

ERRATA.*

Page 47, line 6, page 48, line 8, and page 49, lines 5, 9, and 10 from bottom, for *clitellus* read *clitellum*.

Page 79, line 9, for *Opilonca* read *Opilionca*.

Page 108, line 11, for *longitudinal* read *circular*.

Page 109, line 8, for *worms* read *body*.

Page 115, line 1, dele initial *R*.

Page 122, line 10, for *ten* read *twenty*.

Page 138, line 16, for *Blackisded* read *Black-sided*.

Page 185, line 13 from bottom, page 228, line 17, and page 229, line 7 from bottom, for *troosti* read *troostii*.

Page 187, line 12 from bottom, page 272, line 6 from bottom, and page 275, line 1, for *kirtlandi* read *kirtlandii*.

Page 187, line 15 from bottom, for *lineata* read *lineatum*.

Page 213, line 17 from bottom, for 7 read .7.

Page 214, line 7, for 7 and 3 read .7 and .3.

Page 224, line 13 from bottom, for *Tortoise* read *Tortoises*.

Page 225, line 3, for *picta* read *marginata*.

Page 240, line 6 from bottom, for 1824 read 1825, and before pp. insert IV.

Page 242, line 8 and 12 from bottom, and page 243, line 1, for *Macroclermys* read *Maeroclemmys*.

Page 252, line 11, for *Crematogaster* read *Cremastogaster*.

Page 269, line 22 from bottom, and page 271, line 1, for *fasciatus* read *fasciata*.

Page 272, line 9 from bottