphocoryne avenæ* Fab.—Fig. 1.)

Up to the present time the writer has been unable to ascertain whether other species described in Europe or this country are identical with this insect or not, though it is quite certain that the accounts or descriptions published by the earlier entomologists of this country on the apple louse all refer to the same species, particularly since the genuine *Aphis mali* DeGeer was first observed by the writer in the spring of 1897, from which date it has spread through several of the Eastern States.

The first elaborate account of the common apple louse of the United States was published by Dr. Asa Fitch in his First and Second Report for 1856, under the cognomen of "The apple plant-louse," which he erroneously considered to be identical with the European *Aphis mali*, to which since his time it has been referred by subsequent authors. These authors took it for granted that Doctor Fitch knew the species well, though all of them were unaware of the range of food plants to which the species adapted itself during its cycle of existence. It is really strange that Fitch, after having seen thousands of the apple louse, should have considered the insect found by him on the leaves of the plum to be a different species, which he subsequently described on page 123 of the same report, under the name of *Aphis prunifoliæ*, notwithstanding that, as stated by himself, "Its generation and habits are so similar to those of the apple plant louse that a separate account would be little more than a repetition of what has already been related."

To make the history of the species still more complicated, leading later on to many errors, Fitch published (on pp. 91, etc., of his Sixth

Report for 1856) a very interesting article on the grain *Aphis* (*Aphis avenæ* Fab.), in which he made the unfortunate mistake of confounding several other species with the true grain louse; erroneous figures of one of which were published on Pl. I, figs. 5 and 6, representing a species of Siphonophora *Koch*. This error of judgment in distinguishing genera as found upon grain has mainly been the cause to divert the attention of later entomologists from the true characters of the species described by Fabricius.

Until the spring of 1880 the writer also entertained the opinion that the species treated of by Prof. Cyrus Thomas, in his Eighth Report (pp. 51–55), was identical with that mentioned and described by Fitch as *Aphis avenæ* Fab. During the spring of 1880, however, the writer became suspicious that something was wrong, since the description given by Thomas did not agree with that published by Fabricius. At that time I happened to examine a lot of aphides from Pocomoke City, Md., which were reported to be extremely numerous and destructive to wheat in that vicinity. These, in my opinion, agreed exactly with the description of *Aphis avenæ* Fab., and Kaltenbach, but not with the description by Thomas, and I have held to this opinion ever since. The same form, having been found by myself or received from various localities, infesting grains or grasses, agrees well with the description of the species published by Fitch, but not with that of Thomas.

In consulting Mr. O. W. Oestlund's description of his *Nectarophora granaria* (Aphididæ of Minnesota, p. 82, 1887), I am forced to believe that the species observed by him is also the same as the *A. avenæ* Fab., though, having failed to obtain any specimens from him, I am unable, at present, to verify my suspicion.

While consulting the original notes of Doctor Fitch, I found also a clipping from the Kingston (Canada) Daily News, of August 16, 1866, containing an article on the grain louse which was doing much damage at the time. The article was written by a Mr. Lawson, of the Botanical Society of Canada, who considered the insect as new, and in the same article he described it under the name of *Aphis tritici*. After a careful scrutiny, I am confident this is the same as *A. avenæ* Fab., but, since descriptions of insects in newspapers are not considered as authoritative, I have declined to recognize his name of the species.

During the fall of 1880, while solving the life history of the hop louse (*Phorodon humuli*) at Richfield Springs, N. Y., at a time when the return migrants of the apple louse were very abundant on the leaves of apple trees or still swarming, I happened to discover also some colonies, both of the migrants and the apterous forms, in various stages of development on the leaves of a grass, *Dactylis glomerata*, growing in the orchard. After careful comparison of these with others on the apple, which, up to a comparatively recent time the writer had considered identical with the European apple louse, *A. mali* DeG.

Some years ago I examined and compared a number of specimens, labeled by Fitch, and now contained in the collection of the United States Department of Agriculture, both of his *A. mali* and his *A. avenæ*, as well as a number of specimens of *A. avenæ* kindly sent me by Dr. H. Schouteden, Brussels, Belgium, all of which confirmed my opinion which is that the American apple louse and the grain louse are identical, and that the European *A. mali*, of which the first American colonies were found in the spring of 1897, is quite a distinct species, not even generically identical with the genuine grain louse of Europe, nor with the grain louse described by Thomas as *Siphonophora avenæ*. On further examination and comparison of the insect under consideration, I have concluded that it belongs to the genus Siphocoryne of Passerini, described in "Aphididæ Italicæ" (p. 52, 1863). He there states that the nectaries are clavate, while otherwise it is similar to Aphis, placing with it but three species; failing, however, to discover the clavate character of the nectaries in *avenæ*, which occasionally exhibits this character but faintly, so as to make them appear cylindrical and was therefore still retained by him in the genus Aphis; whereas in the true genus Aphis the nectaries are always more or less distinctly tapering.

According to my own observations, after the migrants had been transferred from apple and Cratægus to grain and grasses, I have found a certain range of variation in the comparative length in the joints of the antennæ, as well as in the nectaries of the progeny of the apple louse, the extreme forms of which may easily induce superficial students to consider them as distinct. Large series, however, of the various forms, more or less due to the season or abundance of food, have convinced me that all of them belong to but one species. Some of the most constant characters of this insect are the comparatively small or minute terminal fork of the front wings, which frequently varies considerably in the same specimen; the more or less strongly pronounced tuberculation of joints three and four and frequently also the fifth joint of the antennæ, and the clavate character of the nectaries, which frequently becomes rather pronounced.

Observations thus far made tend to show that the species is biennial and that the progeny of the spring migrants from the apple subsist almost exclusively upon various grains and grasses until the fall of the second year, when a generation of return migrants makes its appearance. The earliest ones of these produce the sexual females, whereas the others, appearing several weeks later, are the true males, thus closing the cycle of existence of the species. These observations show also that the progeny of the migrants from the apple are rarely seen during the heated term, and that most of them station themselves close to the base of the plants; though I have, on one occasion, also found a colony of *Siphocoryne avenæ*, including the winged form, about the middle of August, on the leaves of *Panicum sanguinale*, in

which the characters above mentioned were still those of the genuine apple plant louse. This similarity was evidently due to the general dryness of grasses common during summer, whereas from September till winter and the following spring, grasses as well as grain became more succulent and nourishing, with the result that nectaries as well as antennæ developed more rapidly as the season and growth of plants advanced. These organs reached their maximum development toward the end of June, after which a general retardation set in, until the sexupares or return migrants were almost identical with those found on the apple during the spring, though stray specimens may frequently be encountered during the season, which indicate an overlapping of two different series.

The annexed list is for the purpose of indicating the localities and plants on which the grain louse has thus far been observed:

Apple (*Pyrus malus*), United States, April to June, and September to November.

Pear (*Pyrus communis*), Washington, D. C., October and November.

Hawthorn (*Cratægus coccinea*, etc.), Washington, D. C., May and November; Newark, Del., November.

Quince (*Cydonia vulgaris*), Washington, D. C., May and November; St. Louis, Mo., June.

Plum (*Prunus* sp. ?), Washington, D. C., June; Richfield Springs, N. Y., May.

Choke cherry (*Padus virginiana*), Oakwood, Nebr., October.

Wild black cherry (*Padus serotina*), St. Louis, Mo., October.

Dogwood (*Cornus* sp. ?), St. Louis, Mo., October; evidently accidental.

Celery (*Apeum graveoleus*), Washington, D. C., November; with larvæ.

Tickseed (*Coreopsis* sp. ?) Brookings, S. Dak., September; with larvæ.

Shepherd's-purse (*Capsella bursa-pastoris*), Washington, D. C., November; probably accidental.

Burdock (*Lappa major*), Washington, D. C., November; accidental.

Wheat (*Triticum vulgare*), Washington, D. C., March to June; Pocomoke City, Md., April; Adonia, Va., April; Trenton, N. J., May; Massachusetts, November; Carroll, Ohio, October, November; Wooster, Ohio, January; Lafayette, Ind., June; Laporte, Ind., December; Sherman, Tex., April; Los Angeles, Cal., April; Champaign, Ill., November.

Rye (*Secale cereale*), Atlanta, Ga., April.

Oat (*Avena sativa*), Washington, D. C., November; St. Louis, Mo., November.

Meadow grass (*Poa pratense*), Washington, D. C., October to December

Bluegrass (*Poa compressa*), Ashland, Nebr., October.

Timothy (*Phleum pratense*), Washington, D. C., August, November.

Finger grass (*Panicum singuinale*), Washington, D. C., August, November.

Orchard grass (*Dactylis glomerata*), Richfield Springs, N. Y., October.

Upright chess (*Bromus racemosus*), Washington, D. C., June.

Rescue grass (*Bromus unioloides*), Washington, D. C., January, 1903.

Thus far 22 plants are herewith recorded on which the species has been observed, of which 8 are trees, 4 are weeds or herbs, and 9 grains or grasses.

Siphocoryne avenæ Fab.

Aphis avenæ Fab., Entomologia Systematica, Vol. IV, p. 214, 1794.

Aphis mali Fitch, First and Second Reports on the Noxious and Beneficial Insects of New York, p. 49, 1856.

Aphis prunifoliæ Fitch, First and Second Reports on the Noxious and Beneficial Insects of New York, p. 122, 1856.

Aphis avenæ Fitch, Sixth Report of the Noxious and Beneficial Insects of New York, p. 91, 1856.

Siphonophora avenæ Thomas (in part), Eighth Report, Noxious and Beneficial Insects of Illinois, p. 52, 1879.

Aphis annuæ Oestl., Synopsis of the Aphididæ of Minnesota, p. 66, 1887.

Aphis fitchii Sanderson, Thirteenth Annual Report Delaware College, Agricultural Experiment Station, p. 137, 1901.

DESCRIPTION OF THE SPECIES.

Winter egg.—The hibernating or winter eggs are deposited during the months of October to December on the trunk and branches of the apple, pear, quince, hawthorn, and plum, under loose bark, in cracks, depressions, in the crotches, and around the buds, where they remain dormant until the following spring. They are about 0.6^{mm} in length, pitch black, and highly polished. In favorable years they become frequently so numerous as to cover entire branches, when they may be readily observed. Yet, notwithstanding the great number of eggs, the majority, through one cause or another, are destined to perish during the coming winter, when numbers of them are washed off by rains, sleet, or snow.

Stem-mother; first generation.—The young larvæ, hatching from these eggs, make their first appearance, according to the advancement of the season, from about the middle of March to the middle of April, at about the time that the buds commence to burst. They are at that time about 0.6^{mm} in length, at first yellowish green, though changing within a few hours to a rather dark green; the head changes to dusky or almost black in front and the eyes to a dark brown. The legs are dusky, rather stout, and somewhat hairy. The antennæ are short and four jointed, with the third and the spur of the fourth much the longest and subequal in length. The nectaries are very short and tuberculiform, while the rostrum reaches almost to the end of the body. Within about a month after hatching they reach maturity. The mature stem-mother measures about 1.4^{mm} in length, by almost one-half of it in diameter about the middle of the abdomen. They are now of a greenish-yellow color, with the medio-dorsal line dark green, while the head, the first three joints of the antennæ, the greater part of the legs, the lateral border and incisures of the abdomen are rather pale. The remainder of the antennæ, sometimes also the entire legs and tail, are dusky and the eyes brown, while the nectaries are still paler than the body, with the apex only dusky. All are covered with an extremely delicate, pruinous secretion, which is often almost invisible above, though generally more conspicuous on the under side of the body. The antennæ are rather slender, about one-half the length of the body and five jointed; the third joint is much the longest and almost as long as the rest beyond it. The nectaries are quite slender, cylindrical or somewhat stouter at base, though frequently with a slight indication of becoming clavate toward the end, and with the apex more or less distinctly flaring; they reach generally to or beyond the end of the body and are about as long as the spur of the last antennal joint. The tail is elongate conical, about half the length of the nectaries, covered with minute points and provided with a few bristles each side. The last abdominal segment is semicircular, its edge lined with minute, acute teeth, and fringed with a series of bristles.

Second generation.—The majority of the progeny of these stem-mothers reach maturity during the first half of May, almost all of which acquire wings, to enable them to spread from tree to tree or from one locality to another, for the preservation of the species, as otherwise they are liable to extermination by various enemies, which gradually increase in numbers and species.

The pupæ measure about 1.8^{mm} in length, and are of a more or less translucent,

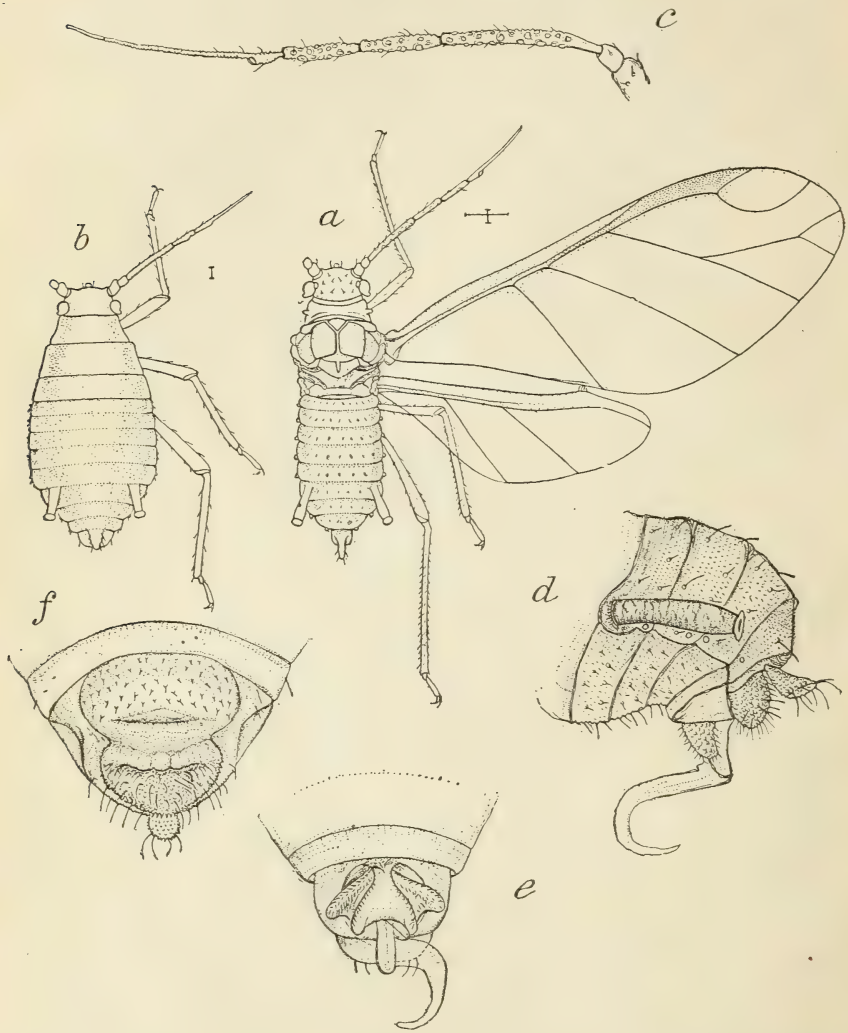

FIG. 1.—*Siphocoryne avenæ* Fab.: *a*, migratory female; *b*, sexual female; *c*, antenna of migratory female; *d*, side view of end of body of winged male; *e*, under side of end of body of male; *f*, under side of end of body of sexual female; all greatly enlarged (original).

pale, greenish-yellow color, marked with three darker green stripes, which are linear on the thorax and much the broadest on the abdomen. The head, four basal joints of the antennæ, the wing-pads, and nectaries are whitish, often with a greenish or yellowish tinge; frequently there is also a reddish or ferruginous patch near the inner base of the nectaries; the future ocelli are indicated by brownish spots. The

remaining joints of the antennæ, the tarsi and tip of nectaries are blackish, the apex of the femora brownish or purplish, and the tibiæ dusky toward the end. The antennæ are six jointed, the third joint and the spur longest and subequal in length, each of them almost subequal to joints four and five combined. The nectaries are similar to those of the stem-mother, with traces of the future clavate character of the imago.

Migratory female (fig. 1, *a* and *c*); *second generation.*—The winged form of this generation is extremely active and may be observed at favorable times to swarm in considerable numbers, and, settling on the proper kind of trees, proceed at once to deposit their young ones. The head and thorax of these migrants are of a polished black, with the depressions or sutures of the thorax more or less distinctly greenish; the eyes are brown; the antennæ, terminal two-thirds of the femora, apex of the tibiæ, the tarsi, and nectaries are black. The abdomen is greenish yellow, marked with three or four black, lateral spots in front and one or two beyond the nectaries; the tail varies from dusky to black. The basal section of the femora and the tibiæ vary between green and yellowish green, whereas the median line and lateral margin of the abdomen are frequently dark green. The expanse of their wings is about 7^{mm} and the length of the body 1.5 to 2^{mm}. The antennæ are rather short and stout and reach to or somewhat beyond the middle of the body; in the length of the various joints there is more or less variation in different specimens and frequently in the same specimen; the third joint and the spur are longest and generally subequal in length, with the fourth next and the fifth shorter than either of them. Joint 3 is always strongly tuberculated, frequently also the fourth and sometimes also, more or less so, the fifth. The nectaries are of medium size or generally about as long as the fourth antennal joint; as a rule more or less, though sometimes distinctly clavate, with the bulge toward the end and most conspicuous on the inner side; the apex is flaring. The tail is curved upward, rather less than half the length of the nectaries, elongate conical and rounded at the apex; its surface bears numerous minute points, while on each side of its terminal half are about three curved bristles; the last abdominal segment is similar to that of the stem-mother. The venation resembles that of Aphis; the stigma is elongate lanceolate and its vein arcuate, while the terminal fork of the third discoidal vein is smaller than usual, sometimes minute or even wanting in one wing or the other.

The third generation is composed of both the apterous and the winged forms which reaches maturity about the middle of May, while the fourth generation, which has spread to various related trees or shrubs, makes its appearance about the middle of June; the last or fifth generation, which is usually small and scattered, may be observed from the middle of June till the early part of July, after which time all have disappeared, leaving the trees free of them until the middle of September, when the pupiferous females or return migrants again make their appearance and continue to do so until the middle of November, to restock the trees with sexual females, which it takes about a month to bring to maturity, by which time, or from about the middle of October, the winged males make their appearance, having in the intervening time attained maturity on grain or grasses, and continue to do so till the middle of November or, during favorable seasons, even later.

The pupiferous females, or return migrants, are as a rule somewhat larger than the spring migrants; their expanse of wings ranges between 6 to 8^{mm} and the length of their body between 1.5 to 2.4^{mm}; the antennæ are also somewhat longer, with the third joint usually much shorter than the spur, though joints three to five vary just as much in length and tuberculation, as well as in the size of the terminal fork, from the spring migrants. The general coloration of the body has also become quite variable. In some specimens the color is of a rather yellowish green with the lateral spots very distinct, whereas in others it is of a grayish-green or dusky shade, or sometimes almost black. All except the palest forms show a more or less distinct

bronzed reflection on the dorsum, the under side being generally paler and covered with a more or less distinct pruinous secretion. Otherwise they are like the spring migrants.

Sexual female.—The mature sexual females (fig. 1, *b* and *f*) measure from 1.6 to 1.8^{mm} in length; they are oval and almost equally tapering toward each end. The antennæ are short, about half the length of the body, and five-jointed, the spur being the longest, with the third joint somewhat shorter; all of the joints are plain. The nectaries are short, and do not reach to the end of the body; they are usually tapering, cylindrical, or rarely slightly clavate; the tail is still shorter, its basal half rather broad, with the sides parallel, while the terminal part is broadly triangular and covered with minute sharp points. The posterior tibiæ are more or less distinctly inflated and provided with numerous circular, sensorial pores. The color of these sexual females varies more or less; some are of a pale, dirty orange, marked with irregular dusky spots, while others are still darker, spotted only along the sides; many are entirely of a greenish dusky color, often exhibiting in front of the nectaries a lateral row of small, oval, whitish spots; all are, however, provided with a reddish shading around the base of the nectaries. The eyes are brown, the antennæ, legs, and tail dusky and the nectaries black. Each of them contains from two to four or five eggs. These females, either before or after copulation, forsake their position on the leaves or branches and commence to travel restlessly about, in order to select a secure spot for depositing their eggs, when, especially during warm days of October, every part of a tree may be seen covered with them, either in copula or engaged in depositing their eggs.

Male.—The males (fig. 1, *d* and *e*) as a rule are generally smaller than the migratory females; their expanse of wings ranges between 5.4 to 7^{mm} and the length of their body between 1.2 to 2^{mm}. The general appearance of the male is very similar to that of the migratory female, though the abdomen is narrower and the last two segments more protruding. The general color of the abdomen is either orange or greenish yellow, though frequently there is a more or less defined, dusky, median line, terminating, between the nectaries, in a dusky spot. The antennæ are generally somewhat longer and stouter than in the migratory female; joints three and four more strongly and more densely tuberculated and the spur longer than joint three. The genital armature consists of two elongated, triangular lobes or claspers, rounded at the end and covered with erect hairs, between which projects a cylindrical sheath, containing the colorless and flexible organ, which frequently may be observed extruding in a hook-like fashion.

Before maturity of the females the males rest motionless on the under side of the leaves from which they draw their nourishment, though no sooner have the females cast their last skin than they become very nervous and restless and walk briskly about on the branches and the trunk on which the females have congregated, so that frequently thousands of both sexes may be observed, among them many in copula, and often several males may be seen paying attention to the same female.

All of those destined to produce a sexual generation the following fall remain and multiply on grains and grasses, though producing at certain times a migratory form to enable them to spread and to protect themselves against destruction over a large area of the country, during which time for a greater or less extent certain external changes take place, the extreme forms of which may easily pass as distinct species, when toward the second fall they return again to the original form.

NATURAL ENEMIES AND PARASITES.

Fitch, in his admirable work on the apple louse, refers to the larvæ of various aphis lions (Chrysopa) and ladybirds (Coccinellidæ) as being very effective in keeping the aphides in check, whereas in con-

nection with the grain aphis he mentions the following parasitic or predaceous insects.

Toxares triticaphis Fitch; *Praon avenaphis* Fitch; *Allotria tritici* Fitch, and *Allotria avenæ* Fitch. Of the Coccinellidæ he mentions *Hippodamia parenthesis* Say; *Coccinella 5-notata* Kirby, and *Coccinella 9-notata* Hbst.

The only species bred by me from the grain aphis thus far, though in considerable numbers, is *Aphidius nigriceps* Ashmead.

There were also bred by me a number of specimens of *Syrphus americanus* Wied., the larvæ of which prey voraciously upon the lice.

The following original specimens, preserved by Fitch and bearing his identical numbers and names, as found in his notes, are: 4987, var. *pallidicornis;* 4988, *triseriata;* 4990, *obsoleta;* 4992, *bicincta;* 4993, *nigricollis;* 4994, *tergata;* 4995, *thoracica;* 4997, *nigriventris;* 5000, *fulviventris*, and 4991, without a name attached, which is probably identical with his variety *immaculata*. None of the following numbers of *A. mali*, mentioned in his notes, were found: 1125, 1126, 4987, 5004, 5548, 5549, 11603 and 11604, ♂, 11605 and 11606, ♀, nor 11844–11853. One specimen, a male, marked by Fitch with the printed number 839, is preserved in the State Cabinet of Natural History of New York, at Albany, N. Y.

Of *Aphis prunifoliæ* Fitch, the following specimens, mentioned in his notes, are still preserved: *a*, *d*, *e*, *f*, *g;* while *b*, *c*, *h*, and numbers 3772–3783 are lost.

Of *Aphis avenæ* Fitch, but three specimens were found; two specimens bore No. 15237 and the other one 15238, while 15239 is lost.

THE ENGLISH GRAIN LOUSE.

(*Macrosiphum granaria* Buckton.—Fig. 2.)

Siphonophora Koch, Pflanzenläuse, p. 150, 1857.
Macrosiphum Passerini, Gli Afidi, p. 27, 1860.
Nectarophora Oestlund, Aphididæ of Minnesota, p. 78, 1887.

In accordance with priority, the generic term Siphonophora, as adopted by Koch, had already been preoccupied by Eschscholtz and described by him in "Syst. d. Acaleph." in 1829, though, without knowing this fact, it was again applied by Brandt, "Bull. Acad. St. Petersburg," in 1836, for a genus belonging to the Myriapoda. Oestlund, recognizing the preoccupation of Siphonophora, substituted for it (Aphididæ of Minnesota, p. 78, 1887) the name Nectarophora, overlooking the fact that Nectarophora was antedated by Macrosiphum *Pass.* (Gli Afidi, p. 27, 1860), a generic term, unfortunately, adopted by Oestlund for a species with long and clavate nectaries, found on *Rubus strigosus*, which he named *Macrosiphum rubicola*, a generic term also adopted by Del Guercio (Afidafauna Italica, pp. 144 and

159) for a number of species agreeing with the characters of Macrosiphum Oestlund, overlooking, however, the fact that Macrosiphum was preoccupied by Passerini for a genus structurally quite different. Dr. M. H. Schoutenden was the first to observe this error, and changed Macrosiphum *Oestlund* to Nectarosiphon, in contradistinction to Macrosiphum *Passerini*.

The principal characters of this genus, as accepted by authors, are:

GENUS MACROSIPHUM *Passerini*.

Front of head deeply concave, provided with large, terminally diverging frontal tubercles or projections for supports of the antennæ. Antennæ long and filiform, as long or usually much longer than to the end of the body or tail, with the spur of the sixth joint very long and bristle-like. Nectaries very long, cylindrical, tapering, and frequently projecting beyond the tail. Tail long, slender, more or less distinctly contracted near its base, curved upward. Legs long and slender. Wings large, the third discoidal vein with two forks; stigma rather long, narrow, elongate lanceolate. The majority of the species are large and frequent the foliage of weeds, cultivated plants, and grasses.

Macrosiphum granaria Buckton.

Siphonophora granaria Buckton, Monogr. of British Aphides, vol. 1, p. 114, 1876.
Siphonophora avenæ Thomas (in part), Eighth Rept. Nox. and Benef. Insects of Ill., p. 51, 1879.

With regard to this species much uncertainty has existed. Buckton was the first to introduce this name in his writings on English Aphides, on the supposition that the insect in his hands at the time was identical with that treated of by Kirby and Curtis under the name of *Aphis granaria*, concluding also that *A. avenæ* Fab., *hordei* Kyber, *cerealis* Kalt., and *Siph. cerealis* Koch were all of them the same species. After examining, however, the extremely short and in every detail insufficient description of *A. granaria* by Kirby (Linn. Soc., 4, p. 238, 1798), I doubt very much that the species mentioned by Kirby and Curtis under the above name is identical with the one described by Buckton, but believe that the species treated of by them was the genuine *Aphis avenæ* Fab., and, while investigating this matter, found that a description of *A. hordei* was never published and that the name of it was simply suggested by Kyber (Germar's Mag. d. Entomologie, vol. 1, pt. 2, p. 11, 1815), with a footnote to the effect that he intended to describe the species later on. It was surely not identical with *A. cerealis* Kalt. and Koch, which I have known for some years to exist in this country. Buckton, while describing his *granaria*, seems to have mainly depended on the superficial description of the species by Curtis (Farm Insects, pp. 287–290, figs. 9, 10, 11, and Pl. J, figs. 10, 11, 13, 1860, the figures of which are absolutely unreliable). As far as the description of *avenæ* is concerned, I am confident that it does not belong to Siphonophora *Koch*, since the frontal tubercles so characteristic of Siphonophora are wanting. Curtis states that the

antennæ are inserted in front of the face, close to the inner margin of the eyes, which character alone would remove it from Siphonophora and bring it nearer to genera with rudimentary frontal tubercles, more or less closely related to Aphis. I should, therefore, not be surprised if future studies should disclose the fact that the species described by Curtis is identical with *Siphocoryne* (*Aphis*) *avenæ* Fab. Buckton was apparently misled by the colored figure of a migrant on Pl. J, on which a number of spots on the abdomen are represented which have not been mentioned in the description, which plainly indicates that he described one and figured quite a different species found on grain at the same time. At any rate, the first substantial description and illustration of the present species must be credited to Buckton.

As to the *Siphonophora avenæ*, as described by Thomas, in which he includes *granaria*, *cerealis*, and *hordei*, I will say that he is very much mistaken. On page 52, and partly on page 53 of his report, Thomas simply reproduces the description of the true *Siphocoryne* (*Aphis*) *avenæ*, as described by Fitch in his sixth report (p. 95, etc.), which he considered, without a doubt, as being identical with a species found by him on grain, whereas his description of the insect (p. 53) tallies well with *Siphonophora granaria* as described by Buckton.

Until quite recently I considered the species treated of by Thomas as being identical with *A. avenæ* Fab., until a careful examination of specimens found by me on oats at Stettin, Prussia, July 26, 1898, convinced me that the species found then was identical with the one described by Buckton and agreeing also with the short description of *avenæ* Thomas (Eighth Report Nox. and Benef. Insects of Ill., p. 53, 1879), though not with the species described by Fitch under the name of *A. avenæ*.

Prior to that date and since then the same species had been received by the Department from Concord, N. C.—May 25, 1882, found infesting the ears of wheat. During December, 1888, it was found on wheat at Lafayette, Ind. In 1889 it was found on wheat at Washington, D. C., and during August of the same year at Lafayette, Ind., on oats. In June, 1897, it was found on wheat and grass at Washington, D. C., and in May, 1898, on wild rye (*Elymus virginicus*) growing in Virginia near the shore of the Potomac. During the month of June, 1900, it was found at Milford, Del., on wheat and rye, and in various localities in Kansas, where it sometimes proved to be very abundant and destructive to wheat and oats, and on heads of wheat at Macomb, Ill.; it was also reported as doing much damage to wheat at Northville, N. Dak. During April and May of 1901 it was reported as doing much damage to wheat from Adonia, Farmville, Shirley, and Spring Garden, Va., while, lastly, it was found to be very numerous on young volunteer wheat in the District of Columbia.

The list of grains and grasses on which it has thus far been observed is rather small, though there can be no doubt that it will eventually be found to subsist on many other grasses and possibly also on some weeds or other cultivated plants.

That it must have existed in this country for a considerable length of time seems evident from the fact that its distribution has spread from Virginia to North Dakota, and that it will gradually be found in all the intervening States both north and south, as well as in the Western States or wherever wheat or other grains are grown, where occasionally it may prove a serious pest.

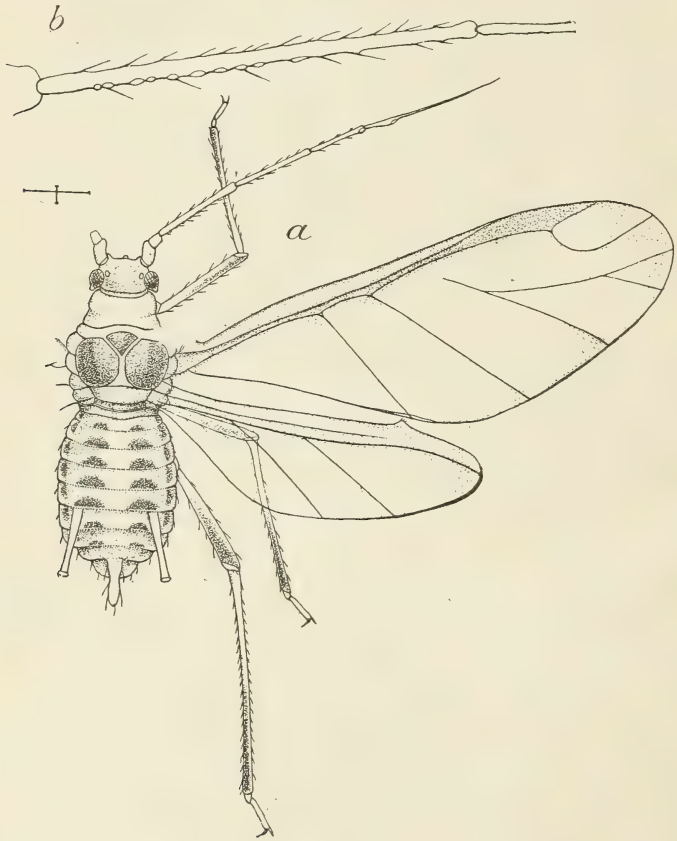

FIG. 2.—*Macrosiphum granaria* Buckton: *a*, migratory female; *b*, third antennal joint of same, all greatly enlarged (original).

DESCRIPTION OF THE SPECIES.

Apterous female.—Length 2.4 to 2.8^{mm}; fusiform, broadest near the base of the abdomen. Frontal tubercles large, diverging at the apex, as usual, in this genus; antennæ bristle-shaped, as long or slightly longer than the abdomen; joint six, including the spur, longer than joint three; generally there are one or two small, circular and projecting sensoria near the base of the third joint; all of the joints are very sparsely beset with short and stiff bristles which are rarely slightly clavate. The

nectaries are long and reach beyond the tip of the abdomen, though rarely beyond the tip of the tail; they are cylindrical, tapering, becoming again slightly stouter toward the end. The tail is rather long and stout, curved upward, and about two-thirds the length of the nectaries, lanceolate, and more or less distinctly constricted about the middle; it is densely covered with acute, minute points and furnished each side of its terminal half with three, backward-curved, long bristles. The legs are long and provided with short, stiff, and simple hairs.

The color of the apterous female is yellowish-green, often slightly pruinose; frequently darker toward the end of the body; the head varying from yellow to brownish-yellow. The eyes are red to brown, while the tail varies from white to a distinct yellow. The antennæ, as a rule, are black, though sometimes the first joint may be yellow or the first three joints dusky. The terminal half or more of the femora, apex of the tibiæ, the tarsi, and the nectaries brown to black; the rest of the leg is yellow. The body is frequently marked with a brownish puncture or spot each side of the prothorax; sometimes there is a narrow dusky or black line, composed of minute spots, each side of the mesothorax and a dorso-lateral row of about five linear or rounded, blackish or dusky spots each side of the abdomen, which sometimes are extremely faint or even wanting. Occasionally there are also two additional small black or dusky spots between the nectaries. Lateral spots in front of nectaries black.

Winged migrant.—Expanse of wings 9 to 9.4^{mm}; length of body 1.4 to 2.6^{mm}. Antennæ long, generally about one-third longer than the body; the third joint about one-third shorter than the sixth and provided along its exterior or posterior edge with from six to eleven more or less elevated, round sensoria along its basal third. The hairs of the various joints are similar to those of the apterous female, though sometimes one or the other may be distinctly clavate. The nectaries, tail, and legs in general appearance and size are very similar to those of the apterous form. The wings are almost twice the length of the body, while the venation corresponds very much to that of Aphis.

Color yellowish-green to green; the mesothorax yellow and its lobes brown to black. Sometimes a small, oblique, dusky, subdorsal spot and a transverse pale-dusky band may be observed on the prothorax. Head brown or brownish-yellow; eyes red to brown. Antennæ black, the first joint sometimes brownish-yellow externally. Nectaries black, the tail yellowish or greenish-yellow; sternal plate and lateral spot in front of wings black. The abdomen is marked with four or five small, transverse, blackish dorso-lateral spots and four black lateral spots in front of nectaries; the coloration of the legs is similar to that of the apterous female. Wings clear, the costa dusky, and the subcosta yellow; stigma yellowish, its inner margin dusky; veins yellowish-brown, changing to black toward the end.

In order to distinguish this species, besides the maculations of the abdomen, from near related species infesting grains and grasses, I have adopted the rule of measuring the comparative length of the antennal joints, the nectaries, and the last fork of the wings by tenths, with the accompanying result of variation:

Joint 3, variation between 19 and 29.
Joint 4, variation between 13 and 20.
Joint 5, variation between 11 and 17.
Joint 6, variation between 24 and 34.
Nectaries, variation between 11 and 16.
Last fork, variation between 22 and 36.

The sexual generation or the eggs have thus far not been observed.

Of their natural enemies or parasites none have been observed, though there can be no doubt that various species of ladybirds as well as the larvæ of Chrysopids and Syrphids will prey upon them whenever they become sufficiently numerous to attract their attention.

THE GERMAN GRAIN LOUSE.

(*Macrosiphum cerealis* Kalt.—Fig. 3.)

Aphis cerealis Kalt., Monog. d. Pflanzenläuse, p. 16, 1843.
Siphonophora cerealis Koch, Pflanzenläuse, p. 86, 1857.

This species was first described by Dr. J. H. Kaltenbach (Monogr. der Pflanzenläuse, p. 16, 1843). At the time he considered it as being identical with *Aphis hordei* Kyber, which, however, had never been described.

As food plants the following grains and grasses are mentioned by him: Wheat (*Triticum sativum*), rye (*Secale cereale*), oat (*Avena fatua* and *strigosa*), barley (*Hordeum murinum*), chess (*Bromus mollis* and *secalinus*), orchard grass (*Dactylis glomerata*), velvet grass (*Holcus lanatus*), and meadow grass (Poa), feeding on the ears, the racemes, the petiole, and occasionally in small colonies on the leaves of grains and grasses, on the former of which, during July and August, they may frequently be observed in enormous numbers.

Buckton (Monog. of Brit. Aphides, vol. 1, p. 114, 1876), as well as Thomas (Eighth Rept. Nox. and Benef. Insects of Ill., p. 51, 1879), make it a synonym of *granaria*, and the latter author considers it also a synonym of *Aphis avenæ* Fab., neither of them recognizing, however, the characters by which it may be separated from either of them; since then, nobody, at least in this country, appears to have taken the trouble to separate the species referred to, notwithstanding that the range of this species appears to be as large as that of the other grain-inhabiting Aphides.

That both *granaria* and *cerealis* are likely to be considered as but one species is very obvious, since both are of about the same size and coloration and may frequently be found intermingled on the same plant, though the maculation of the abdomen of *granaria* is absent in *cerealis*, in which the antennal joints and the nectaries are also constantly shorter. Divided by tenths, the following variations in these organs will be observed in the present species:

Antennal joint 3 varies between 18 and 27.
Antennal joint 4 varies between 13 and 21.
Antennal joint 5 varies between 11 and 17.
Antennal joint 6 varies between 24 and 37.
Nectaries vary between 10 and 18.
Last fork varies between 13 and 22.

The above table, compared with that of *granaria*, shows that, as a rule, all of the measured parts are shorter than those of the species treated of before.

Specimens of this species were first discovered in small numbers in June, 1884, on wheat at Cabin John Bridge, Md., while during the same month, after harvesting of the wheat, it was found by me to be quite plentiful on rye and oat near Washington, D. C., and among them many of the winged insects, mainly stationed on the petioles and green seed capsules, which had become more or less discolored on that account. Whereas the majority of larvæ were found on the under side of the leaves, none were observed on the stems or roots. At the same time and in the same field they were also found infesting the ears and leaves of *Agrostis vulgaris*, *Bromus secalinus*, and *Dactylis glomerata* growing between or near the grain. During September of 1884 migratory females found on wheat were received from Oxford, Ind. As an illustration of how far certain species of aphides may be distributed by currents of air, it may be worth while to mention the fact that a number of migrants of this species were dipped up from the surface of the Alantic Ocean 94 statute miles from the nearest land, in the neighborhood of Nova Scotia, July 3, 1887, by the Fish Commission steamer Grampus. During November of the same year the species was found breeding on oat at Washington, D. C. In May, 1889, it was found on oat at Paxton and on wheat at Pleasantville, Ind., while at the same time it was reported as being very plentiful on wheat at Shiloh Hill, Ill. During June of the same year it was reported as being very abundant on wheat and oat at Glendale and Columbus, Ohio, and Vincennes, Ind., and from Selkirk, Mich., on wheat and rye, at which time it was also found to be very abundant on oat at Highlands, N. C. In August it was found on oat at Ottawa, Canada, and in October on clover growing among the dry stubble of wheat at Washington, D. C. In January, 1890, specimens were discovered on wheat in Indiana and at Liberty, Va., covering the plants and killing large numbers of them. In May of the same year they were found on rye at Landisburg, Pa., while from Trenton, Morristown, and Camden, N. J., the report came that they covered the wheat and rye and were doing much damage. During June of 1890 they were reported from Storrs, Conn., Lunenburg, Pa., New Harmony, Ind., Milton, Ky., and Larue, Ark., as ruining the wheat and oat crop. In June and July of 1891 the species was observed on wheat at Millville and McGregor, Iowa, and Nashville, Tenn. The species was also found in May of 1892 on wheat at Columbus, Ohio; in November on *Setaria viridis* at Washington, D. C.; in June and July of 1894 on timothy and wild rye in Virginia, opposite Washington, and in September on the ears of oat at Shelton, Mont. Lastly, they were reported as doing much damage to the ears of wheat from Brookings, S. Dak., since which time nothing has been heard of the species from any locality.

The food plants on which, thus far, it has been observed in this country are:

Wheat (*Triticum vulgare*), rye (*Secale cereale*), wild rye (*Elymus virginicus*), oat (*Avena sativa*), meadow grass (*Poa pratense*), green foxtail (*Setaria viridis*), red top (*Agrostis vulgaris*), cheat (*Bromus secalinus*), orchard grass (*Dactylis glomerata*), and red clover (*Trifolium pratense*).

Its range thus far has been found to cover most of the northern States, including Canada, east of the Mississippi, but having gradually spread beyond that border as far west as Montana and South Dakota, and may soon be expected to make its appearance along the Pacific slope.

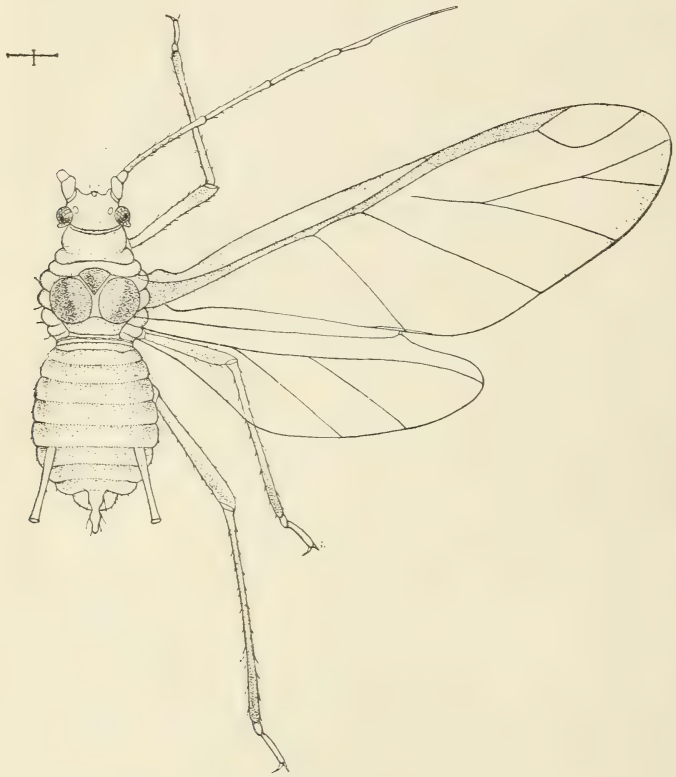

FIG. 3.—*Macrosiphum cerealis* Kalt.: migratory female; greatly enlarged (original).

DESCRIPTION OF THE SPECIES.

Apterous female.—Length of body 2 to 2.6^{mm}; broadest about the middle of the abdomen, tapering gradually toward the head and more rapidly posteriorly. Antennæ as long or slightly longer than the body; third joint shorter than the sixth and generally provided near the base with one or two small, circular, and projecting sensoria; all of the hairs small and simple or but slightly clavate. The legs are long and their hairs short, stiff, and simple. The nectaries, as usual, are tapering and reach about to the end of the abdomen. Tail long, curved upward, and almost of the length of the nectaries; it is somewhat constricted about its basal third; its terminal section elongate lanceolate; the surface is densely covered with minute, acute spines and

each side provided with three backward-curved bristles. General color a somewhat polished green with a yellowish tinge along the dorsum and with a few irregular darker green markings. The head is rather dark yellow and the antennæ black with the two basal joints brownish or somewhat dusky. Eyes dark brown. Nectaries black, the tail dirty yellowish. Terminal half of femora black, the basal part pale greenish or yellowish; tibiæ dirty yellowish, their apex and the tarsi black.

Winged migrant.—Length of body 2 to 2.4^{mm}; expanse of wings 7 to 8.2^{mm}. Antennæ longer than the body, reaching to or beyond the tip of the tail; joint 3 shorter than the sixth and provided with 4 to 12 circular and elevated sensoria along the basal half. Hairs minute, sparse, and simple. Nectaries as usual, reaching slightly beyond the end of the body, though not beyond the tip of the tail, and about one-third longer than the tail.

Color of the abdomen green or yellowish green, the median line generally of a darker shade. Head light brown or pale dusky; eyes reddish to dark brown; ocelli clear, with the inner margin black. Prothorax greenish yellow and frequently marked each side with a dusky impression of three more or less distinct, dusky, longitudinal stripes. The mesothorax and metathorax are generally yellow, with the lobes, the sternal plate, and lateral spot in front of anterior wings brown or, rarely, black. Antennæ and nectaries black, the two basal joints of the antennæ sometimes dusky. Tail either colorless, pail greenish, or almost yellow. Legs yellow, the terminal third of the femora, apex of the tibiæ, and the tarsi black. Wings colorless, the subcosta and base of front wings yellow or greenish yellow. Stigma yellowish or pale dusky. Costa and veins brown to black.

The sexual generation has not been observed.

Of the enemies and parasites preying on this species which have been observed by the writer, the following may be mentioned:

The true parasites, bred from this species are: *Aphidius avenaphis* Fitch and *Aphidius obscuripes* Ashm., *Lygocerus niger* Howard and *Asaphes vulgaris* Walker; while the enemies observed to feed upon this plant-louse are the following ladybirds and their larvæ: *Megilla maculata* DeG., *Hippodamia convergens* Guer., *glacialis* Fab., *13-punctata* Linn., and *Coccinella 9-notata* Hbst.; also larvæ of the following Syrphus-flies: *Syrphus americanus* Wied., *Xanthogramma emarginata* Say, *Allograpta obliqua* Say, and *Sphærophoria cylindrica* Say; specimens were also bred of two small Muscid flies, the larvæ of which feed on the aphides, as *Leucopis nigricornis* Egger and *Leucopis simplex* Loew.

THE CLOVER PLANT-LOUSE.

(*Macrosiphum trifolii* n. sp.—Fig. 4.)

Specimens of this new species have been occasionally found at Washington, D. C., since the fall of 1889 until the summer of 1892, on wheat (*Triticum vulgare*); and on oats (*Avena sativa*), at Wooster, Ohio, which, at the time, on account of their food plant and general appearance, I considered to be but a variation of the (so-called) *Siphonophora avenæ* Thomas. During July, 1892, I found it also feeding on the stems of red clover (*Trifolium pratense*), and during November of the same year on the petioles and leaves of strawberries,

at which time I concluded them to be different from the other grain lice though possibly related to, but quite different from, *Siphonophora fragariæ* Koch. The following year it was again found on strawberries during November at Washington and very numerous in June, 1894, on the stems of red clover and on the stems of the common sow-thistle (*Sonchus oleraceus*). During the same month this species was also observed to be very common on red clover at Cadet, Mo., and on the leaves of dandelion (*Taraxacum dens-leonis*) at Washington. In

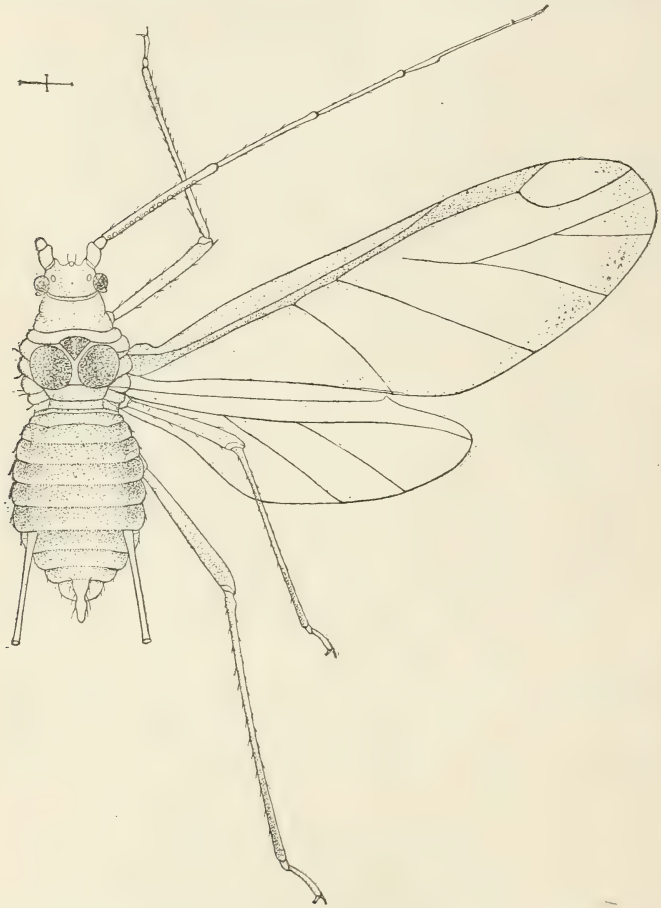

FIG. 4.—*Macrosiphum trifolii* Perg., n. sp.: migratory female; much enlarged (original).

April, 1900, it was reported as being very numerous on red clover at Charlottesville, Va., and in June on oat at Wooster, Ohio.

While investigating the specimens found on strawberries it occurred to me that they might possibly be identical with the species briefly described by Riley, under the name of *Siphonophora fragariæ*, var. *immaculata*, in the Rural World, for December, 1875, found on this plant at Kansas City, Mo.; but, after an examination of the few poorly preserved specimens, I found them to be different, and, since

it does not agree with any of the green species known to me, I have concluded to describe it as new, particularly as it may occasionally prove to become very injurious to grain.

DESCRIPTION OF THE SPECIES.

Apterous female.—Length of body 2.4 to 3^{mm}. Antennæ slender, reaching to or beyond the tip of the tail; third joint shorter than the sixth, provided with one to three small circular and elevated sensoria; hairs minute, sparse, and simple. Nectaries very long and slender and longer than the third antennal joint; much thinner at the apex than at the base, curved upward and reaching to or beyond the tip of the tail; tail long, tapering, more than half the length of the nectaries, densely spiny, and provided each side with four backward-curved hairs. Color, green or yellowish green, and frequently slighly pruinous, most densely so on the head and incisures of the body beneath, giving these parts a whitish cast; the median line of the body is generally of a darker green. The eyes are brown. The antennæ of the fully mature specimens are black, with the two basal joints more or less distinctly yellowish; in younger specimens they appear yellowish, with the apex of joints three to five and the last one black. The nectaries are usually yellowish or slightly dusky, changing to black toward the apex and greenish toward the base. Tail pale greenish or yellowish. Legs pale brownish-yellow, base of femora greenish; apex of tibiæ and the tarsi black.

Migratory female.—Length of body 2 to 2.4 ^{mm}; expanse of wings 8.4 to 9 ^{mm}. Antennæ slender and much longer than the body, the third joint much shorter than the sixth; the sensoria of the third joint are much more numerous than in that of the other two species found on grain, covering about three-fourths of the posterior edge of its base and ranging between 13 and 18 or more. The hairs of the antennæ are also longer and generally simple, though sometimes also faintly clavate. The nectaries are very long and slender, but slightly stoutest at base, reaching far beyond the tip of the tail and at least as long as the third antennal joint. The tail is of the same shape as usual in this genus and but slightly over one-third the length of the nectaries, usually densely covered with minute sharp spines and bordered each side by four slender bristles. The venation of the wings is as usual, though the terminal fork is longer than in the other two species. The general color is yellowish-green, the median line of the abdomen darker, though many of the spots wanting. The head and thoracic lobes are yellow or brownish-yellow. Eyes brown to black; ocelli clear, bordered with black. Antennæ black, the two basal joints and base of the third either green, brownish-yellow or dusky. Occasionally there are two black spots at the posterior edge of the metathorax and a black border on the scutellum. Femora green on basal half or more, changing gradually to yellow, brown and black toward the apex; tibiæ brownish yellow with base and apex black. Nectaries dusky to black and greenish at base. Tail green or slightly dusky. Wings colorless, their base and subcosta faintly greenish. Stigma pale grayish-green, the veins black.

Variations by tenths of the comparative length of the antennal joints, etc., are as follows:

Joint 3, 28 to 35.
Joint 4, 23 to 30.
Joint 5, 21 to 25.
Joint 6, 38 to 43.
Nectaries, 28 to 31.
Third fork, 22 to 32.

Compared with the other two species it will be seen that the proportions of these organs are much the largest, those of *cerealis* being the smallest.

The sexual generation or their enemies have not been observed.

THE CHESTNUT WEEVILS, WITH NOTES ON OTHER NUT-FEEDING SPECIES.

By F. H. Chittenden.

INTRODUCTORY.

The public is quite familiar, and disagreeably so, with "wormy" chestnuts. The grower who depends on the cultivation of chestnuts for a livelihood, or a portion thereof, knows "how the worm gets in the nut," and if he be a good observer he knows that it develops from a minute egg deposited by a long-legged, yellow or ochre-colored weevil, with a fine, slender snout longer than the body. From eggs so or deposited hatch the disgusting "worms." Thus much is known to the chestnut grower; also to many it is known that there are at least two species of the weevil. It was not until the year 1890 that any extensive work was undertaken to determine the life habits of the various species which are concerned in injury to chestnuts, hazelnuts, hickory nuts, and acorns. In that year Dr. John Hamilton[a] published an excellent eight-page account of the habits of our best-known species, eight in number.[b]

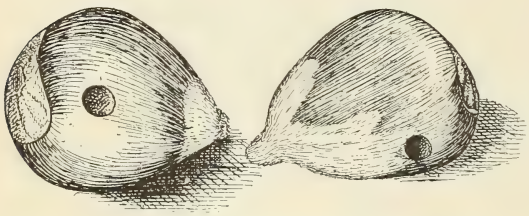

Fig. 5.—Chestnuts showing exit holes of chestnut weevil larvæ, enlarged one-fourth (original).

The economic side of the question has received considerable notice in articles by Messrs. Gerald McCarthy,[c] J. B. Smith,[d] and J. A. Lintner.[e] The article by the first-mentioned author is of considerable value, as it contains extracts from experienced growers of chestnuts, fifteen persons in all; and that of the last writer is especially useful because of the full bibliography presented.

For many years, and particularly within the past three, numerous complaints have been made of damage by these pests, and frequent appeals for better means of controlling them are made.

The larvæ, grubs, or "worms" as they are more commonly called, develop with the nuts so that those which first attain maturity are ready to leave the nuts nearly as soon as gathered. Others remain

[a] Balaninus: Its Food Habits, Can. Entom. (Vol. XXII, pp. 1–8).

[b] Nine or ten other species have been described, but we know little of their habits, and they therefore need not be considered in the present article. (See Capt. T. L. Casey, Annals New York Acad. Sciences, Vol. IX, 1897, pp. 655–664.)

[c] Bul. 105, N. C. Agr. Expt. Sta., 1894, pp. 267–272.

[d] Rept. N. J. Agr. Expt. Sta., 1895 (1894), pp. 481–485.

[e] Twelfth Rept. N. Y. St. Ent. 1896 (1897), pp. 267–272. It should be mentioned, that certain notes by the writer (Ent. Amer., Vol. VI, p. 172) were not included.

until long afterwards, and not infrequently it happens that when nuts are stored in barrels, boxes, or similar receptacles, some nuts which were apparently sound when placed therein, are found with one or more holes in their shells, while the disgusting grubs can be seen in great numbers at the bottoms of the receptacles. The size of the exit holes varies from one-sixteenth to one-eighth inch, the smallest ones doubtless being made by a single larva of the smaller species of weevil, and the larger by the larger weevil, or perhaps by several of the smaller species. Injury varies according to the number of larvæ present and the size of the nut, as will presently be more fully explained (see fig. 5.)

During comparatively recent years the culture of chestnuts has assumed considerable proportions, especially in the States of Pennsylvania, New Jersey, Maryland, and Delaware, and has taken a new impetus since the extensive introduction and development of Japanese and European varieties. These are grafted on American seedlings or native stocks, and thus many nearly valueless trees on equally unpromising soil are converted into sources of profit greater by far than if the same land were planted with other crops which could be grown. In short, were it not for the "worms" and "blights," chestnut growing might develop into a most profitable industry in regions adapted to it.

RECENT INJURIES.

During 1903 we received, among other reports of losses by nut weevils, two from Mount Joy, Pa., which are in brief as follows:

April 20 it was reported that chestnuts were grown very extensively in that vicinity, one firm having as many as 800 acres under cultivation. The chinquapin weevil was known to our informant, who identified it among others of its genus, but subsequently it was learned by the receipt of specimens that the chestnut weevil was also present. He noticed that they appeared about the middle of July, remaining in the orchards until the first of September. He calculated that usually one in every four nuts was infested, and observed as many as thirty young grubs in single large nuts of the Paragon variety.

In November our second correspondent corroborated the above statements, reporting that one firm had recently lost from 15 to 20 per cent of their chestnut crop of 800 acres from the ravages of weevils. From 75,000 to 80,000 grafts were growing there. Paragon nuts containing both forms of weevils were received, with report that from forty to fifty grubs were found in one nut, indicating the astonishing prevalence of the insects in that region. In such nuts every bit of meat was consumed, and some of the weaker weevils were starved. In the smaller nuts, one or two worms to a nut was the rule. Native nuts adjoining the orchard under cultivation were admitted to be neglected.

ESTIMATES OF LOSSES.

A fair estimate of the total damage done annually by weevils to chestnuts grown for market in all portions of the United States would probably fall little short of 20 or 25 per cent, while in some years the percentage would exceed that, running as high as 40 or 50 per cent. Growers in some localities report no damage, others place their loss as low as 5 or 10 per cent, while instances are cited of whole crops being destroyed. A loss of 10 per cent, as with many other crops, although existent, is frequently passed over unnoticed. The amount of loss is dependent on locality, season, and to a certain extent perhaps on the variety of chestnuts grown. The greatest damage is usually incurred in regions where chestnuts have grown wild for many years, and the least in localities where there are no wild chestnuts or chinquapins and the nuts are grown only for market and carefully gathered. The greatest damage, from available sources of information, appears to be done in Massachusetts, Pennsylvania, New Jersey, New York (in the vicinity of New York City), Delaware, Maryland, Virginia, Tennessee, and North Carolina.

In Georgia Spanish and Japanese varieties have been cultivated for years without attack by weevils being noticed. In New Jersey 50 per cent of the same varieties have been ruined. One grower in Missouri has reported no damage to 50 trees of an American variety about 18 years old, while another, at South Haven, Mich., has reported no injury for a period of three or four years to Japanese and Spanish chestnuts grown there, while from 5 to 20 per cent of the crop of native chestnuts was annually destroyed. The same correspondent reports having received 4 pounds of chinquapins from Tennessee, all infested. A Delaware grower has reported every nut on a single tree completely destroyed by the "worms," and Dr. J. B. Smith the nearly complete destruction of the chestnut crop of New Jersey for 1893.

THE SPECIES OF CHESTNUT WEEVILS.

The weevils which we know to depredate on chestnuts are two in number, the chinquapin weevil, *Balaninus proboscideus* Fab., and the chestnut weevil, *B. rectus* Say. Like all other species of the genus they have extremely long, slender beaks or snouts, nearly as fine as a horsehair, and in these species considerably longer than the body in the female. By means of this long snout the female is able to penetrate the thick burr of the chestnut with its long spines and to cut out with the minute and sharp mandibles at the tip a little hole for the deposition of her eggs. These are deposited, by means of a long ovipositor, through the husk, to the growing nut. The two species resemble each other greatly in color and in markings, the general color of both being golden yellow above (generally described as ochraceous or even clay

yellow), and a little paler on the lower surface. The disk of the thorax is dark brown, with a wide bright band each side, and the elytra are ornamented with rich brown markings of variable size and extent.

THE CHINQUAPIN WEEVIL.

(*Balaninus proboscideus* Fab.)

The chinquapin weevil or larger chestnut weevil (fig. 6) is considerably the larger and more robust, while the female rostrum or snout, although proportionately of about the same length, is a little more prominent because less curved, the curvature being toward the tip, and more widened at the base. The first joint of the antenna proper (omitting the scape or long joint nearest the head) is shorter than the second, and the mesosternum is less convex. The body measures from one-third to nearly one-half of an inch in length, and the snout of the female is sometimes five-eighths of an inch long. That of the male is nearly as long as the elytra.

Occasional individuals lack the darker markings, some being paler while others are darker, even reddish. The ground color, as may be seen in abraded specimens, is really black, and the color is due to scales very similar to those of butterflies and moths.

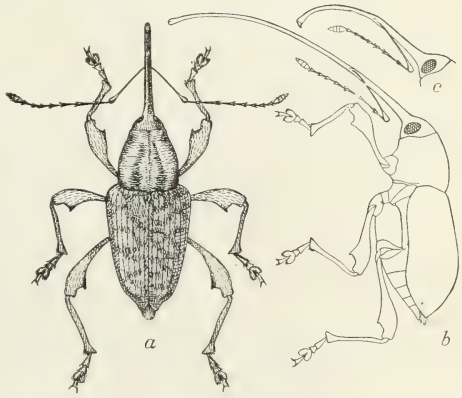

FIG. 6.—Chinquapin weevil (*Balaninus proboscideus*): *a*, female beetle; *b*, same in outline from side; *c*, head, rostrum and antenna of male, three times natural size (original).

The egg of this species, or, for that matter, of the genus, has apparently escaped observation, since no description has been made of it.

The larva of *proboscideus* (fig. 7, *a*) is slightly different from the normal curculionid in form. It is milk white, robust, fully three times as long as wide, the upper surface rounded and convex; the sides are somewhat flattened, and the lower surface is much flattened when the larva is at rest on a smooth surface. The entire surface is very strongly wrinkled transversely, and there are a very few short hairs scattered sparsely over the different segments. The spiracles are irregularly rounded and rather prominent. The head (fig. 7, *b*) is nearly circular or slightly longer than wide, pale yellowish brown, marked with the usual inverted Y-spot, and the mouth parts are mostly black or very dark brown. The first thoracic segment has a narrow pale yellow cervical plate divided at the middle, and nearly twice as

wide as the head. The head is about one-fourth as wide as the widest portion of the body. The fully developed larva in ordinary resting position measures nearly half an inch, while extended it measures a full half inch.

Although, like most Curculionidæ, the larva has no true legs, it crawls with comparative ease, though slowly, by means of the flattened lower surface, being aided somewhat by the transverse wrinkles. The hairs are so short as to be of little or no apparent assistance in locomotion.

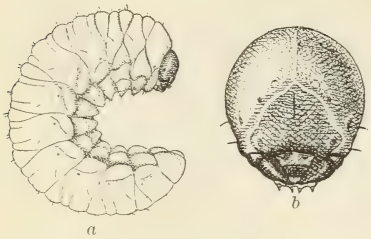

FIG. 7.—*Balaninus proboscideus:* larva, about four times enlarged, at left; head much enlarged, at right (original).

The pupa has not been seen by the writer.

The occurrence of the chinquapin weevil has been noted at Providence, R. I.; in the neighborhood of New York City; Moorestown, Woodside, Orange Mountains, N. J.; at State College, Allegheny, Jeannette, Mount Joy, Sylvania, Princetown, and Eastmont, Pa.; Newark, Del.; Baltimore, Md.; Virginia; West Virginia; Washington, D. C.; Cincinnati and Newark, Ohio; Illinois; St. Louis, Mo.; Sharpstown, Ind.; Clarkville, Tenn., and Rosedale, Kans.

THE CHESTNUT WEEVIL.

(*Balaninus rectus* Say)

The lesser chestnut weevil (fig. 8) has the scape of the antenna longer than in *proboscideus* and the first joint longer than the second. In the female the rostrum is strongly curved, the thorax is longer than wide, and the elytra are strongly acuminate apically. The tooth with which the femora or thighs are armed is small, with the entering angle rounded. The average length of the body is about one-half of an inch, but the size varies, as in all of these insects.

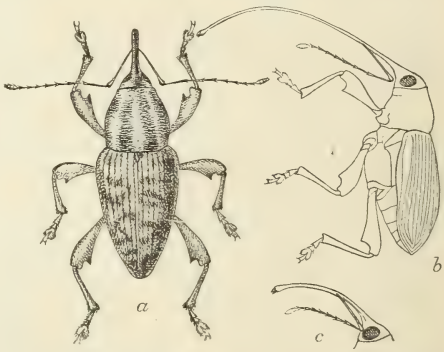

FIG. 8.—Chestnut weevil (*Balaninus rectus*): *a*, female beetle; *b*, same, lateral view; *c*, head, with rostrum and antenna of male, four times natural size (original).

The distribution of these two weevils does not differ markedly, but *proboscideus* appears to be somewhat more abundant southward, while *rectus* is the more prevalent northern form. Where chestnut growing is an important industry the two species appear to be nearly equally numerous.

The chestnut weevil occurs in Canada; Mount Tom and Marion and

elsewhere in Massachusetts; Penn Yan and Ithaca, N. Y., and in the neighborhood of New York City, on Long Island and Staten Island; and in neighboring portions of New Jersey, as also elsewhere throughout the latter State; Mount Joy, St. Vincent, Allegheny County, Pa.; North Carolina; Baltimore, Md.; Washington, D. C.; Pennington Gap and elsewhere in Virginia; French Creek, Harpers Ferry, Fort Pendleton, and Berkeley, W. Va.; Ohio; Retreat, N. C.

The larva, as would be supposed, is much smaller than that of the chinquapin weevil, being only a third of an inch long and about a third as wide as long. The body is milk-white and the head light brownish yellow, the X-mark with a short lateral branch each side.

TIME OF APPEARANCE OF THE TWO CHESTNUT SPECIES.

Balaninus proboscideus, according to Hamilton's observations, appears at the time of the first blooming of chestnuts, and disappears when the blossoms have fallen. In his rearing experiments at Allegheny, Pa., the beetles began to issue June 25, and ceased July 12. Mr. Th. Pergande reared the beetles in the District of Columbia from August 10 to September 15. As 80 examples were reared by Hamilton and the mean temperature was nearly normal (although not so considered by Hamilton himself), these dates are approximate for regions with a climate like that of Allegheny, Pa.

Balaninus rectus was reared by Hamilton from June 28 till October 1, 95 examples having been under observation. This experience coincides somewhat closely with the writer's who has found this species in the field, although somewhat scatteringly, when chestnuts were in bloom, and reared specimens in captivity during the latter days of September which remained alive nearly a month.

From present knowledge it is evident, therefore, that *proboscideus* might be somewhat more easily controlled than *rectus*, with its much longer active period. In most other respects the two species show very close agreement as to their life history.

HIBERNATION.

The chestnut weevils, as also all related species, so far as we know, hibernate exclusively in the larval condition and in the soil. This gives a larval period of at least ten months, and some individuals (reared in confinement, it is true, but under comparatively natural conditions) pass over till another year, this being the exception, but evidently a provision of nature for the continuance of the species. In such cases the larval condition lasts nearly two years. This has been noticed by Doctor Hamilton in the case of several species, and in our own rearing jars in the case of the smaller chestnut weevil, *Balaninus rectus*.

Larvæ pass the winter at varying depths, according to the soil and the degree of its hardness. In a large jar, full of moderately moist sand, in which chestnut "worms" have been placed by the writer, the larvæ have penetrated to a depth of 9½ inches in a possible 10 inches. They make cells considerably larger than themselves, so that they have ample room to move about. The larger cells of *proboscideus* are half an inch long and about one-sixth of an inch in height. As a rule, the larvæ rest on their backs in a moderately curved position. Ordinarily they remain in perfect quietude even in a moderately warm temperature, but respond to stimulus.

FOOD HABITS OF SPECIES OF NUT WEEVILS.

Of the eight species of nut weevils of the genus Balaninus known to inhabit America north of Mexico, the food habits are approximately known, largely through the investigations of Dr. John Hamilton (l. c.). The following summary is given of the observed host plants:

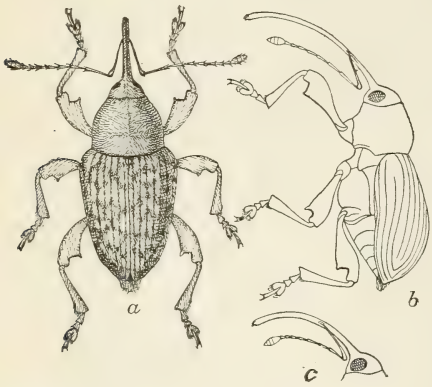

FIG. 9.—An acorn weevil, *Balaninus victoriensis: a*, female, dorsal view; *b*, same, lateral view; *c*, head of male, showing antenna and rostrum, four times enlarged (original).

Balaninus rectus Say, the common chestnut weevil, is nearly confined to chestnuts and chinquapins, having been reared only from these nuts, with the exception of a single lot (identified as this species) which bred from acorns from Arizona. It appears to be the only species affecting chestnuts in the extreme northern portion of the United States where Balaninus occurs.

Balaninus proboscideus Fab. (*caryatrypes* Boh.), the chinquapin weevil, depredates chiefly in chestnuts and is quite as great a pest as the preceding in some regions. It also breeds in chinquapin.

Balaninus quercus Horn affects in about equal numbers acorns of different species of biennial fruiting oaks, not being found in annuals (white and chestnut oaks). Mr. Fdk. Blanchard has reared this species from acorns of *Quercus rubra*, and the writer obtained many specimens from the same or a closely related species.

Balaninus nasicus Say prefers the acorns of the annual fruiting oaks (white and chestnut), depredating sparingly on those of biennials.

Balaninus caryæ Horn has been reared from pecans from Indiana, and has been found so abundantly on hickory as to leave no doubt that "wormy" hickory nuts are also due to the work of the same species. As a rule, however, it does much less injury to these nuts than do the others to acorns and chestnuts. Mr. Blanchard has also reared this species from shagbark hickory.

Balaninus uniformis auct. prefers the acorns of biennials, but depredates occasionally on chestnut oak. In some localities, at least during certain seasons, as, for example, at Ithaca, N. Y., this species is the most abundant, while in western Penn-

sylvania Hamilton found it comparatively scarce. Possibly the variation in numbers may be seasonal.

Balaninus victoriensis Chttn. n. sp.[a] is also an acorn weevil, having been collected in great numbers on oak by various collectors.

Balaninus obtusus Blanch. has been reared from hazelnuts only (Hamilton, Can. Ent., vol. XXII, p. 6). In 1891 hazelnuts were reported badly injured by this species in Iowa (Alda M. Sharp, Bul. 17, Iowa Agl. Ex. Sta., p. 450).

Balaninus confusor Ham. has been reared from the acorns of bear or scrub oak (*Quercus nana ilicifolia*), but it probably lives on the fruit of other oaks.

FIG. 10.—Pecan nuts showing exit hole of pecan weevil larvæ, one-third enlarged (original).

An interesting fact was brought out in the rearing of the last-mentioned species which has a bearing on the habits of the genus. A single individual was reared from a large apple oak on a species of golden rod (*Solidago nemoralis*), due to the larva of a two-winged fly, *Acinia solidaginis* Fitch (see Can. Entom. Vol. XXV, p. 310), showing the possibility of the different species developing on other than their normal food plants. In this case, as Hamilton remarks, oviposition on the gall was probably a mistake on the part of the parent beetle. Three of the larvæ were observed. It might be impossible for species with short snouts like the hazelnut weevil to oviposit in chestnuts on account of the thicker husk and longer spines, but, on the other hand, it might be possible for some other species to depredate on hazelnut in the event of absence of the normal host plant.

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[a] *Balaninus victoriensis* n. sp. (fig. 9).—With a view to lessening the confusion which has existed with reference to the name of this species, which is generally known in collections as *uniformis* Lec. or *obtusus* Blanch., the writer presents a brief analysis which, together with the illustration, will more clearly define its identity:

Body black or nearly so, covered with dense gray scale-like pubescence; elytra variously mottled with brown, slightly elevated, pubescent spots. Rostrum ♀ four-fifths as long as body (including head), moderately, nearly uniformly arcuate. Antennal joints as figured, length a little shorter. Length, 7 mm.; width, 3.5 mm. Habitat: Victoria and elsewhere in Texas. Related to *uniformis* Lec. from California, which is described as "*densissime fulvo-pubescens, concolor,*" etc. The latter is smaller. *B. obtusus* is much more robust and has a much shorter rostrum in ♀.

THE HICKORY-NUT WEEVIL.

(*Balaninus caryæ* Horn.)

Nearly every year inquiry is made in regard to the cause of the holes in hickory and pecan nuts, but during 1903 there were reports of greater injury of this nature than ever before, more particularly to pecans grown in Texas, where considerable loss was reported by Mr. Glenn W. Herrick, and in Georgia, where Mr. Wilmon Newell stated that in one locality (Thomasville) 75 per cent of the crop was a failure. A shortage was also reported near Jackson, Miss., and Mr. J. F. Jones estimated the loss of 25 per cent of the crop in the vicinity of Monticello, Fla. There is little doubt that the species of weevil involved in attack in all cases is *Balaninus caryæ* Horn, although the adult has not as yet been reared.

As this species may be destined to become one of the principal pests of the pecan orchards of the South, the accompanying illustration is furnished, together with a few words of description. The beetle (fig. 11) is quite as large as the chinquapin weevil, from which it may be distinguished, however, because of the first antennal joint being longer than the second, and in the much darker color. The ground color is dark brown, nearly black, and the scaly covering (which characterizes the chinquapin and chestnut weevils) in this species is less obvious, much darker, and hair-like. Moreover, the rostrum of the female is comparatively a little shorter, although of about of the same curvature, and less widened at the base.

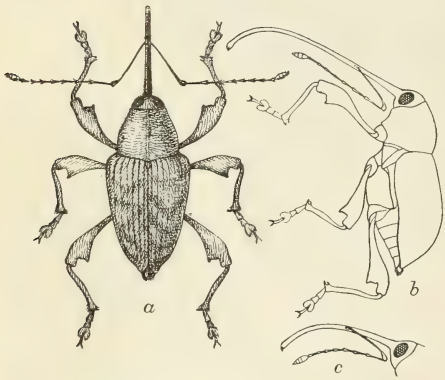

Fig. 11.—Hickory-nut weevil (*Balaninus caryæ*): *a*, female, dorsal view; *b*, same, lateral view, in outline; *c*, head with rostrum and antenna of male, about two and one-half times natural size (original).

The larva differs from that of *proboscideus* in being decidedly yellow, having the head bright red and wider than long. The cervical plate is also darker.

This species was described from Brooklyn, N. Y., in 1873 (Horn, Proc. Amer. Phil. Soc., Vol. XIII, p. 460). In the national collection are specimens from St. Vincent, Allegheny, Limerick, and elsewhere in Pennsylvania; Cincinnati, Ohio; Sharpstown, Ind.; Virginia; Iowa City, Iowa, and Holly Springs, Miss.

During January, 1904, Mr. Wilmon Newell sent a considerable number of larvæ, mostly in good condition, found in the pecan nuts. Most of the nuts, however, found at this time under trees contained holes from which the larvæ had escaped at an earlier date.

NATURAL ENEMIES.

At least one natural enemy is known of tne genus Balaninus, a braconid parasite, *Urosigalphus armatus* Ashm., which develops within the body of the larva of all the common species. A second parasitic proctotrypid, *Trichasis rufipes* Ashm., has been reared from acorns infested with *Balaninus nasicus* and *Holcocera glandulella*, and it is quite likely to be a parasite of the chestnut weevils.

METHODS OF CONTROL.

It is greatly to be regretted that no very practical remedy for nut weevils is known or can be suggested at the present day other than the early destruction of the "worms" in the nuts and observance of cooperative clean cultural and other methods, which will presently be mentioned. Before discussing these methods it may be well to preface a statement of the uselessness of ordinary measures employed in the control of similar insects.

UNSATISFACTORY METHODS.

Stomach poisons.—The peculiar structure of the mouth-parts of these insects (very minute mandibles placed at the end of a rostrum or beak as fine as horsehair and longer than the body in the females) is almost sufficient proof of itself that the adults do not feed on leaves, but depend for their sustenance on the substance of the growing nuts or inner husks, which they penetrate when making a nidus for the deposition of their eggs. The first appearing beetles, with little doubt, feed on the undeveloped very young nuts, and to a considerable extent on the juices within the husk. There is, therefore, no seeming possibility of our reaching these insects at all by means of stomach poisons, particularly as we are unable to place the insecticide where the insects would be obliged to eat enough of it to kill them.

Contact poisons.—Possibly contact poisons might have some effect, but this is also doubtful, and such frequent applications would be necessary, considering the long periods of these weevils in the adult stage—from about the middle of July to the first of September and even later—that this would not be profitable in any case. Again, there is great difficulty in applying a spray so as to reach all portions of a tree where the nuts are borne. Kerosene emulsion, sprayed on the trees at the particular time when the insects are most abundant, before they have deposited their eggs, might act to some extent as a deterrent, but this is also doubtful.

The water test of infestation.—Having serious doubts as to the efficacy of an old-fashioned test as regards the difference between "wormy" and healthy chestnuts, an experiment was made with common small chestnuts obtained from a street vender November 11. In

the first place 40 per cent were obviously "wormy," and only 60 per cent apparently good. Of the apparently good nuts a number were placed in water and left for several minutes, when two sank after remaining on top, and one which had sunk rose to the surface.

Results of water test with common small chestnuts.

Nuts which rose to surface.		Nuts which remained on bottom.	
	Per cent.		*Per cent.*
Uninfested	10	In perfect condition	40
Showing minute marks only; good flavored; salable	20	Slightly injured	30
Containing full-grown grubs	10	Badly infested	20
Containing immature grubs	60	Completely filled with grubs	10

Noticeably wormy nuts as observed from the outside, and by the loss of weight after the escape of the "worms," naturally all rose when placed in water.

These experiments show that the obviously injured nuts will rise to the surface as a general rule, but the remainder require some further test than whether they will sink or float. The reader is left to his own conclusions.

DIRECT REMEDIES.

Bisulphid of carbon.—The value of bisulphid of carbon as a fumigant for nuts infested by weevils is often asked, and it would seem at first thought that its use is hardly desirable, for the reason that the larvæ or grubs are frequently so large when the nuts are harvested that purchasers would not be deceived if they took the precaution before buying of opening a few, so that there is little gain in this direction. The shell of the nut is so firm and compact that it would appear difficult for the bisulphid to penetrate and kill the larvæ. Nevertheless, a prominent grower in Pennsylvania informs me that he successfully uses bisulphid of carbon, applying it when the nuts are first harvested. In some cases the dead weevil larvæ are so small that the average person would not refuse a nut which shows only slight attack, while if these same larvæ were permitted to obtain full growth they would have nearly consumed the nut. He uses the bisulphid on one of the largest nuts grown in this country from foreign stock, and, since as many as 40 larvæ have been found by him in single nuts, one can readily see that prompt fumigation is desirable, at least in his locality. We could not claim the same for all others, because the first nuts that are brought to market in the District of Columbia are more badly infested than those purchased later; and the chinquapins, which are for sale two or three weeks earlier than the chestnuts, were, at least in 1903, very badly infested when marketed, and bisulphid would have had very little beneficial effect on them. It seems probable that this remedy would be more useful in cold locali-

ties than in warm ones, it requiring longer for the beetles to develop in the former than in the latter. An early opportunity will be taken to experiment with this remedy and growers generally are advised to do the same, taking care to use only practically air-tight receptacles and to follow the advice furnished in Farmers' Bulletin No. 145. In the meantime we can not advise its use on a large scale.

Scalding and drying.—Many growers make a practice of gathering nuts as rapidly as they fall and plunging them into boiling water long enough to kill the contained insects and not injure the nuts for market, after which they are dried before being packed and marketed. Mr. William P. Corsa, of this Department, reports success in scalding and drying the nuts in the sun before storing. Some use a sieve, which is plunged into the boiling water and quickly removed. He uses a washtub, in which he places a bushel or so of nuts, pouring enough boiling water in to come 1 or 2 inches above the nuts. Then, by stirring vigorously with a stick, the weevilly nuts will come to the surface in the same manner as do peas and beans affected by pea and bean weevils. The infested nuts are then skimmed off, and can be destroyed or fed to hogs with profit and safety, provided the animals do not have a too exclusive diet of this form of food. About five minutes in the water is a sufficient length of time. Some growers claim that salt water is preferable, the brine serving to keep the shell soft and pliable and the kernels more palatable than when not thus treated.[a]

Different methods are employed in drying. A good way is to place the nuts in the sun and agitate them occasionally by stirring or shaking in a bag until thoroughly dry, because if moisture remains unevaporated it is apt to form mildew when the nuts are packed for shipment prematurely.

It should be unnecessary to state that nuts desired for planting should not be scalded, and care should be also taken not to cook the kernels which are desired for market. Some nut growers claim that the hot-water treatment is objectionable because the nut shells lose a certain degree of polish, rendering them less desirable for market.

Some growers of chestnuts destroy the weevils by kiln drying.

Heat.—Infested nuts can be subjected to a temperature of between 125° and 150° F. without injuring them for food or for seed, and this will effect the destruction of the larvæ within.

Cold storage.—Cold storage has been employed and is successful in arresting the development of the larvæ. The appearance of the nuts is scarcely different from those not so stored, but the nuts thus treated, after becoming dry, are deficient in flavor, having, in the author's opinion, a slightly acrid and moldy taste.

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[a] Note the writer's observations on this head on pp. 33 and 34.

Trap crops.—The use of varieties particularly susceptible to the weevils scattered through orchards of other varieties to attract beetles from them where they can be more readily dealt with has been suggested.[a] The reports that have been made of the liability to attack of different varieties of chestnut, however, do not, as a rule, show what varieties are in any noticeable degree immune. On this head Mr. G. H. Powell informs the writer that the Paragon, Cooper, and Ridgely are more affected by weevils than are the Japanese varieties, taken as a whole.

Jarring the trees.—This remedy was suggested by the late Doctor Lintner, because, as he says, it has been found very effectual with the plum curculio. As a matter of fact, it has not been found fully satisfactory against the plum curculio, and will be found still more difficult, not easier, in controlling the chestnut weevils. The only weevils that can be dislodged are those which happen at the moment to be disengaged, crawling from one nut to another, or in search of their mates. Like several other species of insects, these nut weevils remain paired almost continuously and while oviposition is going on. Even when the snouts of the weevils are not buried deep in the husk of a chestnut, their long and very strong legs enable them to maintain a firm hold, which the hardest jarring that the tree could stand would not dislodge. This is not mere theory, but is the experience of collectors, including Mr. Schwarz and the writer.

PREVENTIVES.

Choice of location of the orchard.—It is a matter of great importance that the locality in which chestnuts are planted or grafted on old trees be made with reference to the chances of immunity or of injurious attack by nut weevils. As may be readily inferred from what has been said in previous paragraphs, it is highly inadvisable to select for a chestnut orchard a locality in the immediate vicinity of much woodland abounding in wild chestnut and chinquapin, and perhaps oak, as the first two trees furnish the principal breeding places of these insects, and are therefore a constant menace to successful chestnut culture. To what extent, if at all, acorns furnish food for either chesnut weevil remains to be learned. A prominent chestnut grower, who has suffered considerable losses from weevils, has admitted that native chestnuts are neglected in the near vicinage of his cultivated groves. Mr. H. E. Van Deman, a practical nut grower, has directed the writer's attention to another phase of planting, which is that Paragon and other cultivated varieties are frequently grafted on native chestnuts in rocky and uneven soil, where it is not only impossible to gather a complete crop, but, what is of equal importance, the remnants can not

[a] G. Harold Powell (Bull. XLII, Del. Coll. Agr. Expt. Sta., 1898, p. 14.)

be collected. Hence, to secure clean culture, it is imperative to plant or graft only on perfectly smooth soil, first, for economic or commercial reasons, and, second, to permit the collection of all of the nuts, leaving none for the propagation of the weevils.

Careful harvesting.—One of the most feasible remedies and one that had been advised for years is to pick all of the chestnuts from the ground, taking the greatest care to leave none, and either place them in tight boxes or in barrels, where the grubs when they issue will not be able to reach the ground, or fumigate with bisulphid of carbon before shipping to market. The grubs crawl out soon after the nuts have been gathered, and as they require a considerable degree of moisture they will, if kept in closed receptacles, die without being able to reach the ground. The trouble is that enough nuts are usually left in the orchards or in the woods owned by the farmer or his neighbors to serve for the propagation of the insects for following years. In order to make this method of treatment thorough it will be necessary to secure the cooperation of neighboring landowners, not only of those who grow chestnuts for market but of all who may own woodland containing chestnut and chinquapin, which would serve for the continued propagation of the insects.[a]

The collection of remnants is no great hardship, and there are probably cases where it would be profitable to allow pigs the run of pecan orchards to destroy what nuts remain after the main crop has been harvested. In the absence of a sufficient number of the nuts it is not probable that pigs would learn to root for the grubs, if these have left the nuts and are in the ground, because of their small size and the depth to which they are able to penetrate.

It has been suggested that turkeys might be useful in destroying the chestnut weevils, but it does not seem probable that this remedy would be a safe one. If the turkeys were allowed to roam through the orchards when the burrs are first opening the beetles are also there, and if the birds attempted to devour them they would probably soon desist, owing to the strong outer shell of the beetle and its long, strong, and spiny legs. If many beetles were swallowed, they might cause the death of the turkey. Again, the hogs would probably not devour the nuts after having their mouths irritated by the spines of the chestnut husks.

Cooperation.—Although the results of the observance of clean culture on the lines that have been indicated might not be at once apparent, it can be only a matter of time, if this work is systematically carried out by all growers over a considerable territory, when infestation would be greatly decreased. An important point to ascertain is as to

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[a] It seems probable that the two chestnut weevils under consideration confine their attacks to chestnut and chinquapin, and that the acorn-feeding form from Arizona identified by Hamilton as *Balaninus rectus* will prove a different species.

how far the insects fly. Their structure indicates that they are strong fliers and capable, with favoring winds, of migrating considerable distances; but under ordinary circumstances they probably do not fly many miles at a time or in a given year.

THE ACORN MOTH.

(*Holcocera glandulella* Riley.)

In connection with a consideration of the nut weevils a few words should be said in regard to the acorn moth, a Tineid whose caterpillar develops in nuts and acorns, usually in the deserted holes of the Balaninus weevils.

The adult, or moth, is variable in color, but is more or less ashy gray, the forewings being characterized by transverse pale stripes which are not specially well shown in the illustration, but which will answer for present purposes. The moths vary in size as well as in mottling, the average expanse of the forewings being a little less than three-fourths of an inch (see fig. 12, *f*). The moth, properly mounted, looks decidedly wider than as figured. The life history of this species was long ago described by Riley in his Fourth Missouri Report (pp. 144, 145). After the weevil, which was the original inhabitant of the nut or acorn, has deserted its temporary tenement, the moth drops an egg into the already injured nut. The caterpillar hatching from this egg develops upon what has been left by the larval nut weevil, meanwhile securing the opening formed by the beetle with a covering of silk to prevent the entrance of natural enemies. Farmers who grow nuts as a side issue and who do not make a special study of the insects affecting their acorns or other nuts are often prone to the opinion that the true nut depredator is the caterpillar inclosed in these nuts after they have fallen and been left on the ground.

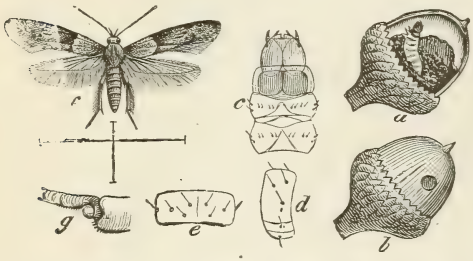


FIG. 12.—*Holcocera glandulella:* *a*, acorn showing larva at work; *b*, acorn showing closed exit hole; *c*, head and thoracic segments of larva; *d*, a lateral segment of larva; *e*, a dorsal segment; *f*, moth; *g*, base of antenna; *a*, *b*, natural size; *c*, *g*, much enlarged; *f*, slightly enlarged (after Riley).

The acorn moth caterpillar has been described as pinkish-yellowish or grayish-white. Its recognition is facilitated by the illustration, *a* showing the larva within the nut, and *b* the closed exit hole. There is no difficulty in distinguishing this caterpillar from the weevil larva or grub, as it has, like most common caterpillars, a complete complement of three pairs of legs and ten false legs. Within the nut it changes to the chrysalis stage, and the moth issues through the door. The moths appear from April until September. Whether or not this

species has any other food plant than the fruit of oak has evidently never been ascertained, but it seems probable that it is one of the "husk worms" complained of by the growers of chestnuts, or that the husk worm is an allied species. It is an inhabitant of the Atlantic States, and probably extends from Canada at least to Missouri.

THE COWPEA-POD WEEVIL.

(*Chalcodermus æneus* Boh.)

By F. H. Chittenden.

For the past two years many complaints have been received from the cotton-growing regions of the South of injuries to cotton by a species of weevil known as *Chalcodermus æneus* Boh. Attempts were made by several persons of experience to ascertain whether or not the insect really did injury to the bolls or squares of cotton after the manner of the Mexican cotton boll weevil, for which it was mistaken, always,

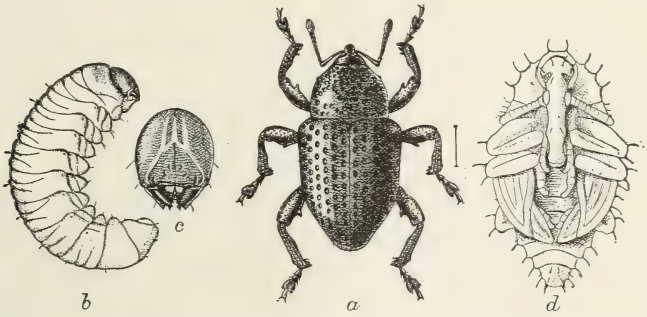


Fig. 13.—*Chalcodermus æneus:* *a*, beetle; *b*, larva, in profile; *c*, larval head; *d*, pupa, all about five times enlarged except *c*, more enlarged (original).

however, with negative results. On looking over the records of the Division of Entomology extending back into 1887 we find that the insect has a natural food plant in the cowpea, particularly when this plant escapes from cultivation or grows wild, and that it is capable of committing considerable injury to both cultivated cowpea and beans. In September, 1903, we received pods of cowpea affected by this species, which permitted sufficient study to furnish a fairly good knowledge of all stages except the egg, and an approximate understanding of the insect's life history.

DESCRIPTIVE.

The adult *Chalcodermus æneus* is one of the true weevils of the family Curculionidæ, of shape similar to the well-known plum curculio, to which, indeed, it is not distantly related. The general color is black, with more or less pronounced bronzy tinge. The elytra are coarsely and strongly punctate, as is also the thorax, which is suddenly narrowed anteriorly. It measures about one-fourth of an inch in

length and is quite robust. (See fig. 13, *a*.) From a closely related species which probably has similar habits (*C. collaris*) it differs in the thoracic ornamentation, the latter (illustrated in fig. 16) having the thorax deeply, longitudinally, and somewhat irregularly strigose, while the body, particularly the elytra, is paler, with a distinct brownish and more bronzy hue.

June 3, 1901, Mr. H. P. Gould, sent from College Park, Md., numbers of the latter weevil, with report that they had been received from Mr. L. C. Reid, Rhodesdale, Md., where they were very destructive to watermelon vines. They attacked them usually in the bud and gathered in little clusters or knots, the plants soon withering and dying.

FIG. 14.—*Chalcodermus æneus:* lateral view, much enlarged (original).

The egg of *æneus* has not been described. The larva presents few characters for specific description. Its general appearance is shown at *b* (fig. 13), *c* representing the head, greatly enlarged. The pupa (*d*) shows much resemblance to the pupa of the plum curculio. Both larva and pupa are milky white in color, and the surface of each is sparsely hairy.

DISTRIBUTION.

Horn records this species from Georgia and Florida; Boheman from Mexico. In the national collection we have specimens from Grant, Fort Drum, Kissimmee, Bartow, and Key Largo, Fla.; Frierson and New Orleans, La.; Atlanta and Morgan, Ga.; Victoria and Harvester, Tex., and South McAlester, Ind. T. To this we must add reported occurrences at Dawson, Ga.; Denson Spring, Crockett, Palestine, Mount Pleasant, Augusta, and Groesbeck, Tex.; Morgan, Ga.; Cocoanut Grove, Fla., and Wedgefield, S. C.

FIG. 15.—*Chalcodermus æneus:* work of larva (original).

RECENT REPORTS OF INJURY.

July 25, 1901, Mr. R. T. Smith, Grant, Fla., wrote that this species was found piercing the pods of string beans.

During May, 1902, Mr. W. M. Scott wrote of its occurence on cotton at Dawson, Ga. Complaints of injury were received also from other sources, with indication that the insect occurred in considerable numbers where reported. One correspondent said that "the weevil seems to confine itself to the stalk of the plant and stem of the leaves, inserting its beak and sucking the plant to death," while another reported that it damaged the leaves and buds, finally killing the plant.

Our first report of injury, in 1903, was from Prof. H. A. Morgan, Baton Rouge, La., to whom the beetles had been reported as troublesome to cotton by boring into the buds, leaf, stalks, and stems, this occurrence being noted near the Texas line. Later Prof. E. D. Sanderson wrote of similar injuries in Texas, and furnished data in regard to the sources from which reports of injury had emanated. These were from Denson Spring, Crockett, Palestine, Mount Pleasant, Augusta, and Groesbeck, and began with May 29 and ended June 12. Injury, however, could not be confirmed.

At Morgan, Ga., the beetles were also found on cotton and were mistaken for the cotton boll weevil. At Frierson, La., the beetles were also reported on cotton in two fields, July 7. In both cases the cotton fields where the insects were found were planted after cowpea, and in both instances the planters had observed considerable loss in cowpea the previous year, with little doubt due to these insects, although they were not detected as the cause of the loss. Dr. A. W. Morrill, of this office, who visited the infested locality, made some observations on the insect in confinement, which coincide with those reported by the first correspondent quoted in Georgia. The beetles fed on the stalks and petioles or leaf-stems and larger veins of the leaves of cotton, even when cowpeas were available, and their attacks caused wilting and dying of the leaves. When many punctures were made in the petiole just below a leaf the leaves were sometimes completely severed. In no case, however, did they attack either bolls or squares.

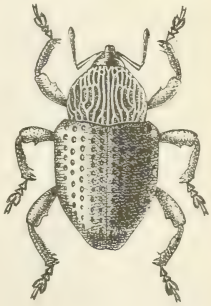


FIG. 16.—*Chalcodermus collaris:* adult (original).

EARLIER BIOLOGIC DIVISIONAL RECORDS.

The Division of Entomology has received reports of occurrences of this species in earlier years as follows:

September 27, 1887, from Mr. E. A. Schwarz, Cocoanut Grove, Fla., larvæ and pupæ in pods of cowpea. April 9, 1888, complaint of injury to string beans from Dr. Charles S. Herron, Bartow, Fla., who stated that the gardeners in Polk County were sustaining a heavy loss because of their crops of string beans being "stung" by this insect, the spot where the pods were attacked becoming black and rendering the beans unfit for shipment. When alarmed, the insects, after the manner of the weevils of this group, dropped to the ground and were difficult to capture. August 19 and 24, 1894, Mr. Schwarz wrote of the occurrence of this species at New Orleans, La., where it was ovipositing in cowpea. September 18, 1899, Messrs. James H. Aycock & Sons, Wedgefield, S. C., sent the beetles from cotton, mistaking

them for the Mexican cotton boll weevil. It is possible that the former species might have entered the cotton bolls for hibernation, but the damage was not due to them, but evidently to a disease. It was noted by our correspondent that they were found in cotton fields which had "peas" planted along the sides.

BIOLOGIC NOTES.

September 28, 1903, Mr. A. Fredholm, Fort Drum, Fla., sent pods of cowpea affected by the larva of this species, as was positively proved by rearing. At this time most of the larvæ were mature. In a second sending of pods, however, made considerably later, the insect was still in the larval stage. The first pupa was found October 18, transformed inside of a seed, and, as all other pupæ that were noticed were in the seed, it is presumable that in most cases the larva transforms within a pod; but if the pod be rotten and lying on the ground, the pupa can easily roll away and transform to adult in any convenient spot on the earth.

The greatest difficulty was experienced in rearing the larvæ in the unnatural conditions of the office laboratory, first because we did not know the natural conditions under which the insect lived or its habits, and second because the weather was entirely unsuitable to it. If the larvæ were permitted to remain in the molding pods they died of mold, and if they were taken from the pods they failed to develop. One was found that had transformed to pupa in a pod which was rapidly decaying, and, by placing it in earth slightly moistened, it was finally reared. These notes are only given as an example of what one may expect in rearing in colder regions, under unnatural environments, species that are obviously subtropical. The larva in question transformed to pupa October 18, and to adult November 13. In this instance the pupal period was twenty-six days, which is undoubtedly from two to four times as long as normal.

NATURAL ENEMIES.

It was noticed about the middle of October, 1903, although cowpea pods were kept in a room which is ordinarily dry, that all affected by this insect were gradually becoming blackened, and a few days later assumed an advanced stage of decomposition, this being the case even when only a single larva inhabited merely the end of a pod. The molds completely covered most of the pods and was referred to Mr. A. F. Woods, Plant Physiologist and Pathologist in this Department, who stated that among them was a species of Phoma, which was either parasitic or on the border line of parasitism, and in wet seasons, at least such as the one just past, did some injury to peas. It had not, however, to his knowledge proved a very serious trouble. He also

wrote, in response to inquiry, that the presence of the larvæ in one end of the pods had caused the tissue there to die prematurely and permitted the entrance of moisture, which naturally checked the further development of the seeds, thus corroborating the writer's views on this subject.

Two species of hymenopterous parasites have been reared from this Chalcodermus *Ennyomma clistoides* Town., and *Sigalphus* sp. (See Insect Life, Vol. VII, p. 280.)

The holes left in the pods affected by this weevil, which form by cracking or otherwise, leads also to secondary infestation by other insects, including scavengers. Among these, reared during the past year from cowpea, was Glover's grain moth (*Batrachedra rileyi* Wals.), which has elsewhere been mentioned somewhat more in detail (Bul. 8, n. s., pp. 32, 33) as attacking corn and cotton bolls injured by insects.

REMEDIES.

From what has been learned of the habits of the cowpea-pod weevil it does not seem that it demands remedial treatment in cotton fields. In fields of cowpea it would be difficult, although possible, to kill the insects with an arsenical spray. This would necessarily have to be applied by underspraying in order to reach the insects, and it is extremely doubtful if this would be profitable. It should be ascertained when the insect normally develops in greatest numbers in the fall, and this may lead to a partial solution of the problem. If it be found in any stage in cowpea when the pods are picked for seed, and any other species of seed weevil like *Bruchus chinensis* or *B. quadrimaculatus* are also present, fumigation with bisulphid of carbon is indicated. If otherwise, the plants, if badly injured, should be promptly and deeply plowed under. As to infestation of beans, injury may be obviated by not planting this crop in the immediate neighborhood of cowpea which has been infested the previous year. It is unnecessary to state that it would not be wisdom to spray affected beans just before picking, but within a week or two of this time it could be done if the beans were afterwards washed or a storm ensued, without any danger whatever to the consumer. In case a spray is used, arsenate of lead combined with Bordeaux mixture is advised, according to directions furnished in Farmers' Bulletin 127 (1903 ed., pp. 11–13).

ADDITIONAL OBSERVATIONS ON THE TOBACCO STALK WEEVIL.

The trouble experienced through the ravages of the tobacco stalk weevil (*Trichobaris mucorea* Lec.), at the experiment station of the Bureau of Soils located at Willis, Tex., and in charge of Mr. Lawson H. Shelfer during 1902, as reported by Mr. Chittenden in Bulletin 38 (pp. 66-70), was such as to raise grave doubts as to the possibility of the soils station being able to continue their tobacco experiments during the following year. Accordingly by request of Prof. Milton Whitney, Chief of the Bureau of Soils, Mr. G. H. Harris, of this Division, was detailed to Willis to make observations on this insect during January and February, after which another field agent, Mr. J. C. Bridwell, was appointed for the purpose and detailed by the Bureau of Soils, under the direction of the Entomologist. The work, therefore, continued from January until September, when Mr. Bridwell finished his report, which follows. It should be added that, according to Mr. Bridwell's observations, the acreage under cultivation to tobacco was not entirely sufficient for the thorough study of the life history of the stalk weevil and that the insects were not present in such abundance as to make it possible to make perfectly satisfactory tests with insecticides. Nevertheless, it is to be regretted that an under-spray of an arsenical solution was not made on insects isolated on leaves for the purpose, that we might learn whether the beetles would devour a sufficiency of the poisoned leaves to destroy them. It seems probable that arsenate of lead might be so used, in spite of the woolly texture of the under surface of tobacco; at least we suggest, if a good opportunity should offer, that it be tried. From the observations of Messrs. Shelfer, Harris, and Bridwell there can be no doubt that this is one of many species of insects which are what we term periodical, or, in other words, irregular as regards injuriousness; and it may be some time before injury is reported similar to that which happened in 1902, while again the insect might appear in great numbers a year or two hence. Some additional facts were learned in regard to the insect's life history, and it is to be especially noted that it feeds on potato, which has suggested the use of potato and jimson weed as trap crops.

WASHINGTON, D. C., *September 5, 1903.*

SIR: I have the honor to submit the following report upon the tobacco stalk weevil (*Trichobaris mucorea* Lec.), based upon work done at Willis, Tex., by Mr. G. H. Harris in January and February, and by myself from March until July, of the present year. The principal work undertaken was field observations of the habits of the weevil, and endeavor was made to determine its life history and particularly the place and manner of hibernation, its food plants, and if possible its original food plant, and whether the species is single or double brooded.

The remedies suggested by the habits of Trichobaris were studied, though the acreage of the tobacco and the degree of its infestation by this species at Willis were too small to make satisfactory experiments in some lines. This was particularly true

of the poisoning experiments contemplated. The principal remedies studied were the use of trap rows and the destruction of the tobacco stalks and stubs. The results obtained may be stated briefly as follows:

Among cultivated crops *Trichobaris mucorea* attacks both the Irish potato and tobacco. It feeds upon horse nettle (*Solanum carolinense*), but its particular and almost exclusive wild food plants are the two jimson weeds (*Datura stramonium* and *D. tatula*), the latter quite common at Willis. Since both Daturas are introduced weeds, it is evident that the weevil fed originally upon some other plant. There is a native Datura (*D. meteloides*) in the Southwest, and, as Mr. Schwarz has taken *Trichobaris mucorea* from it in Texas and Mr. Coquillett also in California, this is without doubt its original food plant, and its occurrence at Willis indicates an extension of its range following the introduction of the other species of Datura.

The mature weevil, as a rule, hibernates in the stalks of tobacco or jimson, emerging in the spring when the weather is warm enough for the growth of the somewhat tender Solanaceæ. This year, which in Texas was nearly a month behind the usual season, the weevils were found feeding in the field in the middle of April. After a feeding period of a few days they copulate and oviposition begins. In the jimsons the egg is laid in the forks of the branches, but in tobacco at the lower side of a midrib of a leaf where it joins the stem. The larva may succeed in penetrating at once to the pith, and in tobacco bores out the pith from the root to the tip of the stem, producing a stunted "cabbage" plant in which the stem stops growing and all the leaves are produced in a kind of head on the short stem. The more usual course, however, is for the larva to wander about for a time just under the bark. It is not unusual for it to complete its transformations without penetrating to the pith at all. The course of the larval tunnel is usually irregularly spiral and the whorls are frequently so near together as to produce a girdling of the stalk, an effect known to the planters as "ring worm." This girdling may not particularly injure the plant, but frequently the plant is so deeply cut and so weakened that it is likely to be snapped off by strong winds. Ordinarily the insect's transformations are completed in the pith. When this is the case the fully grown larva cuts a cylindrical hole through the wood to the bark and uses the woody particles thus obtained to construct its pupa case. The life cycle was not observed, but it was estimated that this period did not exceed 75 days. Apparently there is only one brood in a season, the weevil maturing in June or July and in some cases probably later, remaining in the tobacco or jimson stalk if undisturbed until the next March or April.

Two other species of Trichobaris were found at Willis and their habits observed. These are *T. texana* Lec., boring in the larval condition in the stems of bull nettle (*Solanum rostratum*), and *T. compacta* Casey, breeding in the seed pods of the jimsons. These species may readily be mistaken for *T. mucorea* by one not familiar with insects.

It is hardly feasible to poison the weevils upon tobacco by means of a spray, since they feed almost exclusively upon the under sides of the midribs in a position almost impossible to reach by spraying. They might be reached by dipping the plants in a solution of lead arsenate when they are planted out. Poisoning on trap rows of jimson or potatoes by means of a spray would be effective if done thoroughly, for on these plants the weevils ordinarily feast upon the upper side of the leaves.

Ordinarily there will be but little use of trap crops, but undoubtedly considerable benefit would be derived by planting a trap crop of jimson or Irish potatoes in cases where the proper care has not been exercised in destroying the weevils. Perhaps the potatoes would be preferable, and they should be planted very early and then thoroughly sprayed a few days before the tobacco is planted out.

The main reliance in all cases should be the burning of all stalks and stubs of tobacco and jimson. The sooner this is done after the tobacco is cut or pruned the better, for some of the weevils will emerge from the split and broken stalks and hiber-

nate elsewhere. Even if this is not done until the latter part of the winter almost all of the weevils will be destroyed. This method, if continued in a given region from year to year will almost eliminate the injury of the weevil in that region.

Respectfully submitted.

J. C. Bridwell.

Dr. L. O. Howard,
Division of Entomology, Washington, D. C.

REPORT OF INVESTIGATIONS AND EXPERIMENTS ON FULLER'S ROSE BEETLE IN SOUTHERN CALIFORNIA.

By Fdk. Maskew, *Horticultural Inspector.*

The insect found infesting and destroying the strawberry fields at Tropico, and the strawberry, raspberry, and Loganberry vines at Burnett, Los Angeles County, has been identified (from specimens sent) in the Division of Entomology of the Department of Agriculture as Fuller's rose beetle, *Aramigus fulleri.* A very complete account of the biology of this insect and a comprehensive list of its food plants may be found in Bulletin No. 27, new series, of that Division. The economic points contained there may be summed up as follows: The insect is wingless, probably one-brooded; the eggs in batches of from 10 to 60 are secreted by placing them between the loose bark and the stem of the plant just above the surface of the ground, and the principal injury to the plant attacked, in case of the strawberry, is accomplished during the larval period.

The writer's attention was called to the condition of strawberry fields in Burnett, May 19. At that time the vines were commencing to wilt badly, and upon lifting some of them they were found infested with a grub. This case was promptly reported, specimens sent for identification and a complete inspection of all the strawberry plants in Burnett commenced. Associated with me in this investigation was Horticultural Commissioner Strong, and it is due to the exercise of his practical judgment on many occasions that several of the most important facts in the case have been cleared up. The number of strawberry plants in this immediate vicinity may be safely placed above the 2,000,000 mark. These were inspected, row by row, and all the dead and wilted plants lifted and examined. This survey showed the strawberry fields and vines with few exceptions to be in a good, thrifty condition, and also showed that the insect in question was confined at this time to two well-defined spots. Outside of the infested areas the death of the plants had been induced by several causes; in rare instances the cause could be traced to wireworms and also cutworms, and occasionally a colony of ants had killed the plant by loosening and removing the soil from around the roots; but by far the greatest number, fully 90 per cent, had succumbed to causes other than insect depredations. One grower assured the writer that the cause was exhausted vitality, the plant having blossomed itself to death. Another attributed the

cause to the presence of alkali salts in the irrigating water, while a third was confident that in his case it was the result of commercial fertilizer. In the opinion of the writer, based upon the observation of thousands of plants, the prime cause of death to the young plants was careless setting.

The principal varieties grown in this district are the Brandywine, the Lady Thompson, and the Arizona. The Brandywine is the only variety found to be attacked by the grub up to the time of writing.

The method of attack upon the plants, as observed this season, is as follows: In the latter part of April or early in May the grubs enter the plants by boring into the stem 1 or 2 inches below the surface of the ground and tunnel upward to the crown. Here the work continues till the plant is killed. No evidence was found of any boring into the stems of the plant above the crown, nor any destructive work upon the foliage. Upon the death and eventual drying up of the plant the grub apparently returns to the soil, being found in great numbers in the soil immediately surrounding the roots of the dead plants. In very few instances were grubs found in plants that had become dried up, and in no single instance was a pupa ever found in the plants. The depths to which the grubs penetrated the soil appeared to be governed to a great extent by the moisture. In parts of the field where the plants had all been killed and the soil allowed to become dry, the majority were found at a depth of about 5 inches. Where irrigation had been continued and the soil was moist they were found within 2 inches of the surface.

The first pupa was found June 3, and the first beetle June 17. July 28 beetles were numerous upon and under the litter on the ground, and the soil surrounding the roots of the plants contained numerous specimens of larvæ, pupæ, and beetles.

Experiments were made, at the request and with the assistance of the owner of the infested patches, with carbon bisulphid. The object sought was to learn whether the soil could be practically cleared of the grubs, and the question of injury to plant life was not taken into consideration. The ground was irrigated, and then allowed to dry off until the moisture conditions were judged such as would conduce to the most effective diffusion of the vapor. One-third of an ounce was used as a dose, and injections were made as follows: One injection every lineal 3 feet in the row, one every 18 inches, and one every 2 feet. In this instance the majority of the grubs and pupæ were found at a depth of 5 inches, and an effort was made to place the dose approximately near this depth.

Twenty-four hours afterwards an inspection of the treated rows was made, and the following methods were employed to determine the results obtained. Four feet was measured and staked off in each row treated, the soil was removed from a width of 24 inches and to a depth

of 8 inches, and carefully sifted; all insects were removed, and placed in a broad, shallow box, and allowed to remain in the sunlight 15 minutes before being counted. The count resulted as follows:

Results of experiments with carbon bisulphid in destroying grubs and pupæ of Fuller's rose beetle.

	Grubs.			Pupæ.	
	Total.	Dead.	Alive.	Total.	Dead.
One-third ounce to 3 feet	55	43	13	1	1
One-third ounce to 2 feet	42	35	7	0	0
One-third ounce to 1½ feet	36	34	2	2	2

Several forms of insects were found, including young sand crickets and wireworms in different stages, and these in every instance were dead. A second investigation later on failed to show any sign of insect life in the row that had received a dose of one-third of an ounce every lineal 18 inches. The cost of treating at this distance, which was apparently complete in its effects, would be approximately 10 cents for 75 feet of row.

This is probably the first reported instance of this insect attacking the roots of berry plants. However, the writer is of the opinion from evidence gathered that it has been working unrecognized upon the roots of strawberry in different parts of this county for some time. Fortunately, the natural spread of the pest in berry fields will be slow, owing to its inability to fly, and every effort should be made to take advantage of this condition, and to prevent its distribution by other agencies, by discouraging and preventing, where possible, the sale or removal of young plants from infested areas. It will prove practically impossible to detect with certainty (such as is required on other forms of nursery stock) whether or not eggs are present upon the berry plants offered for sale in wholesale quantities. Our past experience with this insect upon citrus trees teaches us that in its adult form it is very difficult to kill, even with our most complete and powerful methods.

This investigation has developed no practical method of combating the beetle upon berry plants, but has suggested several methods of relief and control against the larval and pupal stages.

The first practical measure of relief that suggested itself for strawberry growers with a badly infested field or old plants is to take new land. In case this method is adopted, the infested field should be promptly plowed not later than June, and summer fallowed, this to be followed by a crop of grain and summer fallowed the second season.

In the case of strawberry growers who are not in position to obtain new land, who have brought their land up to a state of high fertility,

and, having at a great expense perfected their irrigation facilities, desire to continue growing berry plants upon the same ground, the carbon-bisulphid treatment if thoroughly employed will afford practical relief. This will probably have to be modified to suit conditions, and to be effective it should be used *before* the insects change to the beetle form.

In the fields of young plants the destructive work of the insect can be controlled by careful watching during the latter part of April and the month of May. All young plants which have been found infested contained but one grub. These were very small, of a bluish color, and apparently but a few days old. A careful search of the soil surrounding them failed to show any other grubs. If these plants were carefully lifted as soon as they commenced to wilt, the cause would be invariably brought up with them; and if the insects be promptly killed, the work of destruction would be very materially curtailed. A simple method that would make this work complete suggested itself to the writer during the investigation. By pushing an iron wheelbarrow containing a bed of hot coals before him, a man could effectually destroy the wilted plants taken from say two rows on either side. This would be a quicker method than searching for the grub, safer than hauling away the plants, and would be effective against any eggs remaining unhatched upon the plants.

There is no practical method known to me of saving the plant that has become infested with the larva of this insect. Carbon bisulphid stands out prominently as a remedial agent for this and other subterranean forms of insect life, and is worthy of better and more extended acquaintance on our part with its practical merits along this line.

No evidence of the presence of the strawberry weevil, *Anthonomus signatus*, nor the larvæ of an insect that works in the crown of the strawberry and was formerly supposed to be identical with *Anarsia lineatella*, the peach worm of this State, was found in any of the strawberry fields covered by this investigation.

ADDITIONAL NOTES.

Writing in response to inquiry as to the value of water in the treatment of soil infested by the larvæ of Fuller's rose beetle about the roots of strawberry, Mr. Maskew stated that although water might be of service as a remedy, it could not be used in the vicinity of Longbeach, Cal., but his experiments tended to prove that elsewhere it might be successful. "It might be possible to drown them out, but the soil in this locality is a loose, open gravelly loam, and takes water like a sponge. Water is costly in this region, and this method might cost as much or more than carbon bisulphid." It was customary to irrigate the strawberry fields about every ten days during the bearing season. In the moist or wet ground larvæ and beetles were all within

1 or 2 inches of the surface. On the dry ground they were 5 or 6 inches below the surface. He noticed no difference in the numbers of larvæ and pupæ under the above conditions, but never found a beetle in the wet ground, except once in a while one on the lower leaves of a plant. In the dry ground he found the beetles by hundreds July 28, 1903.

He observed that water had a bad effect on the insects in their younger stages, which corresponded with our office experiments. He filled an 8-inch flowerpot with soil taken from an infested field, and in it placed 20 pupæ and 10 larvæ, covering with a piece of lawn and placing the pot in a tin pie-plate. He applied water as for a growing plant, with the result that only one beetle was obtained by this experiment.

As the first sending of larvæ received by the writer, who had charge of them, failed to transform in moist earth, another lot was placed in a large earthern pot and kept moderately dry, the top only being slightly moistened occasionally. From this jar nearly all the beetles issued, showing that if it should be possible to irrigate at the time when the species is undergoing transformation from the larva to the pupa, and from pupa to adult, the insect could be killed by this method alone. We have also to record the receipt of larvæ and adults of this species from Mr. Harry G. Wolfgang, Leetonia, Ohio, who wrote January 11, 1904, that it was especially destructive to citrus, hibiscus, and vinca, the last being a new food plant, while we have not received previous records of the occurrence of this species in Ohio.—F. H. C.

IMPORTATIONS OF BENEFICIAL INSECTS INTO CALIFORNIA.

By C. L. Marlatt.

In the annual reports of the Entomologist of this Department for the past four years (1900–1903) brief accounts have been given of the introduction of various foreign beneficial insects, including the South African black scale parasite, *Scutellista cyanea*, the European moth parasite of the larger scale insects, such as Lecaniums and mealybugs, *Erastria scitula*, the European plant-louse ladybird, *Coccinella septempunctata* and an Australian species, *Leis conformis*.

Of these importations the only one which has yielded a marked success is that of the South African parasite, and this insect is apparently duplicating against the black scale the wonderful work of the Vedalia against the white scale in California. In his annual report for 1900 Doctor Howard gives the history of this importation, and the earlier one into Louisiana. The subsequent annual reports cited bring the records down to the summer of 1903. In August of this year (1903) Mr. Craw, first deputy commissioner of horticulture, and quarantine officer of California, replied to a telegram of inquiry that the most

sanguine expectations had been surpassed by this species. He telegraphed under date of August 28 that it is established in every county south of Concepcion, that it is very plentiful in Los Angeles and San Diego counties, and that he is still sending it out from his office in San Francisco. The Los Angeles commissioners had also by that time distributed over 400 strong colonies near Escondido, and stated that the insect was spreading naturally and rapidly from the points of distribution, and as a result there was a feeling of great confidence among orchardists.

The writer spent portions of November and December in California, and particularly investigated the status of this parasite. A visit to the office of the horticultural commissioners of Los Angeles County November 27, 1903, enabled him to note the process of breeding and shipment of colonies of the Scutellista. The secretary of the board, Mr. Jeffrey, stated that 1,000 colonies had been sent out from his office, and that probably as many more had been distributed directly from orchards.

The principal source of supply at this season was the pepper trees. Hitherto these trees have been rather maligned as harboring the black scale, and facilitating the reinfestation of adjoining citrus and olive orchards, but with the introduction of the Scutellista this tree plays a very useful rôle, because the black scale upon it seems to breed more irregularly, at least in some regions, than on the orange, and hence supplies food in the proper stage for the parasite over a much longer period than is the case with citrus trees.

The Scutellista larva feeds only on the eggs, and never has been discovered to attack the young or gravid female host insect. It is therefore desirable that the scale should be present in the egg stage at practically all seasons of the year to allow the parasite to go on breeding unchecked. There is some evidence, however, as will be shown later, that the parasite may have a resting period corresponding to the winter months, during which the great mass of the black scale is in the larval stage, thus accommodating itself to the habits of its host.

It will be apparent that the usefulness of this parasite depends on how nearly it destroys all of the eggs produced by the female Lecanium, and it is very interesting, in this connection, that the repeated examinations made by Mr. Jeffrey and others and by the writer revealed in no instance the escape of a single egg in a parasitized scale. If the eggs are few in number the parasite comes to full development, but yields a much smaller insect; on the other hand, a large, well-fed female scale will develop a parasite of unusually large size, but the larva in either case seems to continue feeding as long as there are any eggs to be devoured.

A common method of distributing the parasite is to cut branches from pepper trees and tie them to the orange trees in various places

through the groves. The distributions made from the central office in Los Angeles are of bred parasites, which are sent through the mails in small wooden boxes. The abundance of this parasite on the pepper tree is something amazing. Some branches of this tree plastered with scale insects were examined, and every scale contained the parasite, either in the larval, pupal, or adult stage, and they were emerging in the breeding jars by hundreds.

Later, December 19, the writer, in company with Mr. Jeffrey, made an exploration of the region between Monrovia and Azusa, in Los Angeles County, chiefly about the latter place. Various ranches were inspected where the Scutellista had been liberated. The black scale in these ranches was practically cleaned up, and the few remaining scales were parasitized. The natural spread of this parasite from one ranch to another was well illustrated in this region, and all of the ranchers were most enthusiastic over the outlook. Nothing in the way of control by a natural enemy has given such promise or has roused so much interest in California since the introduction of the Vedalia.

The following day a trip was made, in company with Commissioner Strong and Horticultural Inspector Fdk. Maskew, through the coast region near Long Beach. Here a most interesting outcome was noted. Mr. Maskew, who has been very much interested in the distribution of this parasite, and had failed to get as large a supply from the Los Angeles office as he desired for his local distributions, accidentally discovered that the horseweed (*Erigeron canadense* L.) growing in the neighborhood of some pepper trees bordering an orchard where a colony had been placed was thickly infested with the black scale, and, to his surprise and delight, he found that the scale on this weed was extensively parasitized by the Scutellista. From this stock he was enabled to distribute quantities of the parasite throughout his district. More interesting still was his discovery that the black scale occurred quite commonly on various other weeds, such as cocklebur and ragweed, and very extensively in an adjoining field of Chili-peppers, and that on all of these plants the infestation with Scutellista was becoming very general, so that he had here an immense stock of parasites for distribution. The writer visited this locality, and confirmed by a personal examination the abundance of the scale on the plants named, and particularly on the Chilipeppers, and the general infestation of this scale with the parasite.

The evidence pointing to the partial hibernation of the parasite, already noted, was furnished by Mr. Maskew. He had made considerable collections of the scale on the horseweed for breeding and for dissemination in orchards. The weeds were at this season of the year entirely dead and dry. Some of them had been kept in jars very much exceeding the normal time for the emergence of all the para-

sites, but were still yielding them, indicating that there is at least a notable irregularity in the time of emergence, and a possible resting or hibernating period. In the coast districts, as represented by Long Beach, the black scale is not so distinctly single-brooded as it is in the higher regions bordering the mountains, and this was especially notable in the case of the Chilipeppers. It is evident, from what has been said that the danger of the parasites being exterminated during the winter is not very great in southern California.

The writer also investigated the conditions about Santa Barbara, where there have been some distributions of this parasite, and notably the Gillespie ranch. This ranch is remarkable for the great variety of horticultural and ornamental plant species and varieties represented in it. It is under the charge of Mr. Compton, an experienced horticulturist and gardener. The writer was assured by Mr. Compton that two years ago the olive and citrus orchards and many of the ornamental trees and shrubs were covered with the sooty fungus from the black scale which thickly infested the premises. About that time he obtained a colony of Scutellista. In April of 1903 this parasite had so multiplied that he was unable to find a scale anywhere that did not contain a larva of the Scutellista. At the time of my visit these premises were in splendid condition, perfectly clean, and as fresh looking as could be wished, and this result seemed to have been accomplished in the main by this parasite. So perfect had been the work that a living scale was not to be found anywhere. It must be said, however, that this was an off year for the black scale in this region, and that on other ranches where the Scutellista had not been introduced the black scale was doing less damage than ordinarily. For example, the Crocker-Sperry ranch, which the writer saw some seven or eight years ago blackened with *Lecanium oleæ*, was this year comparatively free from serious attack. This ranch, however, had been regularly treated with petroleum washes.

The method of hibernation, or the winter behavior of this parasite, in view of its extraordinary promise, are matters of particular interest, and the writer, therefore, under date of February 24, 1904, requested Mr. J. W. Jeffrey, the secretary of the board of horticultural commissioners of Los Angeles County, and Mr. Frederick Maskew, an inspector of the same county, already referred to in this report, to send any data which they had obtained bearing on the subject of hibernation, or the exact conditions of going through the winter in orchards, on pepper trees and other plants; and also, in the same connection, any records which they might have showing the time covered by a full generation, or the variation of this period at different seasons of the year. The information given by Messrs. Jeffrey and Maskew is appended herewith, and should be credited to the horticultural commissioners of Los Angeles County, all of the members of

the commission and inspectors being more or less jointly responsible for the work done on this parasite and the information gained. As pointed out by Mr. Jeffrey, the South African parasite presents such varied phases of development in different localities and situations, under different scale conditions, that it is impossible to form accurate conclusions without a thorough study of its life history made in a systematic manner. The general status of the distributions and abundance of the parasite and winter conditions are given by Mr. Jeffrey, in letter dated March 7, as follows:

From the 15th day of last August to the 15th day of January this office has distributed about 25,000 adult flies. They were taken from a colony established upon a pepper tree at Pasadena on the 26th day of August, 1902. During this period of five months of distribution the greatest activities occurred in August and December, 32 per cent being sent out in December. You will notice that the time covered is concurrent with that of the greatest development of the scale upon the pepper trees from which we obtained our supplies. But the most active orchard work of the flies must occur in the early summer, when the scale is in the egg stage upon the citrus trees.

From the first of January to the first of March the Scutellista entered a period of greatest dormancy, in which a large portion died in the larva, pupa, and adult form. We are now breeding them again in large numbers. However, we noticed in several orchards in sunny situations the insects working all through this time of general dormancy as if it were midsummer, the orchards being in all cases young, and, consequently bearing scale in all stages of development.

From this we conclude that with the exception of a short time in the cooler weather the Scutellista has no period of inactivity, but works in all cases where the scale is in the egg stage.

Mr. Maskew's notes, received with the above, are very interesting and instructive, and are quoted substantially as received below, and are the result of instructions from the Horticultural Commission of Los Angeles County to make weekly observations on colonies liberated in his own inspection district:

October 15.—A few flies. Pupæ common but not numerous. Larvæ (not identified) very abundant.

October 19.—Flies more in evidence. Pupæ very abundant. Larvæ (not identified) becoming more scarce.

October 30.—Flies very numerous; numbers of them to be seen upon the wood and foliage. Old scale showing evidence of a general exit. Pupæ under scale becoming scarce. Larvæ (not identified) in all sizes but more rare.

November.—*Scutellista cyanea* was found in all three stages during each week of this month, but upon a different class of host plant. The majority were found upon horseweed, cocklebur, pepper trees, and olive, about in the order named from a numerical standpoint. Flies bred from parasitized black scale upon belladonna and chili pepper taken during the month of November, proved to be *Tomocera californica*, *A. mytilaspidis*, and one unknown to me which had all the earmarks of a Proctotrupid.

December.—*Scutellista cyanea* was found in all three stages during each week of this month, principally upon pepper trees, weeds, and upon chili pepper.

January.—During each week of this month the parasite was found as follows: Larvæ very scarce, pupæ and flies abundant, particularly upon chili pepper. A

very large number of dead flies were found under the shells of black scale, more so than during any other time of this investigation. Cause unknown to me.

February.—The larva and pupa of the insect in question were rarely found during the weekly investigations of this month. Flies were abundant upon the foliage of citrus trees and upon the stems of chili peppers during most of the bright sunny days of the past month. The mortality of adult flies under the scale continues, but not so apparently as during January.

"Length of time of a generation under natural conditions." I have but one positive record of this. On August 14, 1903, I liberated a colony of *S. cyanea* (flies) on the premises of G. A. Lindsay, Long Beach. No Scutellista had been placed previous to this nearer than 4 miles away. I was in a position to watch the progress of this colony closely. I soon saw by the color and appearance of the scale (*L. oleaæ*) that they were parasitized. On October 8, 1903, I was investigating the progress of the parasites and upon removing a full-grown black scale, a fully developed Scutellista emerged from the shell into my hands. This makes fifty-five days from the time the flies were liberated and the first appearance of the adult of the next generation.

On October 18, 1903, I found a large quantity of horseweeds in a gulch to leeward of a lemon orchard in which *S. cyanea* had been placed. These were found to be covered with black scale (*L. oleaæ*). Upon investigation it was found that the scale was extensively parasitized, at least 50 per cent; upon a piece of horseweed 16 inches long I removed 80 black scale; 42 of these contained parasites, the majority being *S. cyanea.*

On October 19 I cut these weeds into short lengths, placed them in fruit jars, covered the tops with lawn and distributed them in the different citrus orchards. The owners agreeing to liberate such flies as emerged once every twenty-four hours. On December 18 flies were still issuing from the weeds placed in one of these jars. Later on this jar was removed to the office in Los Angeles, and the commissioners informed me that flies (*S. cyanea*) continued to emerge up to the ninety-seventh day after being placed in the jar. These weeds were mature when placed in jar, and the scale upon them was fully developed.

The points of greatest interest shown in the notes above quoted are that at the height of the breeding season (in August and September) the life cycle of this insect is about fifty-five days, and that during the colder season of winter these insects, as already indicated in my own notes, enter a period of semihibernation which may extend over a period of three months. The bearing of these facts on the usefulness of this parasite is very apparent. The feature of greatest anxiety was how it would pass the winter season during which, in the case of many citrus groves at least, there would be no food for them. This problem seems to be solved by the hibernation of the insect, which bridges very nicely the period referred to. On the other hand, it is shown that where conditions are favorable—that is, in sunny situations and where the food supply exists due to the same conditions, activity continues throughout the winter. There seems to be no possible reason for doubting, therefore, the full establishment of this insect in southern California and its present and prospective great usefulness.

Scutellista cyanea, of which such good showing is now made, as pointed out by Doctor Howard, is probably of Oriental origin, having first been described by Motschulsky, from Ceylon, from which place

it may accidentally have been carried to Italy and South Africa, in both of which localities it has become established, and is most beneficial in keeping in check the larger scale insects.

Other recent importations.—The European moth (*Erastria scitula*) does not seem to have made any very startling developments, and I could get no reports of its having given any evidence of usefulness. It will be remembered that this insect was sent to this office by Prof. Antonio Berlese, of Portici, Italy, during the year 1902, and was forwarded by Doctor Howard to Mr. Alexander Craw. It was liberated in several places, and the preliminary reports were favorable enough to show that there is a good chance of its becoming established.

Of the European ladybirds, *Coccinella septempunctata* and the Australian *Leis conformis*, I could learn nothing especially favorable. The first is an omnivorous feeder, and will eat its own larvæ or the larvæ of other ladybirds as readily as it will plant-lice, and hence its utility is open to some considerable question.

Older importations.—Of the older importations into California the Vedalia is maintaining its usefulness. It is being bred regularly by Mr. Craw and some of the county horticultural officials. Whenever notice of an outbreak of the white scale comes to headquarters some of these beetles from breeding cages are sent out, always accompanied with the request for a return sending of as large a quantity as practicable of wood infested with the scale. By this means the food supply for the rearing of beetles is kept up and it is made possible to send out new beetles promptly to all applicants. The rapidity with which a colony of scale is cleared up by these insects is something marvelous, a few weeks only being sufficient for it to clear up a considerable area of infestation.

The older principal insect enemy of the black scale in California is the imported *Rhizobius ventralis*, which has been so very effective on the Cooper ranch and in some other coast districts of California. It has never proved to be of any special value in the drier regions away from the coast. These conditions seem still to be true of this insect. Its usefulness, therefore, is comparatively limited, as much of the important orange and citrus area is beyond its range of effectiveness. *Rhizobius ventralis* also has shown itself very efficient against *Pulvinaria innumerabilis* on apple. This Pulvinaria very badly infested certain apple orchards, and was completely cleaned up in eight weeks after the introduction of this ladybird, as reported by Mr. Maskew.

Every little while others of the beneficial insects imported by Koebele turn up, even where they seem to have completely disappeared for a number of years, and it is not improbable that more of them have maintained themselves in California than has been believed, though in very limited numbers.

INSECTS INJURIOUS TO STOCK IN THE VICINITY OF THE GULF BIOLOGIC STATION.

By James S. Hine.

The Gulf Biologic Station is located at Cameron, La., near the mouth of the Calcasieu River, which empties into the Gulf of Mexico a few miles from the Texas boundary. The writer arrived there August 14, 1903, with directions from the United States Department of Agriculture to investigate the stock insects of the region. A report on a subject like the present one, observed for a short time, must necessarily be incomplete, and some suggestions are omitted which if developed might lead to important results.

Mosquitoes are very abundant and are serious pests to both man and beast. The director of the station, Prof. H. A. Morgan, is actively engaged in studying them.

Several of the Muscids, such as the stable fly, horn fly, screw-worm fly, and Hippelates flies, are also plentiful.

Although directed to investigate stock insects, the writer understood that horseflies of the family Tabanidæ were to be his special subject, consequently most of his time during a two weeks' stay was devoted to these forms.

The whole country is only a few feet above sea level and is favorable for the development of the Tabanidæ on account of the large acreage of wet and marshy land. Running nearly parallel to the shore of the Gulf is a series of alternating ridges and depressions. The depressions form extensive fresh-water marshes, over a part of which the water stands the year round. Such species as oviposit over mud or stagnant water find ideal conditions in this region, and consequently some of them are abundant.

SPECIES OF TABANIDÆ OBSERVED.

A large number of species have a range such as would safely include them within the fauna of Louisiana; and besides the writer has seen nearly a dozen species from that State, but during his stay there only five were collected or observed, but at least three of these are among the worst stock pests of the family, and taking into consideration their abundance in the region, they are certainly a serious drawback to stock raising.

Chrysops flavidus Wied. was the only one of its genus observed, and owing to the lateness of the season only now and then a specimen was seen. It is said to have been an abundant and troublesome pest earlier.

Tabanus atratus Fab. was occasionally seen. As in other localities, it is present through nearly the entire summer, but usually not abundant enough to be considered a serious pest. Only a few specimens were observed molesting horses and cattle.

Tabanus lineola Fab. is a widely distributed species and everywhere is of especial economic importance. It was common at Cameron, and is one of the three species referred to above as being especially injurious.

Tabanus costalis Wied., the common greenhead, was abundant and appeared to be more persistent in its attacks than any of the others. When sucking blood it is usually located on the under parts or on the fore legs, where an animal has most difficulty in reaching it, and once it alights it is pretty sure to satisfy its appetite before leaving.

Tabanus quinquemaculatus Wied. has not been reported from the United States heretofore, but the commonest species observed at Cameron agrees very closely with Wiedemann's description. Besides, it is reported from Mexico by both Wiedemann and Bellardi, so it would not be strange to find it in Louisiana. This species appears much like *costalis*, but is larger, has two purple bands on the eye instead of one, and the costal cell is hyaline. It is also close to *lineola* in appearance, but the color of the vestiture of the body is decidedly more yellowish, and the upper purple band of the eye is noticeably narrower than in that species. Besides, it averages larger than either *costalis* or *lineola*, but undersized specimens are often met with.

Since no systematic experiments were carried on at the Gulf Biologic Station, what the writer has to say regarding remedies may be considered as suggestions, derived partly from observations on the conditions existing in that section, and partly from work and experience in Ohio.

NATURAL ENEMIES.

The natural enemies of the Tabanidæ is an interesting subject for investigation at the Gulf Biologic Station. The writer is under obligations to Messrs. Ashmead and Coquillett for the names of most of the species mentioned below.

Monedula carolina Fab., a large and attractive species of the family Bembecidæ, is common, and its habit of flying around horses and cattle for the purpose of catching Tabanids and other stock pests is so noticeable that it has received the common name of horse-guard.[a] One commonly sees from one to three or four of these at work around a single animal.

Bembex belfragei Cr. belongs to the same family as the last and like it is an important enemy of horseflies. It has different habits, however, for instead of capturing prey around animals, it flies about the fields in the vicinity of marshes and captures males and females at their breeding grounds. It is a common occurrence to see a specimen carrying an adult Tabanid.

Both the above species deposit their eggs in burrows which they

[a] A name which it shares with the great digger wasp (*Sphecius* [*Stizus*] *speciosus* Dru.).

make in the sand, and they store the burrows with insects for the young to feed upon when they hatch. It is not uncommon to find from half a dozen to a dozen specimens of Tabanus in a single burrow, besides other insects. Professor Morgan says that he has taken seventeen horseflies, one Syrphid, one Tachinid and one Stratiomyiid from a single burrow.

Crabro 10-maculatus Say, another wasp, is an expert at catching Tabanids, and the writer often saw them capture the flies and carry them away. None of their nests was found, but it would appear that they have about the same habit in this regard as the Bembecids.

Erax maculatus Macq. and species of Deromyia were rather common and were often observed feeding upon different species of Tabanidæ.

That chickens may become a factor in destroying stock pests was proved by the fact that they were often observed following cattle in the pasture, picking off such Tabanids as alighted on the lower extremities of the animals for the purpose of sucking blood.

METHODS OF CONTROL.

In my "Tabanidæ of Ohio" I suggested the use of kerosene on the surface of the water for killing larvæ hatched from eggs deposited over water. Of course this method could not be used in cases where deposition took place over damp ground, as was observed at Cameron. One finds eggs of *costalis* and a number of other species in such places quite frequently.

With so much standing water to be considered, it would be an immense undertaking to use kerosene for killing adult flies, as suggested by Porchinski in Russia, and commented on by Doctor Howard in Bulletin No. 20 (n. s.), Division of Entomology (p. 24). It appears that both of the above suggestions, as well as others that might be mentioned, are of most value in special cases; in fact there is seldom a single remedy in use in economic treatment of insects that is appropriate at all times with reference to a particular species or group of nearly related species.

It is my belief that species of the genus Tabanus have a habit which if better understood might be utilized in trapping them in numbers sufficient to materially lessen their ravages. I refer to their habit of collecting in certain places, as on buildings, fences, and the like. The habit has been observed at different times and in different places but I saw it more forcibly at the Gulf Biologic Station than at any other place I have observed. The sexes of the last three species of Tabanus mentioned above flew around the station building in numbers, often resting on the siding and windows or striking against the glass and screens; then flew away so rapidly that the eye could not follow them. August 23, I obtained permission to open the screens from one of the

doors to see what the result would be. The screens from a doorway (7 by 5½ feet) were left open from 10 in the morning to 3 in the afternoon, after which between a pint and a quart of flies of the size of the common *costalis* were procured from the windows upon the inside of the building. All but about a dozen of these were females, which, as was proved by dissection, had not yet laid their eggs. I believe that a trap might be manufactured that would attract Tabanids in the same way that they are attracted to the building to question.

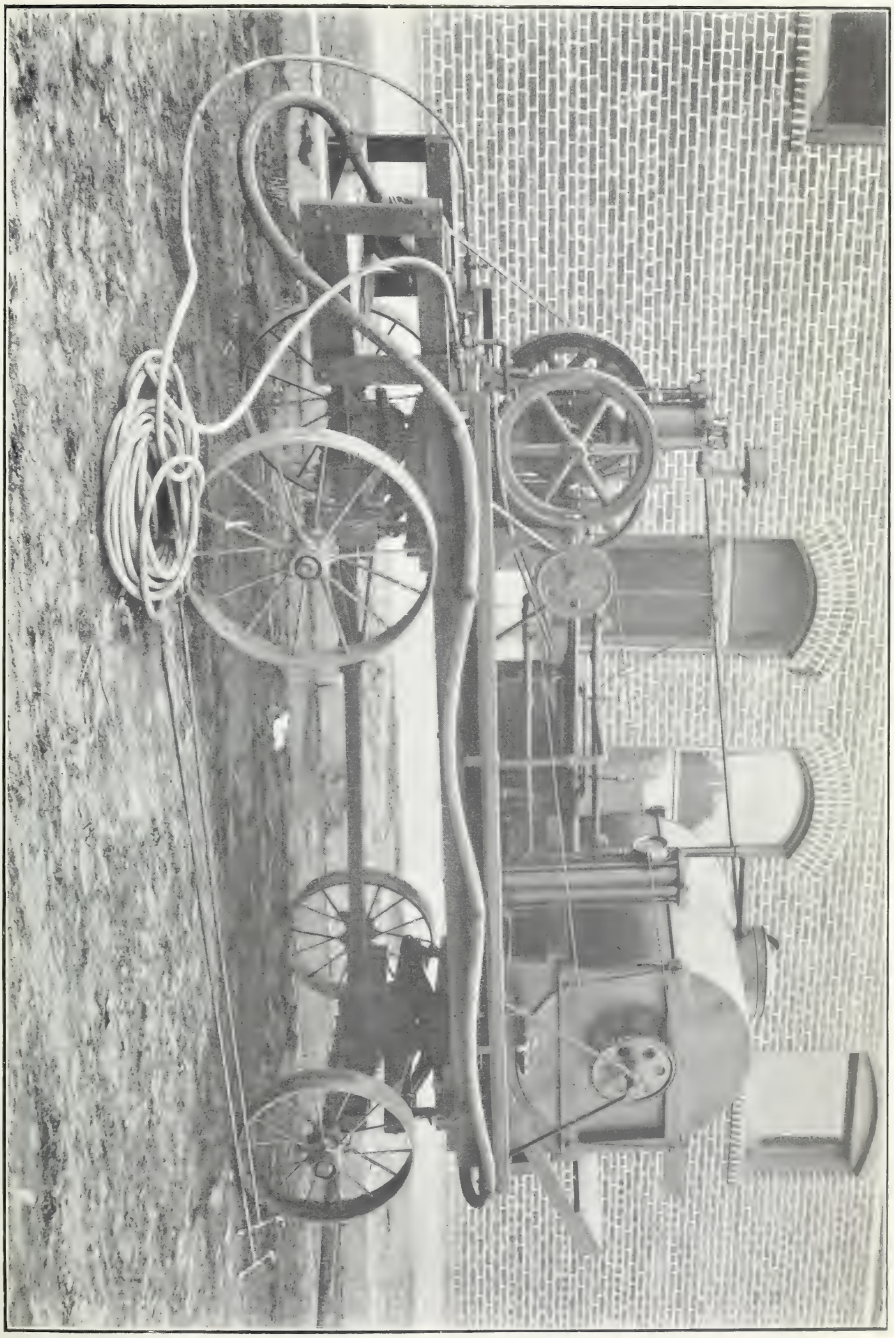
It is worth mentioning that a few females of *atratus* were taken with the above, so it is probable that if this species had been as numerous as the others just as striking results could have been obtained with regard to it.

THE NEW DISTILLATE SPRAY IN CALIFORNIA.

By C. L. Marlatt.

On account of the small margin of profit in the growth of citrus fruits fumigation is now often considered too expensive, and a good deal of spraying is done in California with oil washes. The use of distillate emulsion, prepared substantially after the formula of kerosene emulsion, described in detail in other publications of this Office, has been very generally discontinued, and in its place a mechanical mixture of the distillate and water is employed. The California oil lends itself to emulsifying with water far more readily than do the lighter oils of the East. The process consists in putting the oil and water together in the spray tank, which has a capacity of about 200 gallons. The oil being added to the proportionate amount to give the strength desired, is kept thoroughly emulsified with the water by means of a rotating agitator in the tank operated by the gasoline engine. A very homogeneous and fairly stable milky fluid is secured, which does not separate for hours, and enables the mixture to be sprayed with perfect confidence as to uniformity of strength. Two or four lines of hose are commonly employed, and a pump provided with an air chamber to equalize the pressure.

There has been considerable complaint of spotting of fruit from the use of this mixture. It is now determined, however, that a 2 per cent strength does not hurt the foliage or fruit, but, unfortunately, is not always thoroughly effective against the scale. The lemon tree will stand a stronger mixture than the orange. Mr. F. Kahles, the manager of the Crocker-Sperry ranch, near Santa Barbara, employs a 2½ per cent strength for the orange and a 3 per cent strength for the lemon. Mr. S. A. Pease, the horticultural commissioner of San Bernardino County, uses 2 per cent strength on the lemon and 3 per cent strength on the orange, without injury to leaf or fruit. Mr. Pease has also used a 5 per cent mixture against the black scale on apricot after



DISTILLATE POWER SPRAYING APPARATUS USED IN SAN BERNARDINO COUNTY, CAL.

[From photograph furnished by S. A. Pease.]

the leaves are off of the trees, and the same strength in winter on apple and cherry to kill the eggs of Bryobia.

The writer witnessed the operation of two excellent power-spraying machines of the character above indicated, built under the direction of Mr. S. A. Pease, for use in San Bernardino County. The work in hand was the spraying of some orange orchards of large trees for the yellow scale (*Aspidiotus citrinus* Coq.), and the apparatus worked remarkably well, and the results seem to be most satisfactory. In all, nearly 300 acres of orchards have been successfully treated by Mr. Pease. The following description of this apparatus (see Pl. I), of which the county of San Bernardino keeps three in operation, is supplied by Mr. Pease:

The San Bernardino County power spray machine, built by Osler & Miner, Pomona, Cal., is designed to use either distillate spray or other mixture, and is equipped with a 2-horsepower Root & Van Dervoort engine, and a double-acting pump with 2-inch cylinders on each end, 10 inches long. The piston of the pump is driven backward and forward by use of bent shaft, with which a large cut gear is placed on the end, run by a pinion on engine shaft.

The suction of the pump is taken from the bottom of the agitator tank and discharged into the air tank, which will withstand 300 pounds pressure. The power of the engine is sufficient to run up pressure of 300 pounds or more, and to run four lines of spray hose with two nozzles on each line, which will consume about 250 gallons of spray mixture in thirty minutes. The agitator tank is horizontal, holding 255 gallons, and has a shaft directly through center in which three sets of paddles are bolted, each being 4 inches in width. The paddles are placed on shaft at different places, and point in different directions. As the paddles revolve they throw the mixture in one direction. There are three lines of breakers placed on the inside of the tank lengthwise, which throw the fluid back, making a double mixture. These paddles are operated by means of two sprocket wheels, one placed on end of the bent shaft at engine, and the other on the paddle shafting at the end of the tank, connected by chain.

There is a small horizontal centrifugal pump run by belt from the engine, which is used together with 25 feet of suction hose to pump water out of ditch or standpipe. By this means the agitator tank is filled in four or five minutes. The above apparatus is mounted on a platform over a set of iron trucks with 5-inch tires. A pair of bolster springs are used which will carry a weight of 8,500 pounds.

The methods of supervision of treatment of orchards in California are always instructive. In Los Angeles County there is direct supervision of the work by the horticultural commissioners. The fumigation or spraying is done by contractors, but with the provision that the work must be approved by the proper county official before payment can be collected. At Riverside the work of this sort is done by the county directly, and a charge is made for actual cost, plus 10 per cent. A similar method is followed in San Bernardino County.

THREE BRITISH FRUIT-TREE PESTS LIABLE TO BE INTRODUCED WITH IMPORTED NURSERY STOCK.

By Frederick V. Theobald, *Wyecourt, England.*

The subject of the importation of injurious insects from one country to another is a most important one. That many European pests have been imported into America and into the British colonies is well known. These unwelcome visitors, finding their new surroundings abnormally congenial and their natural enemies absent, often cause far more harm than they do at home. It is unnecessary to mention examples so well known to all interested in economic entomology. The study of the insect pests of other countries than our own is thus rendered very necessary, so that we may be prepared to fight and prevent the new arrivals. This distribution of noxious creatures is most important in regard to fruit and ornamental plants. The notes on three British fruit pests which may easily be introduced into America may therefore not be unwelcome to the members of this Association. The three pests that appear to me to be especially guarded against and which I believe do not occur in the orchards and gardens of America are the following: The pith moth (*Laverna atra*); the apple sucker (*Pyslla mali*); the currant-bud mite (*Eriophyes ribis*).

All these pests occur permanently on trees or bushes in one or more of their stages, the winter in all cases being passed upon the plant, the pith moth in the larval stage, the psylla in the egg condition, and the currant bud mite in all stages. They can therefore be easily transported on nursery stock.

It may be said that the fumigation of the young plants or cuttings with hydrocyanic-acid gas will prevent their introduction, but from experiments I have made I am confident that the ova of the psylla and the bud mites are not in the least harmed by the treatment, and I doubt if the effect of this gas would kill the larvæ of the pith moth in question.

The apple sucker and the big-bud mite of the black currant are both such serious pests that great caution should be exercised in importing stock from England and Europe. For the latter pest we have absolutely no remedy, and the former is most difficult to fight.

THE PITH MOTH.

(*Laverna atra* Haw.)

Syn.: *L. putripennella* Zell.

This small Tineid moth has long been known in Europe by entomologists, but it was not recognized as a pest in Great Britain previous to a short note made by Miss Ormerod in 1890; a few subsequent notes were added by her, but nothing of any special value or originality.

Previous valuable observations had been made, however, by Muhlig, of Frankfort on the Main (*vide* Kaltenbach's Die Pflanzenfeinde aus der Klasse der Insekten, p. 781). During the past three years this insect has been very destructive in parts of England, notably in Sussex and Kent; observations have also been made in Gloucestershire and Middlesex, and I have seen it working among the fruit trees in Cambridgeshire in 1889 and in Huntingdonshire on more than one occasion. Since the attention of the fruit growers has been called to this pest it has been noticed quite frequently. The damage done by the larva is very great, and as there is no known remedy, it is very important to try and prevent its importation and to destroy it by drastic measures when it makes its appearance in an orchard. Miss Ormerod states[a] that "the attack appears to be very seldom noticed with us in connection with apple injury." This is not the case; it has been frequently noticed by growers, but the observations have not been recorded by them.

This pest can easily be detected by its workings and the symptoms it produces; the red larvæ, by tunneling into the buds and shoots (of all classes), cause the former to die off soon after opening and the shoots to at first flag, then wither up and eventually turn brown and die. In the first series of observations I made on this pest I found the terminal shoots only affected,[b] but, as pointed out to me by Mr. Bear, of Hailsham, all shoots and buds suffer indiscriminately, and this has been frequently observed during the past year. The dying off of the young shoots has frequently been attributed by growers to canker (*Nectria ditissima*), which I have seen to produce very similar symptoms. But by breaking open the bud or dead shoot, the true cause is soon seen by the presence of the small, red caterpillar or its brown pupa near the apex of the bud or shoot. So far I have found this insect only on dwarf trees, and reports sent me are all to the same effect. Twelve-year-old trees are the oldest I have at present detected these pests on. The fact that it is mainly on young stock has given rise to the idea in England that it has been imported. This is not so, for it not only occurs on the apple but is mentioned by Stainton[c] as being "not scarce in June on white thorn." Herr Muhlig also says that "the caterpillars live in the same way on the allied white thorn, which they more especially infest in this neighborhood (Aix la Chapelle)." Stainton seemed to doubt that the same species occurs on the whitethorn and the apple, for he says: "The dark variety appears exclusively attached to the apple; it is possible it may be a distinct species." I have found during the past year that those bred from the apple vary from the dark form mentioned by Stainton to the typical

[a] Handbook of Orchard and Bush-Fruit Insects, p. 278. 1898.
[b] First Report on Economic Zoology, p. 68, 1903.
[c] Lepidoptera Tineina, pp. 239 and 240.

shades seen in the whitethorn living specimens, and I am convinced that they are the same.

LIFE HISTORY.

The moth is slightly less than half an inch in wing expanse. The color is subject to much variation; the front wings are often almost entirely black, the posterior wings gray with gray fringes; other specimens have the front wings mottled with dark brown, brown, and rusty brown, and the inner margin of the fore wings is white to beyond the middle, where an irregular oblique white bar proceeds to the tip of the wing, and from this two branches may intersect the black apical portion; the head is almost entirely white. The white markings are particularly variable. This insect occurs in June, according to Stainton,[a] but all those I have bred out appeared between the 12th of July and the 10th of August. The moths are very active, running with great energy, and frequently fall on their dorsal surface. They rest during the day on the twigs and stems and are then scarcely noticeable, owing to their color being similar to the rind. The egg stage has not been observed on the apple trees, but they are apparently laid soon after the moths have hatched out. I have found small larvæ on the leaves in September which I am sure were those of this moth; they reached one-twentieth of an inch in length. The next stage occurs under the bark of a twig, beneath which the small larvæ have eaten their way; others bore into the base of the buds and there they remain all the winter. The hole of entry is so small it can only be detected by microscopic examination. During January and February the young larvæ were found tunneling into the pith of the shoots and also feeding at the base of the buds. In May their work in the pith is most pronounced, and later they work into the flower stalk and eventually the whole shoot, perhaps for 3 or 4 inches, dies away. I have found them in the stalk of fruitlets and many in the buds which never develop to maturity. The larvæ live until June; the majority pupate by the 20th, but some not until the last week of the month. The caterpillar is dull reddish brown with a deep-brown head and first segment; the other segments show more or less traces of pale-brown spots, four in a row on the second and third segments and four placed in a quadrangle on the remaining segments; the two anterior segments have two lateral spots and the others one each; the apex is brown and the sucker feet rather paler. When matured they reach one-third of an inch and pupate near the apex of the shoot or bud. The pupa is bright-ochraceous brown with the head, front of thorax, and tip of the body mahogany red. On the ventral surface of the penultimate segment are two blunt processes, separate and widely diverging with hairy apices; the eyes are black and the wing cases

[a] Manual of Butterflies and Moths, II, p. 399.

and leg cases long and pointed. The pupal stage I found varied between two and three weeks. Prior to the moth hatching the pupa frequently is forced half out of the dead bud or shoot.

According to Stainton, the larvæ also occur in hawthorn berries in September; the black variety only in apple shoots in February and March. Recent observations, however, show that all variations in color breed from the apple, and probably the larvæ in hawthorn berries are of another species, for on the haw or white thorn *Laverna atra* works just as it does in the apple.

Fortunately this insect attacks only small trees, and so can easily be destroyed by hand picking the dead buds and shoots before the moths escape. Where this has been done the pest has been kept under, and in some cases practically stamped out.

Probably autumnal spraying with arsenites would kill the young larvæ before or when they burrow into the rind of the shoots.

THE APPLE SUCKER.

(*Psylla mali* Schm.)

This apple pest causes great loss to fruit growers in this country, and has apparently increased very considerably during the past few years. It very much resembles your pear-tree psylla (*Psylla pyricola*), so ably dealt with by Slingerland.[a] This latter pest I have never detected doing any damage in England. The apple psylla which was recorded as a pest as long ago as 1837[b] has since been mentioned by the late Miss Ormerod in her reports, etc., in which the observations of fruit growers have been recorded, though but little fresh matter was added to Kollar's original paper. This pest having become more serious during recent years, I have devoted two seasons to its study, which have brought to light many new facts in its economy. As it appears to me to be a very likely insect to be imported into America on nursery stock from Europe, I include this species with a hope that the notes may help my fellow-workers should it unfortunately make its way into America.

The effect of this pest on the apple trees is very varied. The larvæ and pupa suck the juices of the buds and frequently check their growth entirely, the buds turning brown and dying; at other times they do not kill the buds, but damage them so far that the leaves, when they open, are crinkled and curled. Later they attack the open leaves and frequently the stalks of the leaves, which then die. The larvæ attack both leaf and blossom buds, but the latter are especially chosen, and a tree attacked by this pest seldom produces any fruit. The leafage that comes after an attack may be irreparably

[a] The Pear-tree Psylla. Bul. 44, Cornell University Experiment Station, 1892.

[b] Insects Injurious to Gardeners, Farmers, etc., p. 270. (Trans. J. and M. Loudon.)

damaged, but I have during the past year seen it completely recover. This no doubt was due to the abnormally wet summer we have had.

The winter is passed in the egg stage, chiefly on the young shoots, and thus it may be transported from one country to another very easily.

LIFE HISTORY.

The adult insects are about one-eighth of an inch in length and at first are pale apple green in color, but as the autumn advances they become varied in color, some reddish, some still green, others mottled with yellow, and others pale green with red or brown markings; the wings are veined in the typical way and are transparent, and sometimes they are iridescent, the veins being pale yellow or green. The adults occur from July until even November and live on the leafage of the apple, where they frequently occur in little colonies, but they soon disperse if the tree is jarred, and move with that characteristic jump and flight common to this group. I have never noticed the adults doing any damage to the leaves, but Miss Ormerod states that "they may be found in parties of five or six on a leaf, especially on a yellowing leaf," which looks as if they may do some harm to the foliage. Egg laying commences soon after pairing and may go on until as late as the end of November, but such is unusual. The females mainly deposit their eggs among the fine hairs of the young shoots, but they may be observed in cracks and crevices of bark. Generally several are laid together and then usually in rows, end to end. The eggs are roughly spindle shaped and white in color, and apparently have one end slightly prolonged, but not as in the pear psylla. As many as 20 or 30 may frequently be counted on a shoot. They remain in this condition all the winter, and I have found many are killed by an application of caustic alkali wash, and this probably furnishes a reason why the pest has not been so harmful where the orchards were usually sprayed with this wash,[a] and occurred in numbers again when this useful orchard treatment was given up.

As soon as the apple buds commence to swell in the spring, the larvæ come from the eggs and soon work their way into the buds. If the buds develop rapidly the leaf and blossom come out and are only stunted; but if the nights are cold, and growth is retarded, they may be killed entirely. During the past year the larvæ were noticed in the opening buds early in May, and they were all in the pupal stage in the second week in June. The larvæ at first are dirty yellow, with brown and dark spots upon them, the tarsi brown and the eyes red; in general form they are flat. After the first moult the larva protrudes a small white opaque globule, which remains attached by a white or pale blue thread. Soon after the second moult the larva becomes pale

[a] Second Report Economic Zoology, p. 50—F. V. T.

green, and there are formed by it a number of tangled white threads. In about another week a third moult leads to the pupal stage. In this the wing-buds are very prominent, and the tips of the antennæ and the eyes become black. Like the larva, the pupa passes out the same oily globules and waxy white or blue threads. Those kept under observation on a tree hatched on the first of June, and they remained until the end of the month. The adults pass a monotonous life on the apple trees. I have also found great numbers of this pest in the winged stage by beating hawthorn hedges in the neighborhood of infested orchards. A well-known fruit grower in Kent tells me this pest also attacks the buds of his cobnuts and filberts. It will thus be seen that there are two ways in which this pest may reach America. Taschenberg inclines to the belief that there is a second brood, but I have been unable to trace one in Great Britain, and Schmidberger does not hint at it. The pest has certainly been distributed about England with infested nursery stock, and I see no reason why it should not find its way to the American Continent and the British colonies. The only preventive we find of any use is spraying with quassia and soft soap as soon as the buds commence to swell and the larvæ are seen to be coming from the eggs. This must be done repeatedly, as the brood lasts some time in hatching out. Late autumnal washing with the usual paraffin emulsion I have found kills the adults and so prevents egg laying. We usually use 6 to 8 pounds of soft soap, 8 pounds of boiled quassia chips to the 100 gallons of soft water.

Carbolic, at the rate of 2 to 3 gallons to 100 gallons of soft water, in which is dissolved 6 pounds of soft soap, has also been found beneficial, and winter washing with caustic alkali wash has given relief.

THE CURRANT BUD MITE.

(*Eriophyes ribis* Nalepa.)

In many districts of Great Britain black currant growing is being stamped out by the enormous increase of the black currant mite (*Eriophyes ribis*), formerly known as *Phytoptus ribis* of Nalepa. This mite produces the disease known as big bud in black currants. It has practically invaded the whole of Kent, and scarcely a plantation is to be found free from this acarus, acres and acres being grubbed up in consequence. There are, nevertheless, regions free from *Eriophyes ribis*, notably the north of Ireland, in Armagh and County Down. In England Northumberland is free; Derbyshire, and a few other counties comparatively so. On the Continent Holland is particularly invaded. The disease has been mainly spread by means of infested cuttings and young bushes. At one time it was thought in this country that the swollen buds were natural, and that they showed strength, and in this way big budded plants were sent out in preference to those with normal

healthy ones. It is no new pest in Great Britain, for in the neighborhood of Maidstone, Kent, it was noticed more than sixty years ago. It did a good deal of damage in Scotland in 1849 and 1850. The first record I know is that which appeared in the Gardener's Chronicle in 1869. Bushes that are attacked can easily be told by the large swollen buds; some of these will be seen dead and brown on an invaded bush; others green yet unopened; others may burst and give out leaves. Fruit buds mainly seem to be attacked, and a bush so infested seldom bears any currants. Mr. E. J. Lewis, the chief authority on this pest in Europe, has, however, observed that now and then diseased buds may burst and bear fruit, but such is very unusual. A bush may have a few or all the buds swollen according to the degree of attack. Infestation seems to begin at any spot; sometimes it shows first at the terminal buds; at others half way up, but most occur at the base of the shoots. The difference between normal and diseased buds is very marked when they are compared; normal buds are conical, whilst infested ones are more or less globular and have a somewhat mealy appearance, and on being opened they are of an unhealthy and pale color, and the mites may be easily seen within with a lens. Hundreds of mites occur in each infested bud, and among them their gray eggs and the young acari.

LIFE-HISTORY OF THE MITE.

The *Eriophyes ribis* when mature reach 0.23 mm. in length; they are narrow and elongated and somewhat cylindrical, usually curved, and vary in color from dull shiny white to pale creamy yellow. Now and again specimens may be seen with a green dorsal line, due to the chlorophyl they have eaten showing through the integuments. The skin is marked with transverse rings, 60 to 70 in number, each having a band of round processes. On the body are five pairs of bristles disposed as follows: The first on the ventral surface midway between the legs and the second pair of bristles; the second much longer and placed just before the middle of the body; the third pair very short and placed more ventrally; toward the apex another rather longer pair, also ventral; the fifth pair are lateral on the apical segment and are the longest. The legs, as in all the Phytoptidæ are four in number placed on the anterior moiety of the body. The basal joint is small, the second has a small bristle, the third has a long one on the upper side, another is present on the upper side of the fourth, and two on the terminal segment, the longer on the outer side near the base; this last joint ends in a lateral curved, long, blunt claw and a terminal bristle with five lateral processes on each side of it.

The mites live and breed in the buds all the year. The male is smaller than the female. The eggs are large, shiny or glassy bodies, varying in color from white to pallid green. The latter color is given

by Mr. Lewis, but I have never seen them this color myself. There is no time during the year in which the reproductive powers are checked as long as the weather is more or less congenial. Mr. Lewis found the eggs fewest in December and January, but during the present year they have been teeming in the buds during the first two weeks of this month (December). No doubt frosty weather checks the reproductive powers. Certainly the increase is most rapid from April to October. When the buds burst in April, the Phytoptids may be seen crawling outside, and as pointed out to me by Mr. Lewis, they attach themselves by the anal sucker and wave their bodies and legs in the air. Mr. Cecil Warburton states that they jump into the air. This is extremely probable, but that they do so to chance falling on to a passing insect so as to be distributed is very problematic.

The life cycle can and does go on from year to year on the bush; when a bud is killed or when it bursts the mites crawl out and make their way to others. This is not all, however, for if we cut down a bush that has been badly attacked we still find next year's shoots showing traces of big-bud and the swollen buds occur low down the shoots. This, I am sure, points to infection coming from the soil. Whether eggs or mites or both retain their vitality in the earth I do not know, but that they contaminate the soil I am fully convinced. Hence we find hand picking and hard pruning only partly successful.

Certain varieties are more susceptible than others, but none except a light-cropping cottage black currant grown in Kent seem to be immune. The Baldwin is the worst sufferer; then come Black Naples and Black Dutch. Lee's Prolific is also attacked, but clean stock of this kind can be procured. Carter's Champion is thought to show some degree of immunity. I do not think any black currant will long resist this pest, which spreads rapidly, being distributed by men walking in the plantations, the mite becoming attached to their clothes, or in mud on their boots. Many no doubt are carried by the wind and numbers by other insects, especially bees of the genus Andrena and Bombus that visit the currants when in blossom.

PREVENTION AND REMEDIES.

With regard to this serious pest, we have tried many things. At first fumigation, with hydrocyanic-acid gas, was considered useful, but later it was found to only be partially successful, and that as the mite increased so rapidly it was of little use. Moreover the gas does not affect any mites in the ground, and if there is any moisture on the buds it affects the mite scarcely at all. In fact, even for cuttings and young stock, it is of little value. I believe hydrocyanic-acid gas is valueless for all acari. A new method of fumigation is being tried by Mr. Wilcocks of the S. E. Agricultural College, which so far seems successful. Should it prove so I shall at once forward the results.

All we can do at present is to grub up all infested plantations and start on fresh land with guaranteed clean stock.

Various sprays, and in fact all known methods of treatment have been found ineffectual.

These, I consider, three very important European fruit-tree pests to be kept in mind, not only because they can easily be imported, but because all three are very difficult to fight, and the last mentioned has so far baffled all attempts to destroy it.

THE CHERRY FRUIT FLY.

(*Rhagoletis cingulata* Loew.)

By F. H. Chittenden.

During June, 1901 and 1902, Dr. A. M. Farrington, of the Bureau of Animal Industry, furnished a lot of cherries infested by a maggot

Fig. 17.—*Rhagoletis cingulata: a*, fly; *b*, maggot from side; *c*, anterior spiracles of same; *d*, puparium; *e*, posterior spiracular plates of pupa; all enlarged (original).

which was subsequently reared by the writer, and proved to be *Rhagoletis cingulata* Lœw. Injury had first been noticed in 1899 and had been continuous since that time. About two-thirds of the cherries on his place in the District of Columbia were destroyed in 1902. Injury was seldom detected until the third week of June, when the cherries were ripe. In our rearing jars the flies issued through the month of April of the following years, but from the fact that the larvæ attain full growth by the beginning of the last week of June, there can be little doubt that the flies issue normally during the latter part of May or early June. Attack was noticed only to Montmorency cherry, a nearly black variety, with a sour and rather unusually strong Prussic-acid flavor. There can not well be more than a single generation of this species on cherry, the larvæ leaving the fruit during the last week of June and first of July, and remaining in the earth until the following spring or early summer. During the season of 1903,

Dr. Farrington reported a complete disappearance of this species from his vicinity, and Prof. M. V. Slingerland, who has studied the species in New York, noted a similar lack of injury in the neighborhood of Ithaca, N. Y.

PROBABLE EXPLANATION OF THE INSECT'S DISAPPEARANCE.

To explain this disappearance the following reasons present themselves. Assuming the natural time for the appearance of the flies in the District of Columbia to be toward the end of May or first of June, the weather that was encountered during 1903 at this time was unusually cool and will doubtless explain the practical extirpation of the species temporarily and locally. In other localities similar adverse atmospheric conditions prevailed which might have produced the same effect. A cold wave was experienced in the latitude of Washington in the last week of April, causing some loss to early vegetable growth. During the third week frosts were prevalent, which also had a damaging effect on susceptible crops. Frosts also occurred during the last week of April. In short, the spring was late for this section. The first three weeks of May showed drought in many sections, and frequent temperatures from 85° to 90°, and nearly 100 during the third week, the end of the month turning cloudy and cool, after which showers were of almost daily occurrence, accompanied by thunder, hail and high winds, these conditions continuing practically throughout the entire month of June.[a] That undue dryness usually causes retardation in development is an established fact, hence there is little doubt that the dry weather had the effect of preventing the metamorphosis of this species, until frost and dampness ensued at exactly the time when the fly should have issued from its puparium, with the result of its destruction in great numbers.

EARLIER RECORDS OF INJURY.

July 17, 1899, we received the same species from the Hittinger Fruit Company, Belmont, Mass., then in the larval condition, with statement that cherries there were very generally affected.

During the same year, as also in 1900 and 1901, this species attracted considerable attention at Ithaca and Geneva, and elsewhere in New York, as recorded by Professor Slingerland in Bulletin 172 of the Cornell University Agricultural Experiment Station. This simultaneous outbreak of a species hitherto unrecognized as noxious in New York, Massachusetts, and the District of Columbia is quite remarkable. A reported case of injury in northern Michigan in 1889, just ten years earlier, is attributed to this species, and probably correctly

[a] See Weekly Crop Bulletin, Maryland and Delaware Section, Climate and Crop Service of the Weather Bureau, of this Department.

(A. J. Cook, 2d Ann. Rept. Mich. Expt. Sta., p. 153), while other reports have been made of destructive occurrences from three to five years earlier at Bonaparte, Iowa; Westboro, Mass.; Batavia, Portland, Cattaraugus, Clifton Springs, Syracuse, and Cayuga, N. Y., and State College, Pa. In two of these localities injury of a similar nature had been noticed as early as about 1865.

It is highly probable that the same species has been destructive for generations in many other localities than those mentioned, but the cause of the trouble has without doubt been undetected, because attributed to that more common and nearly universal cherry pest, the plum curculio.

As this cherry fruit fly has not received notice in any publication of this office, an illustration of the different stages is presented, as also one of the plum curculio (*Conotrachelus nenuphar*—fig. 18) that the two species may not be confused.

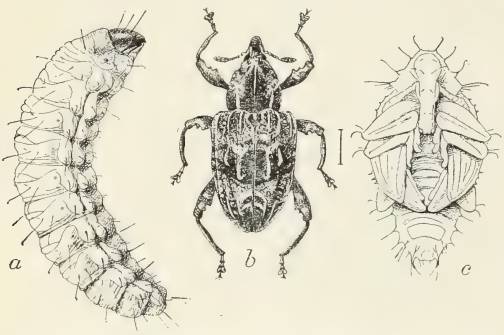


FIG. 18.—*Conotrachelus nenuphar: a*, larva; *b*, beetle; *c*, pupa—all much enlarged (original).

DESCRIPTIVE.

The adult.—The cherry fruit fly is closely related to the apple maggot (*Rhagoletis pomonella*), and might readily be mistaken for that species in all of its known stages. It is, however, a little smaller, and in the adult or fly stage much paler in color, but the wings are similarly banded. The body is piceous, the head and legs pale yellowish brown, the eyes dark greenish, the thorax striped, with the sides marked with a broad longitudinal yellow band, and the abdomen is strongly segmented, due to transverse pale brownish stripes. The wings are somewhat faintly banded with dusky color arranged about as shown in fig. 17, *a*. The body, including the head, is about one-sixth inch in length, and the wing expanse is three-eighths inch.

The egg, as described by Lowe, measures 0.02 inch, is somewhat broader toward one end, and about one-fourth as wide as long at the widest point. "Beginning at the broad end and extending about one-fourth the length of the egg the shell is roughened and somewhat darker; color a dirty yellow."

The maggot or "worm" is so nearly an exact counterpart of the apple maggot that a technical description is omitted. The color is yellowish white, and the form is shown, lateral view at fig. 17, *b*. Near the head there projects on each side a small pale brown somewhat fan-shaped organ, the anterior spiracles (fig. 17, *c*) of which have

many minute branches. The mouth parts, as in most maggots of this character, consist of two minute, sharp, black rasping organs, which answer the purpose of mandibles and which project slightly from the head. The length when mature is one-fourth of an inch.

The puparium or quiescent stage is represented by fig. 17, *d*. It is dark brown in color and of moderately strong consistency.

The distribution has been practically given in the list of localities in which injuries have been noted. It might be defined as extending from Massachusetts and New York southward at least to the District of Columbia, and westward to northern Michigan.

LIFE HISTORY.

The life economy of this species is fairly well understood, owing chiefly to the observations of Mr. Slingerland, but some details remain to be observed.

The egg is deposited just underneath the skin by means of the ovipositor, may be placed in any portion of the cherry, and the egg scars, although not in crescent shape like those of the plum curculio, are easily discovered. Throughout the northern range of this insect, where it is most injurious, oviposition continues over a considerable period, from June until into August, or probably as long as cherries are to be found. Unhatched eggs have been discovered as late as August 16. The exact period of the egg stage has not been observed, but it will probably extend from three or four days to a week or ten days, according to temperature. Soon after hatching the larva penetrates to the vicinity of the pit, feeding on the flesh and forming a rotting cavity similar to that made by the larva of the plum curculio. As a rule the maggots attain maturity simultaneously with the ripening of the cherries, and they thus find their way to the consumer. It has been observed that few affected cherries fall from the trees, in which respect this species differs from the apple maggot. The maggots, therefore, usually drop to the ground, where in a few days they form the puparium stage.

The species is without doubt single brooded, even as far south as the District of Columbia, and probably as far as its southern range extends, and the pupal period therefore consumes about eleven months of the year, this stage being passed in a cell within about an inch of the surface of the ground. As it frequently happens that infested cherries show little exterior effects of damage they are shipped from one locality to another, and the insect can thus readily obtain a footing in new localities; but being a native species, this is a matter that probably has little importance.

As to the varieties of plants affected, thus far there is little doubt that the insect affects chiefly sour or subacid varieties, particularly the Morello and Montmorency varieties, but the Downer and black

cherries are also subject to attack; in fact, no varieties are positively immune. It is probable that the species lives normally on some sour species of native cherry, and if such should prove to be the case these trees should be destroyed or the fruit carefully picked if it have any commercial value.

METHODS OF CONTROL.

The brief account furnished of the life history of this species is indicative of the difficulty of destroying it or preventing its ravages. We can not destroy it with insecticides or capture it by jarring, as in the case of the plum curculio, nor by gathering the "windfalls," as for the related apple maggot. The egg being inserted under the skin and the larva feeding still deeper in the fruit, can not be reached, nor can the fly, which does not feed to any appreciable extent, if at all, on the fruit. This leaves the pupa stage as the only vulnerable one for attack, and the skin of the puparium is so compact that it is probably impervious to any ordinary liquid which would not injuriously affect the tree or the soil.

The most feasible remedy that suggests itself is careful cultivation of the orchard, but this has been practiced by some of the most successful orchardists of New York, and injury was evidently not lessened thereby. An explanation urged by Mr. Slingerland is that the puparia are too small to be crushed, and it is therefore suggested that remedies advised for certain species which have similar habits and infest currants, be employed, remedies which have been advised for years in this Department. These consist in late fall or early spring plowing, so deeply that the puparia will be buried far enough beneath the surface as to render it impossible for the flies to emerge. Where a few valuable trees only are affected the surface soil could be removed to a depth of about an inch or a little more, and either thrown loosely into a hen yard or upon a much traveled highway, or buried deeply, all of which methods would insure the death of the puparia.

Hens have been observed to destroy the puparia, and if the soil under the infested trees were lightly raked and temporary wire nettings were placed around the trees, hens could be confined in this inclosure and would soon destroy the pest.

Clean culture must, of course, be observed, which would include the picking of all of the cherries from the trees, and the destruction of such few windfalls as might be found.

In conclusion, it should be stated that various other remedies than those mentioned have been tried without success in other countries against insects of similar habits. These include attracting to lights, the use of deterrent substances to prevent the flies from ovipositing, spraying with a great variety of insecticides and other substances. Of these one is deserving of mention, a mixture of sulphur and caustic soda in solution, which gave partial success.

One orchardist reported that some success was attained by the use of sticky fly paper, the flies being attracted to anything shining, such as a straw hat.

A perfectly effectual method of preventing attack by a fruit fly in south Africa, but one which would scarcely be used save in the case of the most valuable trees, consisted in inclosing the entire tree above the trunk in a fine-mesh mosquito netting during the time when flies are abundant.

It is quite possible that Morello and Montmorency cherries might be grown in districts where these flies are abundant, as traps to lure the insects from other varieties of trees. This method is certainly worthy of trial. On these trees the fly paper could be used, and considerable expense could thereby be saved.

Finally, would-be growers of cherry, in the regions which have been noted as the seat of the principal outbreaks of this fruit fly, are cautioned against the planting of Morello, Montmorency, and similar sour varieties as a main crop, owing to the greater liability of injury by the pest.

ON THE ORIGIN OF THE NATURAL COLORATION OF SILKS OF LEPIDOPTERA.

By G. Leverat and A. Conte.

(Comptes Rendus, de l'Académie des Sciences, read October 27, 1902.)

With most lepidopterous larvæ the product of the silk glands is not colored. When it is colored it is yellow or green. We ask ourselves, what is the origin of these green and yellow pigments? Are they made by the animal or simply drawn from the leaf upon which it feeds? The first of these hypotheses has been generally held since the work of Alessandrini Joly, R. Dubois, and L. Blanc have shown that it was impossible for a coloring matter contained in the intestine to reach the silk. The contrary results obtained by Bonafous, E. Blanchard, Roulin, and Villon have been denied in an absolute manner and stated to be the consequence of a soiling of the silk thread on its exit from the spinneret. If the coloring matters employed so far do not easily pass through the walls of the silk reservoir, is it the same for all of the coloring principles and for all silkworms? It is to respond to this question that we have undertaken our new experiments. Our trials were carried on with a wild silkworm, *Attacus orizaba*, and the domesticated silkworm (*Bombyx mori*), the French race with yellow silk, and a polyvoltine race from China with white silk. The coloring matters used were neutral red (toluylene red), methylin blue, B. X., and picric acid.

(1) *Attacus orizaba.*—Thirty larvæ born July 16, 1902, were divided into several lots and raised upon oak branches, of which the leaves had been washed with an aqueous solution of coloring matter.

In one lot nine caterpillars were fed from their birth upon leaves impregnated with the neutral red. They ate these leaves without showing any repugnance and developed normally. The general reddish tint of the body indicated the presence of the coloring matter in the blood.

For the purpose of avoiding all possibility of soiling the silk the larvæ at the beginning of cocoon spinning were carefully washed with a stream of water and carried to freshly collected branches. The silk coming from the spinneret is tinted with rose, and the whole cocoon presents a beautiful red coloration.

Two caterpillars of this lot were isolated at the fourth molt and nourished during the last age with leaves deprived of the red coloring. These caterpillars faded and the silk which they spun was scarcely tinted with rose.

Four other caterpillars having eaten natural leaves up to the fourth molt, then received a colored nourishment during the fifth age only, and furnished cocoons as red as those of the first lot which had absorbed the red during the whole larval life.

Caterpillars raised upon methylin blue seemed to eat the leaves with less avidity, their development slower, and they secreted a less abundant silk, which was slightly bluish.

Finally, the last lot of *Attacus orizaba*, fed upon leaves washed with a solution of picric acid, gave cocoons with white silk.

Thus we see that the neutral red passes easily by osmosis through the tissues, while the methylin blue passes through only with difficulty, and the picric acid is completely arrested. In order to reply in the most perfect way to the criticism based upon the hypothesis of the superficial coloration of the silk thread from the possible soiling of the silk, we have taken two caterpillars and injected the neutral red in the next to the last left proleg. These caterpillars were instantly colored with red without appearing in the least incommoded, and spun a slightly rosy silk.

(2) *Bombyx mori.*—The same experiments were made upon the two races of *Bombyx mori*, the one with yellow silk and the other with white silk. In the two cases the caterpillars became colored with violaceous red immediately after the first meal, and gave a bright orange yellow silk in the first case, and a beautiful pure rose for the white race. The color became accentuated according to the duration of the feeding of color food.

This fact demonstrates that the passage of the coloring matter into the silk gland is less easily made than with *Attacus orizaba*. Will the result be the same after several generations submitted to this artificial régime? That is what we intend to find out. From these researches the possibility of making a substance coloring matter, for example, pass from the digestive tube to the silk by means of the blood, is estab-

lished. This conclusion permits us to search for the origin of the natural color of silk in the green coloring matter of the leaves.

The silk is white because no coloring matter has been able to pass through the walls of the silk gland. In the green silks it is the chlorophyl of the leaves which passes through. We have, in fact, proven that with a species which has green silk (*Antheræa yama-mai*) the blood has the chlorophyl spectrum. The yellow pigment contained in the blood of the yellow species is identical, as has already been shown by R. Dubois and L. Blanc, with that of the mulberry leaves, and comes directly from these leaves.

It is not to be supposed that the coloring matter of silks can be made with the animal itself, as the negative results of attempts with artificial coloration have shown.

SOME PRELIMINARY NOTES ON THE CLOVER-SEED CHALCIS-FLY.

By E. S. G. Titus.

During the latter part of the past summer a study of the life history of the clover-seed chalcis-fly was taken up, and in answer to letters sent to several correspondents of this office there were received packages of ripe and ripening cloverheads from various localities in the United States. Clover heads were also received from various other sources. The majority of these were found to be infested with the clover-seed chalcis-fly (*Bruchophagus funebris* How.), by the clover-flower midge (*Cecidomyia leguminicola* Lint.), and in several instances both insects. The chalcis-fly was reared from clover heads from the following localities, the name in parentheses indicating the collector of the clover heads: Hanford, Cal. (F. Benton); Fort Collins, Colo. (L. A. Titus); Marengo, Ill. (E. M. Wright); Urbana, Ill. (F. M. Webster); Winona Lake, Ind. (F. Benton); Richmond, Kans. (E. C. Gentry); Agricultural College, Michigan (R. H. Pettit); Agricultural College, Mississippi (Glenn W. Herrick); St. Anthony Park, Minn. F. L. Washburn); Quaker Street, N. Y. (C. H. Moore); Corvallis, Oreg. (A. B. Cordley); Providence, R. I. (F. C. Pratt); Burlington, Vt. (G. H. Perkins); Pullman, Wash. (C. V. Piper); Danville, Va., Virginia Beach, Va., and District of Columbia.

From some alfalfa seed from Mr. L. L. Marsh, Enosburg Falls, Vt., received through the Bureau of Plant Industry, three specimens of this chalcis-fly were reared.

In order to obtain with any certainty the full life history of these species it was necessary to rear them isolated from each other. A small area of clover, growing wild in the Rock Creek bottoms, was selected and several clover plants were covered with breeding cages. All budded and advanced flowerheads were removed. Owing to the late date at which the experiment was started only a few more heads

formed. After blooming was well advanced fertilization was effected by the introduction of various insects, no attempt being made to determine which particular species accomplished the desired work. Adults of the chalcis-fly (*Bruchophagus funebris*), were later introduced, after the corollas of the flowers were well formed. These insects had been selected from lots reared from clover seed taken in Washington, D. C. Damage by rain ruined many heads and others failed to mature, but in the end several heads became sufficiently matured to be picked, and from these there were secured late in the fall a few adult individuals of the chalcis-fly. Very few of the seeds in the heads developed.

The egg was usually laid in the young forming clover seed. It is apparently inserted *into* the seed beneath the cuticle. The egg is pale white, polished, slightly elongate, and rather slender in form, no trace of sculpturing being seen.

The larva seems to feed on the softer semiliquid portions of the seed and does not attack the essential organs until nearly mature. As it grows it fills about two-thirds of the interior of the seed, curving itself into the wider portion. When nearly mature the larva finishes the seed contents, practically filling the cavity and then pupates. The full-grown larva is pale white from 1.5 to 2^{mm} long. When mature, rather stout, the ridges on the segments quite prominent.

The pupa, at first pale white, changes in color to a deep brown as it matures, and the adult insect, when it emerges from the seed, is shining jet-black with white markings, which latter soon change to deep yellow.

The adult emerges from an irregular hole cut in the seed, usually in what is the upper portion as it stands in the head. I have, however, found the hole cut in various other places. Further rearings will be necessary before any statement regarding length of life in various stages can be made.

Several instances were noticed when for some reason the seed failed to develop (perhaps because utterly destroyed by the young larva), and the larva had made its way through the soft tissues and entered another seed, there finishing its growth. In one instance three seeds were found partly devoured, apparently by the same larva.

A number of parasites were reared from the clover heads received from the various localities, but at present I am unable to definitely state which enemy of the clover head was parasitized by them. One specimen of *Bracon mellitor* Say was reared from a head taken at Washington, D. C. This parasitic insect has hitherto been recorded only from Coleoptera. It could not be determined from what it bred in this instance, but a single coleopterous larva might easily have been present.

The chalcis-fly conducts its ravages in such an insidious manner that

the losses occasioned by it are scarcely recognized, the scarcity of seed at the time of hulling being usually put down as caused by the clover-flower midge.

Heads attacked by this latter insect fail to flower properly, and can be easily recognized in the field by the lack of flowers in all or a portion of the head. Where only a portion of a head is attacked it becomes dwarfed and contorted, the undisturbed florets going on and maturing their seed.

Heads attacked by the chalcis-fly do not apparently differ from sound heads, and seed becomes sufficiently mature before the adult insect emerges to allow it to hull out when thrashed. These light shells are of course instantly swept away in the cleaner, and the grower has no means of ascertaining the true cause of the shortage of the crop. In a large number of heads examined, selected at random from various lots, the percentage of injured seed varied from 40 to 85 per cent, the average being fully 50 per cent to a head. There are at least two generations of the chalcis-fly during the year, the second wintering both as larva and pupa in the seed.

This species was originally described in 1879 by Dr. L. O. Howard as *Eurytoma funebris*.[a] The types were males and females bred from clover in heads, and at that time were presumed to be parasitic on the clover-flower midge (*Cecidomyia leguminicola* Lint.). Dr. W. H. Ashmead, in 1894,[b] referred the species to a new genus which he named Bruchophagus, believing the species of this genus to be all parasitic on the seed weevils (Bruchidæ).

At present the genus contains, besides *B. funebris* How., the species here treated: *Bruchophagus borealis* Ashm., reported by W. H. Harrington from Canada as bred from *Bruchus* sp.; *B. mexicanus* Ashm., reported by "Prof. Tyler Townsend" from New Mexico as bred from *Bruchus scutellaris* Horn [= *chinensis* Linn.] and *B. herreræ* Ashm., originally sent from Mexico by Dr. A. L. Herrera, who stated that it bred from the cotton-boll weevil (*Anthonomus grandis* Boh). Thus far no Bruchus is known to naturally attack clover seed in this country, and it would seem that the clover-seed chalcis-fly, if ever a coleopterous parasite, has changed its diet. A more complete study of the other species of the genus and future rearings may prove that all are simply true seed-miners.

Nothing further was published on this chalcis-fly until 1895,[c] when Dr. A. D. Hopkins, at the eight annual meeting of the Association of Economic Entomologists, reported finding (June 13) numerous chalcis-flies on and in a paper bag in which were stored ripened heads of crimson clover. The flies proved to belong to this species, and Dr.

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[a] U. S. Dept. Agr. Rpt. 1879, p. 196.

[b] Trans. Amer. Entom. Soc., v. 21, 1894, p. 328.

[c] Bul. 6, n. s., Div. Entom., U. S. Dept., Agr., 1896, p. 73.

Hopkins stated that observations led him to believe that this fly was more destructive to growing red and crimson clover seed than the midge. He also noted that while the midge actually prevented the seed from forming, the chalcis-fly fed in the developing seed and allowed it to almost reach maturity before entirely devouring the seed content. The following year, at the next annual meeting of the same association,[a] Dr. Hopkins reported that his studies of the year left no doubt "of the chalcis-fly being a destructive enemy and that it wintered out of doors in the seed as a larva."

Lintner, in his report as State entomologist of New York, for 1896, credits the clover injuries reported by a correspondent of his office, "J. W. J., Muncie, Indiana," to the clover-seed worm *Grapholitha* (*Enarmonia*) *interstinctana* Clem. The description of the injury as reported by the correspondent, "seeds hulled out like beans eaten by bugs" would indicate the work of this chalcis-fly rather than that of the seed worm.

LIFE HISTORY OF THE SALT-MARSH CATERPILLAR (ESTIGMENE ACRÆA DRU.) AT VICTORIA, TEX.

By W. E. Hinds.

While stationed at Victoria, in 1902, there were brought to the headquarters of the boll-weevil investigations during the last part of July and first of August numerous reports of very serious damage to certain fields of cotton which, it was said, were being entirely stripped of leaves by a very "large black caterpillar." One of the remarkable "facts" reported in regard to this strange caterpillar was that "it could not be poisoned." Nothing seemed effectual in stopping the progress of the worms, and the foe was thought by some to be "worse than the boll-weevil." As soon as the larvæ had stripped one field, it was said, they would move in vast numbers to fresh fields where they would repeat their work of devastation.

So alarming were the reports and so urgent the appeals to the boll-weevil investigators, that on August 5 an examination was made in the infected territory. It was found that the damage was being done by the larvæ of *Estigmene* (*Leucarctia*) *acræa* Dru., the "salt-marsh caterpillar," so called because at the time it was first described the larvæ were overrunning the salt marshes in the vicinity of Boston, Mass. The larvæ had nearly completed their feeding when found and a large part of them had crawled out of sight into favorable places for pupation. The thin cocoons, made by interweaving the long hairs from the body with a light web of silk, were found at the surface of the ground under some sort of rubbish. As a rule about one-half of the cell was formed as a lining to a corresponding depression in the earth. A large

[a] Bul. 17, n. s., Div. Entom., U. S. Dept. Agr., 1897, p. 45.

number of caterpillars was taken to the laboratory, where they could be watched and the general facts of their life history determined. All the larvæ spun up within five days after being taken from the field. The average length of the pupal stage was about two weeks, varying only a few days in any case. As the moths were found to be depositing eggs it was thought best to follow the life history of the following generation.

The eggs with which these studies were started were brought from the field on August 21. They formed a compact group nearly an inch across, being placed closely side by side upon the under surface of the cotton leaf. The number of eggs deposited in a group varied, some having been found numbering between 900 and 1,000.

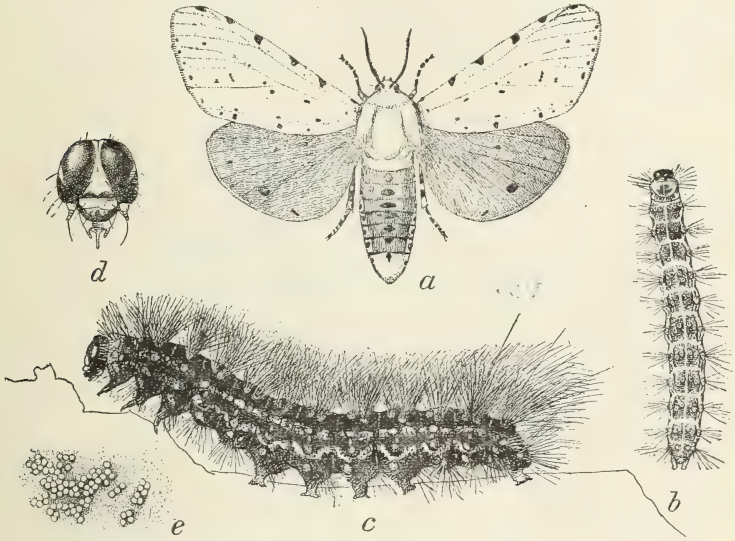

FIG. 19.—*Estigmene acræa:* *a*, male moth; *b*, half-grown larva; *c*, mature larva, lateral view; *d*, head of same, front view; *e*, egg mass—all slightly enlarged except *d*, more enlarged (from Chittenden).

EGG.

The eggs were nearly round, about two-thirds of a millimeter in diameter, and, when first deposited, of a pale yellow color. The surface of each was slightly granular in appearance. As the embryo became nearly developed the color of the egg changed to a dull blue, with a black spot near the middle of the top. Hatching occurred in four or five days. The percentage failing to hatch was very small and no parasites were developed in this lot of eggs.

LARVA.

As they left the eggs the larvæ were about 2.3^{mm} long. Their color was a uniform dark brown, and the length of the hairs was nearly equal to that of their bodies.

The newly hatched larvæ were placed upon fresh, tender cotton leaves and began at once to feed, eating only part way through, so as to leave intact the epidermis on one surface of the leaf. As a rule they chose the under side, probably in part for protection and in part because of the more tender tissue on that side. The length of the body during the first larval stage increased to about 10^{mm} and the color became yellowish brown.

In the second stage of the larva the coloration appeared more clearly. The subdorsal tubercles became black and prominent. There was an interrupted white dorsal stripe and lateral stripes of a tawny yellow color. The hairs were long and black. As the second molt was approached the subdorsal dark stripe became lighter in color and the black tubercles standing therein appeared more prominent. The length of the second stage varied between four and seven days, and during this time the length of the body increased to about 15^{mm}. Feeding was almost entirely confined to one surface of the leaf throughout this stage. This habit of feeding only upon one surface of the leaves easily explains the failure to poison the caterpillar which was at first reported.

At the beginning of the third stage the color of the larvæ appeared markedly darker than in the second. The subdorsal stripes, especially, were very dark, though the color was somewhat variable as it is in all stages. During this instar the larvæ began to consume the entire leaf tissue, that is, they ate clear through instead of leaving the epidermis upon one side. Midribs and heavy veins alone were left. The length of the stage varied between six and ten days. The length of the larva's body increased to more than 30^{mm}.

The fourth and fifth stages showed little change in general appearance. All the specimens bred were dark, while many found in the field were much lighter, and some which seemed to belong to the same species were of a bright, uniform yellow color. The length of the fourth stage varied between five and nine days and the average length of body became about 45^{mm}. The duration of the fifth stage varied between eight and twelve days and the length of the body averaged about 55^{mm}.

The entire time of the larval stage was found to vary between the extremes of twenty-four and thirty-seven days from the hatching of the egg to the spinning up of the larva. The mean average temperature for this period was about 82.8° F., or almost 40° of effective temperature.

PUPA.

Pupation took place in about two days after spinning. The cocoons averaged about 30^{mm} in length by 10 to 12^{mm} in breadth. The length of the pupal stage, or from the spinning of cocoon to the emergence

of the adult, varied between nine and sixteen days, in most cases being about twelve or fourteen days. The time required for the emergence of males seemed to average about one day shorter than that for females.

ADULT.

The moths of this species measure from 1 to 1¼ inches in length with the wings closed. The predominant color as seen from above is white with prominent black spots scattered over both the upper and under surfaces of the wings and in six rows, three ventral, two lateral, and one dorsal, along the abdomen. In the female the wings are white upon the under as well as the upper sides. The back of the abdomen, with the exception of the first and last segments, is of a brownish yellow color. In the males the under surface of the forewings, both surfaces of the hindwings, and the predominant color of the abdomen is brownish yellow, thus making the distinction of the sexes a very easy matter.

GENERATIONS.

The average time required for the development of this generation was very nearly forty-five days. The adults, all of which emerged, mated within a few days and the females deposited their eggs in the breeding cages. No attempt was made to breed another generation, but as numerous large larvæ of this species were seen early the following spring, it appears that a fall brood of larvæ is normally developed and that this brood hibernates in the larval stage. No adults were seen early in the spring of 1903. Hibernated caterpillars taken into the laboratory spun up about the middle of May.

In 1902, the eggs for the generation of worms which did so much damage during the latter part of July must certainly have been deposited by the last of June, and it is very probable, though the actual fact has not been established, that the adults depositing those eggs had come from hibernated caterpillars. Assuming that to have been the case, the normal number of generations for this insect in that locality is three. The period during which the life history was followed in 1902 was exceptionally hot, and it is therefore safe to say that the normal developmental period for each summer generation is about seven weeks.

It is believed that in the Middle States this species has two generations and in the New England States it has been found to have but one.

INJURY TO COTTON.

The occurrence of this caterpillar upon cotton is by no means rare. In fact, occasional specimens may be found in almost every cotton field, but it is only very rarely that they are as abundant and inflict

as serious injury as they did in the case recorded. The writer is informed by those who have seen this larva often before, that it never seriously injures cotton except in some cases where cotton is first planted upon new land.

GENERAL NOTES.

SOME INJURIOUS GARDEN AND FIELD INSECTS IN TROPICAL NORTH AMERICA.

August 16, 1903, Mr. O. W. Barrett, entomologist of the Porto Rico Experiment Station, sent specimens of noxious insects from that country which are interesting because of their relation to species known to occur also on the mainland of the United States. One of these was an unknown species of Aphis, which is stated to seriously affect squashes. A leaf-beetle, *Cerotoma denticornis* Ol., very closely related to the bean leaf-beetle of the United States (*Cerotoma trifurcata*), was said to be injurious to cowpeas. A flea-beetle, *Systena basalis* Duv., was injurious to Russian sunflower; while a leaf-hopper, *Agallia tenella* Ball., was stated to damage the leaves of beans, cowpeas, and other plants. Later, September 30, 1903, Mr. Ed. Ferrer, La Magdalena, Cayamas, Cuba, stated that *Cerotoma denticornis* did a great deal of harm to cultivated beggar-weed (*Meibomia* sp.), which also grew wild in that vicinity, from 30 to 50 per cent of the weight of the leaves being a good estimate of what the beetle devoured.

Diabrotica balteata, another leaf-beetle related to the corn root-worms was received from Mr. A. L. Herrera, City of Mexico, Mexico, with the statement made under date of December 3, 1902, that it was injurious to wheat at Salvatierra, State of Guanajuato. During July, 1903, we received from Dr. Silvio Bonansea, of the City of Mexico, a specimen of *Scyphophorus acupunctatus* Gyll., a weevil quite commonly occurring in southern California which our correspondent stated was damaging henequen (*Agave rigida*). A short account of this species and a note on the occurrence of the larva in the interior of the stems of *Agave mexicana* has been given by Dr. Eug. Dugés in the Annales de la Societe Entomologique de Belgique, 1886, p. 33. A short note on the occurrence of the adults on trunks of grape-vine at Poway, Cal., where they feed on sap, was also published, in Volume V of Insect Life (p. 35).

REMEDY FOR STORED GRAIN INSECTS IN CUBA.

Mr. Limeon Poveda, jr., owner of a breeding farm in the suburbs of San Leandro, the municipal boundary of the Cuban town of Palma Soriano, known also as San Juan, who is also engaged in the practical study of agriculture, writes as follows in regard to the occurrence of weevils in maize and the remedies to be used in combating them:

In spite of the enviable fertility of the soil, which permits the gathering of the crops in less than three months, farmers can only receive a reward for their labor and sacrifice by the immediate selling of the crop as soon as harvested, because it quickly becomes infested by the weevil, which in a few days renders it useless.

For the prevention of this damage the Department has assisted the agriculturists to make the following experiment:

When the corn is harvested and to be gathered into the storehouse, the grain is sprinkled to a height of 12 to 15 inches and then covered by a layer, nearly covering it entirely, of the sawdust of cedar mixed with a little salt (about half a gallon), followed by a thick layer of maize, then by another thick covering of the cedar dust and a little salt, continuing the same process.

This author presents the difficulty, in the practical outcome, of producing a flavor which is disagreeable to the animals and leaves them in a condition unfit for the market.

BEETLES INJURIOUS TO HERBARIUM FUNGI.

We received during March, 1903, through the kindness of Prof. T. D. A. Cockerell, from W. C. Sturgis, some interesting information in regard to injury by certain species of beetles to a collection of fungi and mycetozoa. Professor Sturgis, writing from Colorado Springs, Colo., states that his collection of mycetozoa has been much bothered by the attacks of small beetles which feed mostly upon spores, and especially of the Stemonitaceæ. He complains that some most beautiful and copious specimens were reduced to nothing but sticks and a powdery mass of black excrement within a period of a few weeks by these pests. Among the insects troublesome to his plants are the following:

Arrhenoplita bicornis Ol. Injured Stemonitis, and was alone.

Sphindus americanus Lec., very commonly met and destructive.

Liodes obsoleta Horn., also concerned in injury.

Bæocera (?) sp., also concerned in injury.

Professor Sturgis states that these beetles operate after the specimens have been dried and placed in the herbarium; that they prefer the specimen to the wood as food, and that their depredations are almost exclusively confined to the Stemonitis, Comatricha, and Lamprederma, genera whose species often show a dense tufted habit peculiarly susceptible to attack.

A fifth species, presumably a Cioid from the description, is mentioned as the principal insect enemy to the specimens which have been considered.

A WEST INDIAN FRUIT-TREE BORER.

June 8, 1903, we received a communication from Mr. Bernabe Sanchez Adan, Central Senado, Las Minas, Cuba, with accompanying specimens of the Bostrychid beetle, *Apate carmelita* Fab., which was reported to be destroying orange, plum, and almond orchards. The beetles were described as boring from the outside seeking the core, which they readily attacked, the trees perishing in a short time. By

the same mail we received a second letter, from Mr. J. H. Hemenway, Cienfuegos, Cuba, containing report of depredations by this same insect on the coffee plants, it being described as very common and completely destroying plantations.

This species is mentioned in literature generally as *Apate francisca* Fab., which is a synonym of *carmelita*, the latter being the male and the former the female of the same insect. It may be remembered that a note was published on this species (Ins. Life, Vol. VI, p. 274) as boring in Lagerstrœmia in Jamaica.

SAY'S PLANT BUG.

(*Lioderma sayi* Stål.)

One of the remarkable outbreaks of the year 1903 was that of a large green pentatomid bug (*Lioderma* [*Pentatoma*] *sayi* Stål.). It was most injurious to grain, and especially to wheat, but in some cases attacked a variety of other plants. Among interesting reports of injuries received was one from Prof. C. P. Gillette, who wrote, August 19, that many wheat fields in Montezuma County, Colo., had been reduced from 25 to 75 per cent. Fields of oats were also badly injured, and in some cases beans and peas were attacked. May 9, Prof. T. D. A. Cockerell reported an outbreak in Arizona. At that time the insect was so abundant that it threatened the ruin of the grain crop in the vicinity of Pima, Thatcher, and Fort Thomas. It was noticed that the insect was common also on wild plants in that territory. At Phoenix, Ariz., and vicinity, Mr. Matthew M. Murphy reported considerable damage, especially to late wheat. Mr. C. C. Pitrat, Farmington, N. Mex., reported September 9 that this bug had caused much loss to the wheat crop of that vicinity, the bugs having first been noticed July 20, when the wheat was in the milk. Three or four bugs were found clinging to each head of wheat, seeming to suck the juice from the forming seeds. It was estimated that the bugs had badly damaged or completely ruined about half the wheat in San Juan County. It was observed that the bugs had a very offensive smell, like that of the common squash bug (*Anasa tristis*). Mr. J. J. Starley reported injury to potato vines at Fillmore City, Millard County, Utah. From specimens received from this latter source, eggs were deposited in July, and young were observed July 25. Reports of injury chiefly to grain were also received from Safford and Tucson, Ariz., and Cortez, Colo.

AQUATIC BUGS OF COMMERCIAL VALUE AS FOOD.

October 7, 1903, Dr. A. Hrdlicka, of the U. S. National Museum, submitted for examination a large package of insects which he stated were used as fish food in Mexico, whence they came. These insects

were all of the family Corixidæ, or "water boatmen," and similar to species which are found in boreal America. We also received information that they were on sale in a well-known bird store in the city of Washington. The species were three in number, and were identified by Mr. Otto Heidemann, of this Office, as *Notonecta americana* Fab., *Corixa mercenaria* Say, and *C. edulis* Champ., all of which are described in Biologia Centrali-Americana, Hemiptera-Heteroptera, Vol. II, by G. C. Champion. Writing of *mercenaria*, Mr. Champion states that it swarms in the large lakes near the City of Mexico, and much has been written about it from the economic point of view, the eggs, larvæ, and adults being collected and sold in Mexico as articles of food, it is said, for both man and birds, while of late years they were even being imported into England as food for caged birds. The food value of these insects appears to have been recognized since 1625, by Thomas Gage who is credited with being the first English traveler in Mexico. His observations have been confirmed by Say and Guèrin, the latter stating that *C. femorata* is sold for the same purpose. Immense numbers of these "water boatmen" are sometimes captured on the wing toward evening. Probably all of the "water boatmen," of which there are many species in North as well as Central America, could be utilized for the same purpose, it being merely a question of capturing them in sufficient numbers to make it profitable.

The same month Mr. George L. Hopper, of the Bureau of Fisheries, Crockett Depot, Va., furnished samples of Mexican aquatic bugs of the same species above mentioned, including two other forms, one doubtfully identified as *inscripta*. Mr. Hopper stated that the material sent for examination had just been received in several pounds in the dried state for experiment as food for young trout. The trout were eating them and doing well, and our correspondent was convinced that it was the best artificial food that had ever been used. He stated that the bugs were gathered in large quantities from Mexican lakes, especially Lakes Choleo and Texcoco. Their eggs are glutinous and adhesive to submerged objects in the same manner as is oyster spat. He adds that *Corixa femorata* is used in Mexico for the same purpose, and has long served as an article of food for the natives of Mexico.

Concerning the manner of use of these insects as fish food, Mr. Hopper stated that as they were dry they were run through a coffee mill and ground as finely as desired, after which scalding water was poured over them to soften them. They were then mixed with 20 per cent of mush, and this he stated made the best food for small fish which he had ever seen tried, and he has had many years of experience in this line of work. Thus prepared he stated the cost was about 5 cents a pound.

A NEW ENEMY OF THE PEAR.

Dr. N. Cholodkovsky, of St. Petersburg, Russia, reports in the Zoologischer Anzeiger (Vol. XXVII, pp. 118-119, 1903) the discovery of a new species of Phylloxera, infesting the fruit of several valuable varieties of pears, and to which he gives the name of *Phylloxera piri*. He states that about the middle of September colonies of small and apterous, yellowish-green lice were discovered in small depressions around the stem of numbers of pears, covered with paper bags as a protection against *Carpocapsa pomonella*, at Aluschta, Crimea, Russia; that the infested parts eventually rotted, producing irregular blackish-brown spots on the surface surrounding the stem, and that the lice had apparently lived on the pears for about a month, during which time the young or larvæ spread from one fruit to others.

Thus far this species appears to be indigenous and confined to the south of Russia, and as far as recorded is the only one of this group of plant lice discovered as infesting fruit trees.

The discovery of this new pest on the pear indicates anew the great danger of indiscriminate importations of fruit, cuttings, or growing plants from foreign countries without an adequate supervision and fumigation before shipment and thorough inspection of such a cargo prior to distribution in this country.—Th. P.

INJURY BY A CRICKET IN THE SOUTH.

During the November 11 (1903) meeting of the Entomological Society of Washington the following notes were presented by Mr. A. N. Caudell, the first portion being a letter received several years ago and the latter a report on the specimens by Mr. Caudell.

Mr. Dempsey's letter is as follows:

Jena, Catahoula Parish, La., *May 7, 1887.*

As you requested February 21 last, I send you samples of the destructive locusts which are so numerous in this parish. They infest portions of the hills and swamp lands alike, doing irreparable damage to cotton, sweet and common potatoes, peas, and tobacco. They will not reach you alive, as they die in about twenty-four hours in confinement.

Our farmers are seriously alarmed at their fearful increase and their destructive habits. Their holes in the ground are promiscuously scattered from a few inches to several feet apart, and seldom over a foot deep in the uplands, but they go much deeper in the swamp, as the soil is deeper and the subsoil softer. They are seldom visible in the heat of the day, and do their cutting at night, taking all they want down in the ground, where they eat as they please or feed their young ones. They never infest trees or injure orchards, but if they become much more numerous they may eat everything green.

In 1852 I first noticed them eating young cotton only, and a few years back they began to eat sweet potatoes; now they eat peas and tobacco, and have attacked our gardens. Our parish is composed of small farmers, who lack the means and the knowledge of how to exterminate them, and I fear that for want of discipline, unity of action, or any system of organization that the most profound scientist would fail

to effect a radical cure. Were the evil only ameliorated it might save thousands of dollars and an immense amount of labor, which is worse than wasted by its disheartening nature. * * *

They appear to go in colonies, eating one man's crop while his neighbor's across the fence is not injured.

We find that rapid cultivation, large "gangs" of poultry, and numerous birds keep them in check; but they are becoming too numerous in spite of all we can do.

MICHAEL DEMPSEY.

NOTE.—This insect of economic importance has existed for many years in the United States without being, so far as I know, mentioned specifically by any writer. It is a species of the gryllid genus Anurogryllus, which I have determined as *A. antillarum* Sauss. When mature it is readily separable from its ally, *A. muticus*, by being apterous and having the elytra more abbreviated. Specimens of what I take to be the young have very small wing pads, but they are rarely discernible in the adult. The National Museum contains specimens from Florida, Alabama, South Carolina, Louisiana, and Virginia, where it is injurious to various garden crops, strawberries, peas, sweet and Irish potatoes, tobacco, and cotton.

This species probably occurs not uncommonly in collections, but has never been recorded from the United States. Mr. Rehn tells me it is present in the collection of the Academy of Natural Science of Philadelphia as *Miogryllus saussurei;* but members of that genus have fully developed ovipositors, while Anurogryllus is peculiar in having that organ aborted.—A. N. CAUDELL.

IDENTITY OF A TINGITID FOUND ON CHRYSANTHEMUM.

In Bulletin No. 10 new series (page 99), under the head of Extracts from Correspondence, a short note was published in regard to infestation of chrysanthemum leaves by a little tingitid bug received in June, 1897, from Alabama, the species having been identified at that time as *Corythuca irrorata* Riley. Dr. E. P. Felt has recently brought up the subject of the specific identity of this chrysanthemum pest, and Mr. Otto Heidemann, of this office, has furnished the following notes, which will be of value to the systematic worker.

Under date of June 11, 1903, Dr. Felt sent specimens of the same species, stating that it is seriously injuring chrysanthemum for the past year or two at Coeymans, N. Y. According to Mr. Heidemann the insect in both cases is *Corythuca marmorata* Uhl., described in Proceedings of the Boston Society of Natural History (Vol. XIX, p. 415, 1878), there being nearly perfect agreement of the specimens with the description. The type of this species is in the Harris collection now in the Boston Society of Natural History museum, No. 61, labeled in the handwriting of Uhler as *C. marmorata.*

Corythuca irrorata is a MS. name of the late Prof. C. V. Riley. It has therefore never been described, and as it is exactly like Uhler's *marmorata*, would be a synonym in any case.

CARBON BISULPHID FOR RED ANTS AND WHITE GRUBS.

Mr. Harry B. Williams, 212 Summer street, Boston, Mass., writes in regard to the efficiency of carbon bisulphid as a remedy for red ants and white grubs, both of which insects were troublesome on his lawn, that having tried hot water, kerosene, red pepper, and a few other such remedies, he wrote to this Department for information, receiving Circular 34 and Farmers' Bulletin 145. In applying the remedies, he made holes about 4 inches deep in the lawn, 2 feet apart, inserted a small funnel, and poured a small quantity, about a tablespoonful, immediately into the funnel, pulling it out and covering the hole with moist dirt. He noticed that if the bisulphid touched the grass it shriveled it at once; and if too large a dose was used, it had a tendency to kill the grass, making brown spots appear. He described the treatment as having produced very good results, having cleaned the lawn of both white grubs and red ants.

This is the standard remedy for ants in lawns, and has frequently been advised for white grubs, but the expense of using it is such that it can not always be profitably employed in large fields, though it will answer very well for lawns, and for some gardens.

AGONODERUS PALLIPES A PERMANENT ENEMY OF SPROUTING CORN.

During the latter days of July, 1903, Mr. B. D. Wilson, Hetty, Tex., sent numerous specimens of the common little carabid ground beetle, *Agonoderus pallipes*, together with samples of sprouting corn which they had injured. He reported that there seemed to be twenty of these beetles to a single grain of corn. Out of 50 acres of June corn planted he felt satisfied that he would not obtain more than 5 acres on account of the ravages of this little pest. It is now a matter of upward of twenty years since this species has attracted attention by attacking the kernels of corn in Illinois. (See Forbes's 12th Report St. Ent. Ill., p. 27.) In 1885 we received reports from Illinois and from Iowa that this species was damaging young corn by gnawing into the seed corn and eating the sprouting roots. Damage was said to be quite extensive (see Bul. No. 12, Div. Ent., o. s., p. 45).

ANTHRENUS DESTROYING TUSSOCK MOTH EGGS.

In Technical Series, No. 5, we described a newly discovered habit of the larva of *Anthrenus verbasci* (*varius*) in feeding upon the living eggs of *Hemerocampa* (*Orgyia*) *leucostigma*. Since that time this observation has not been duplicated. In October, however, Mr. D. C. Clark stated that he had noticed the same habit in Baltimore, and that he is confident that it has been during the past season of so common occurrence as to account for the scarcity of the tussock moth caterpillars

upon Baltimore shade trees. Last year, in 1902, this species was about as prevalent as usual. The egg masses were about as abundant in 1903 as in 1902, but upon examination Mr. Clark could find comparatively few which had not been eaten. He found the larvæ of Anthrenus and the cast larval skins in nearly every egg mass examined. In fact, we may say, he could not find a single perfect egg mass to experiment with as to the time of hatching. This observation is of very great interest and importance. Down to the time of our note, above cited, this Anthrenus had not been known to feed upon living animal matter. Are its habits changing?

ABUNDANCE OF THE RHINOCEROS BEETLE IN SOUTH CAROLINA.

In a letter dated July 27, 1903, Hon. Wyatt Aiken, writing from Abbeville, S. C., stated that the rhinoceros beetle (*Dynastes tityus* Linn.) had attacked swamp ash grown as shade trees in that vicinity, and that the odor proceeding from the beetles, which is well known to collectors of insects from its strength and persistence, was very obnoxious. As a remedy, 80 trees were cut down by order of the town council, with the result that the offensive odor disappeared. The explanation is that the insects are more attracted to ash than to other trees, and with the disappearance of their favorite host plants in that vicinity they went elsewhere. Notes on this species, together with illustrations, were published in Bulletin 38 (on pp. 28–32).

In commenting upon the occurrence of this insect the Abbeville (S. C.) Medium of July 30, 1903, states in an editorial that several years previously similar complaints were made at Magazine Hill, which was the particular locality where the insect was a nuisance, and that the city council had destroyed trees at Fort Pickens where the insects had been noticed, as also in other parts of the city. The trees were estimated to be worth $100 each, and the loss was therefore stated to be $8,000.

THE LENGTH OF THE FIBER IN THE COCOON OF THE DOMESTIC SILKWORM.

Authorities and popular works differ greatly in their estimates of the length of the fiber in the cocoon of the domestic silkworm, *Bombyx mori*. Published statements of the length of this fiber could be cited which range all the way from 1,100 feet to 11 miles. Even so good an authority as the Encyclopædia Britannica places it at 300 yards. Recent measurements made in the Division of Entomology show that with certain Milanese yellow cocoons raised in the United States from eggs purchased from France the fiber varies in length from 888 to 1,195 yards.

EFFECT OF THE BITE OF A MIDGE ON A HUMAN BEING.

It is well known that the genus Ceratopogon, of the dipterous family Chironomidæ, or what are termed biting flies, of which the most conspicuous form is the so-called punky of the north woods of Maine, sometimes called by the Indians "No-see-'em." It is somewhat seldom, however, that the species caught in the act of biting can be determined specifically. Mr. F. W. Thurow, Harvester, Tex., sends specimens of *Ceratopogon stellifer* Coq., with report that it is very common in that vicinity (Waller County), and that a great many people have felt its bite. It is sometimes called sand gnat or sand fly, but all agree that it is very tormenting, and that it is worse near creeks that are choked with logs than elsewhere. When our correspondent first went to live in Texas he would pull off his shoes at night and sit down to read. After a while his feet and hands were burning as if he had been wading in nettles. For a long time he was of the opinion that the trouble was nettle rash, on account of the minute size of these little midges, which is well expressed by the Indian name "No-see-'em." The bite of the flies appear to be more intense about the wrists and ankles.

THE QUAIL AS A DESTROYER OF CUTWORMS.

November 14, 1902, Mr. W. F. Wever, Commerce, Tex., wrote in regard to the effectiveness of the quail in restraining the multiplication of insects, more particularly cutworms:

> My grandfather had a low piece of bottom land that cutworms were always very bad in; and upon one occasion I shot a quail in the edge of this piece of land. When the negro woman went to dress the bird, its crop was so full that she cut it open, and found 17 cutworms in it. That stopped the killing of quail, so far as my grandfather's place was concerned. I am satisfied that your Department could do some splendid missionary work along this line.

We frequently receive similar communications testifying to the value of the quail as an insect destroyer, more particularly as a check on the increase of the Colorado potato beetle (see Insect Life, Vol. IV, p. 278, and Vol. V, p. 143). Within a radius of only a few miles of the Capitol, quails are quite common during the summer months, and come very close to cottages along the Potomac River front, and may be seen crossing roads ahead of carriages almost as freely as barnyard fowls; and it seems too bad that a bird which has a tendency to frequent the vicinity of farmhouses and fields of grain and other crops where it would aid in the control of insect pests should be destroyed by alleged sportsmen as soon as the open season begins.

TOBACCO FOR THOUSAND-LEGGED WORMS.

A writer in the Weekly Florists' Review of April 9, 1903, Mr. William Scott, states, in answer to a correspondent of that publication who requested a remedy for thousand-legged worms or millipedes working on his ferns and which he stated were eating some of his asparagus seed, that thousands of these creatures appeared on the surface of rose beds, but that after putting bunches of tobacco stems on the surface to keep down "green fly" or aphides, it was noticed that the "thousand legs" lay around dead, and their demise could be attributed to nothing but the tobacco. Mr. Scott therefore advises that in order to rid greenhouses of "thousand legs" to put plenty of fresh tobacco stems among the pots.

LIGHTS AGAINST THE IMPORTED CABBAGE WEBWORM.

Mr. H. M. Simons, who appears to be the first person who has had experience with *Hellula undalis* in this country, wrote from Charleston, S. C., August 11, 1902, that he captures many of the moths with the aid of a barrel having all but four of the staves sawed out, leaving 4 inches from the bottom to form a tub in which to hold water. From the top of this a light is suspended which attracts the moths. The light barrels, as he terms them, were placed on plant seed beds of cabbage.

A thin scum of kerosene was used in this experiment, but it is suggested that this be eliminated, in order not to destroy predaceous insects, such as ground beetles, which are almost sure to be attracted; this suggestion being made in view of the fact that the destruction of one individual of a beneficial species is equivalent to the destruction of perhaps 20 to 100 injurious ones. The useful insects can be easily picked from the water, and though they may apparently be dead, they usually recover and crawl away.

HAIR WORMS IN CABBAGE.

Many complaints have been made during the present year of what have been termed by various persons as "snakes," "cabbage snakes," "snake worms," and the like, and the subject has attained considerable newspaper notoriety. So many inquiries have been made as to the identity of the creatures and their alleged poisonous qualities that it has been thought well to give a short account of them, more particularly as many persons fully believe the insects to be poisonous. This is, of course, absurd, as the worms are not known to possess any toxic properties whatever, but it is certain that, although they are not injurious to the cabbages their presence is not desirable, as they really injure cabbage for sale. The specimens received during the year, with a few exceptions, have been found in heads of cabbage. We have ascertained

from Dr. C. W. Stiles, consulting zoologist in charge, Bureau of Animal Industry of this Department, that the species is *Mermis albicans*, Diesing,[a] in each case represented by the female. The creature is not an insect nor a snake, but one of the hair worms of the family Gordiidæ. It has been well described by one of our correspondents as a white worm, looking like a piece of basting thread. It is usually found coiled or crawling about in the cabbage in which it is found. Its length when full grown is about 3 inches. This little hair worm has been reported in cabbage, with the usual account of its being injurious and poisonous, from Glades, Clayton, Ga.; Earleyville, Tracy City, Tenmile Stand, and Greenville, Tenn.; Chester and Tucapau, S. C.; Shreveport, La., and several other localities from which no specimens were received.

It is usually stated to be found in the solid part of the head of cabbage between the leaves. One correspondent says that it is a serpent, a vicious little reptile; others that it develops in stagnant water and transforms from horsehair, a very prevalent opinion among many people. A statistical correspondent of this Department makes mention of some current reports in a portion of Tennessee to the effect that a number of people had died from eating cabbage affected by this creature, while others were made very sick. A physician reported that when cabbage infected by the hair worms was eaten that it produced instant death. In one newspaper report this hair worm is stated to have been examined by the State chemist, and found to contain enough poison in it "to kill eight persons." Another newspaper notice is to the effect that it has seriously injured the demand for cabbage in a number of Georgia cities, causing in the aggregate considerable loss to truckers and farmers. The "snake" was said to have no vertebræ, but it would strike "just as if it were a member of the snake family," and tons of good cabbage were being thrown away on account of its presence. In this case it was light red in color and 4 inches long. Crowds assembled to examine specimens and "snakes" was the principal topic of conversation even after one had traveled a mile or two up on the mountain side.

This same species was received in a piece of apple which was apparently sound. It was found coiled inside near the seed. A related species is known to be parasitic upon the codling moth or "apple worm" (*Carpocapsa pomonella*), and there is no doubt that the present species has the same habit, from its occurrence, as described.

One other hair worm (*Paragordius varius*) was sent, found in the water without visible means of support in Virginia.

A very large proportion of the hair worms are parasitic on insects.

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[a] From the studies of Diesing, Meissner, and others, it has been concluded that *M. albicans* is merely the mature sexual form of *acuminata*, but the latter name seems to have priority

The species of Gordius and Mermis are treated somewhat at length in the first report of the U. S. Entomological Commission, published in 1877, pp. 326–334. Among the hosts of hair worms in which they are most frequently found are aquatic insects, also insects of the order Orthoptera, which includes grasshoppers or locusts, crickets, and katydids. They are also sometimes parasitic on beetles, more particularly Carabidæ or ground beetles, bees and flies, and caterpillars of butterflies and moths, and even on snails. Among other sensational reports received were those of what was described as an insect of a brown color which had similar habits and poisonous properties to the cabbage snakes. Only two correspondents responded with specimens when requested. These were referred to Mr. O. F. Cook, who stated that they belonged to the genus Geophilus, which includes several species of myriopods or thousand-legged worms, all of carnivorous habits, and it is possible that they may attack some of the smaller forms of cabbage worms and hence be beneficial.

It should scarcely be necessary to add that inasmuch as the first reports that were received, including the bulk of the newspaper accounts, were of such a nature that it was impossible to identify the creature concerned other than to surmise that it was a species of Mermis, and in reply to inquiry to give what was known of the habits of the genus. It was, therefore, a matter of considerable perplexity to know if this surmise was really correct, and it was also a matter that gave considerable annoyance to many of the State entomologists and chemists of the Southern States where the Mermis abounded.

OBSERVATIONS ON THE HABITS OF THE MORNING-GLORY LEAF-CUTTER.

(*Loxostege obliteralis* Walk.)

During the latter days of August and the first half of September, 1903, this species was very evident on several kinds of ornamental plants growing in yards in the city of Washington. Although morning-glory is the preferred food, when the larva has fully matured it frequently leaves this plant and cuts the leaves of plants on which it does not feed to form its characteristic pupal case, which has already been mentioned and figured in Bulletin 27, new series (p. 104). In spite of its bright colors, the insect appears to prefer very shady locations, and this is fortunate, as it is seldom found in well-kept front yards, but in back yards near high board fences and in places where morning-glory and some other plants of volunteer growth riot over fences, sheds, and outhouses. Here, where the leaf-cutter is well protected from the sun, it develops in great numbers. Indications are that the larvæ usually pass all of their earlier stages on morning-glory, and that it is only in the last stage that they ordinarily forsake this plant for others, but in the event of the scarcity of morning-glory

they could probably develop on various other plants without strong odor. Geraniums have never been found to be eaten, but they seem rather to prefer this plant to cut off for forming pupal cases when they can obtain it. Larvæ were noticed, although sparingly, feeding on violet, Commelina, and plantain, and more commonly on zinnia.—F. H. C.

NEW HABITS OF THE CUCUMBER FLEA-BEETLE.

(*Epitrix cucumeris* Harr.)

Beginning with the first week of June, 1903, the writer noticed general infestation of ornamental petunias by flea-beetles, evidenced by characteristic small punctures in the leaves. The depredator proved to be *Epitrix cucumeris*, and the cause for injury was also evident, as the insect was found developing on *Solanum nigrum* growing as a weed in the flower beds. A few wild plants remaining here and there were overlooked by the gardener. The destruction of the weeds caused the insects to migrate to the petunias. It was also noticed that this species occasionally attacked wild Acalypha, but not the cultivated plant of the same genus.

August 11, 1903, Mr. A. D. Shamel, Tariffville, Conn., reported this species to be doing great damage to tobacco, confining itself to Cuban tobacco, and that it attacked the leaves just before picking. Nothing like it had been seen before, which is doubtless to be accounted for by the fact that tobacco has not been raised on a large scale for many years in Connecticut. There is danger of this species replacing *Epitrix parvula* as a tobacco pest, the brown species doing the greatest injury in the South, the black one northward.—F. H. C.

ON REMEDIES FOR GARDEN SNAILS.

The year of 1903 was remarkable for the numerous complaints made of snails and their injuries to ornamental and vegetable garden and similar plants. From the District of Columbia and westward to Minnesota, as well as in the more southern regions, these creatures did considerable damage, their work closely resembling that of caterpillars. One of our correspondents, Mr. Phares R. Nissley, Landisville, Lancaster County, Pa., wrote under date of February 29, in answer to a letter in which we requested his experience in the use of the remedies advised, that he had used air-slaked lime and salt, and a mixture of salt and lime, and both were effective, but that lime was the best remedy, and when even a small particle was dropped on a snail it would die in fifteen minutes. These remedies were practicable when plants had got well started, but trouble came when tobacco and celery seed were sowed. As soon as they were well sprouted the

snails devoured them, and it was impossible to sprinkle the lime on the plants at this time, showing that the lime is effective practically only on plants that are of sufficient growth to be dusted. We have also advised our correspondents to use soot and fine road dust, and it seems possible that if these or even spoiled flour were mixed with lime and carefully sifted and then gently puffed on the plants by means of an ordinary powder atomizer, of 4 or 5 inches diameter, and costing about 15 to 25 cents, this would destroy or deter the snails from injuring the plants. Salt is also a good remedy for slugs. The reason for the great injury by snails was doubtless due to the unusually cool and very damp weather experienced over a large portion of the country.

EXTRACTS FROM CORRESPONDENCE.

Supposed Cutworm Injury to Orange Fruit.—During August, 1903, we received two communications from correspondents in Florida, one from Dr. Leon A. Peek, of Melbourne, with accompanying specimens of oranges which had dropped from the trees, and which showed what seemed to be the work of climbing cutworms possibly, but the pest itself could not be discovered. One of our correspondents was of the impression that the Mexican or Morelos orange worm was at work. From Mr. G. H. Carr, of Hypoluxo, Fla., we received a similar complaint. In neither case was the correspondent able to locate the culprit. In the first instance of injury the orange sent was a "drop." Our second correspondent believed that the oranges were injured while on the trees.

By using a curculio catcher or large inverted umbrella under the branches and jarring them lightly, the insect should be dislodged, particularly if this method of capturing them were employed at night with the aid of a lantern.

Cotton Bands about Trees for Cutworms.—A correspondent in California wrote this Office in 1903 that he had protected his young walnut trees, 400 in number, by wrapping the trunks with cotton saturated with crude petroleum. This grower may consider himself fortunate if he does not lose all his trees.

Remedy for Cabbage Worms and Plant-Lice.—Edward S. Thomas, Marshfield Hills, Mass., wrote, under date of September 21, 1903, that he had used very successfully a compound called "Fly Killer" (to be used on cows and horses) as a spray to kill the green cabbage worm and plant-lice. It killed instantly and has not harmed the cabbage, so he writes.

The Bollworm Moth at a High Elevation.—We received word from Prof. T. D. A. Cockerell, May 4, 1903, that the previous day he observed at Placita, N. Mex., about 6,850 feet above sea level, specimens of the bollworm moth (*Heliothis armiger*) busily sucking the flowers of wild plum. One of the specimens was unusually reddish.

A Cabinet Beetle in a Locket.—Dr. George S. Yingling, Tiffin, Ohio, sent to this Office, with accompanying letter dated May 30, 1903, a glass charm with sterling silver band, inclosing a common French beetle, frequently used as an ornament, together with larva of the cabinet beetle (*Trogoderma tarsale*) which was destroying it. By careful examination of the top of the charm it was seen that there was a crack large enough for the admission of the larva while it was young.

Food Habits of a Tree Cricket.—Mr. Alva A. Eaton, of Seabrook, N. H., has made some interesting observations on the food habits of *Œcanthus quadripunctata* Beutenmüller, in which, by careful experimentation, he proved that a half-grown specimen of this tree cricket destroyed plant-lice, devouring a full-grown louse in

about ten minutes. The forelegs were used to hold the plant-louse, which was devoured, legs and all. While feeding, the antennæ of the cricket were held erect, and while searching for lice they were held horizontal. A single individual was seen to destroy nearly forty plant-lice.

A Food of Robber-Fly Larvæ.—The Mr. Eaton referred to in the last note, has found the larvæ of a robber fly feeding upon white grubs (larvæ of Lachnosterna).

A Tachina Parasite of May Beetles.—Mr. Eaton has also found the puparium of a Tachina fly beneath the empty carapace of a May beetle (*Lachnosterna* sp.) which it had evidently destroyed before it issued from the ground. Tachina eggs have been found by the writer attached to the thorax of Lachnosterna, but no better proof of this parasitism is upon record.

Strange Habits of a Tropical Cricket in South Carolina.—May 14, 1903, Mr. Harry Hammond, Beech Island, S. C., sent specimens of a cricket, *Anurogryllus muticus* DeGeer, with accompanying information that the insects make holes in cotton fields to the depth of 18 inches, which they line with shreds of cotton leaves, destroying the young cotton for several feet in the row in accomplishing this. Until the discovery of these crickets it was surmised that the damage was entirely due to cutworms, some species of which have the habit of dragging vegetation into holes in the ground. The young of the cricket were found in these holes in June, and the insect lives in cornfields and in fields lying fallow, as also in cotton fields. The species in question is tropical and a native of the West Indies, Central and South America. It does not appear to have been recorded as occurring in America north of Mexico, and nothing appears in regard to its habits.

Hydrocyanic-acid Gas for the Destruction of Mealy-Bugs.—Mr. John L. Chapman, Bradley Hill, Hingham, Mass., wrote November 27, 1903, that, in accordance with directions furnished in Circular No. 37, of this Office, he had killed mealy bugs on grapevines by an exposure of only two hours, the gas being used at the rate of 1 ounce to 300 cubic feet of space. The day following exposure he was unable to find a single mealy-bug on the vines or leaves of the plants exposed to the gas, but the eggs appeared to be intact, which would of course necessitate another fumigation.

Kerosene as a Remedy for the Clover Mite.—Under date of May 4, 1903, Mrs. Mary E. Burrell, Freeport, Ill., writes that kerosene has proved effective in her experience in ridding her house of the clover mite (*Bryobia pratensis*). She used it without dilution, dipping a cloth and without wringing wiping the sill and lower edge of the window sash, also leaving what adhered to the glass on rubbing it over, for an hour or more. Three applications were sufficient to rid the house of the pest.

Carnivorous Habits of *Polystæchotes punctatus* Drury.—A specimen of this species of Hemerobiidæ was sent to the Division of Entomology by Mr. Henry Talbott, of Washington, who had found it on a fishing excursion in the northern States. The specimen was still living, while the wings of three of its companions, which had been placed in a box together with it, were all that remained of them. The bodies, heads, and nearly every portion of the others had been destroyed, including even portions of the wings. The living specimen was not much damaged.

A Mite in Sugar Withstanding Severe Cold Weather.—During January, 1904, Mrs. Eva Bashaw, Mankato, Minn., sent a species of Tyroglyphus found in brown sugar and dried fruit, with report that it was able to withstand freezing. At our suggestion the matter was tested. A paper sack of sugar containing numerous individuals of the insect was left out of doors over night with the thermometer at 8° below zero. It was again put out for three days subject to about the same exposure, and when heat was applied the insects began to crawl about.

A Mushroom-Infesting Mite.—*Tyroglyphus lintneri* Osb., an account of which, with Osborn's illustrations, is given on pages 452 and 453 of Lintner's Tenth Report, was identified by Mr. Banks in connection with injury to young mushrooms picked

from the beds on the morning of December 5, 1902, at Western Springs, Ill., by Julius M. Keil. They were covered with myriads of the little creatures which were devouring them, stopping their growth so that our correspondent was unable to obtain a fair crop.

A Myriopod Stated to Injure Vegetation.—Writing October 2, 1903, Mr. J. F. Schermerhorn, Alton, Ill., sent a specimen of the larger and common myriopod, *Spirobolus marginatus* Say, with statement that it had been found on a leaf of egg-plant and that when disturbed it emitted a fluid that destroyed vegetation within ten minutes. It is well known that myriopods contain a small amount of hydro-cyanic acid, but we have no records of injury to vegetation at the present time by any of these insects in the manner described.

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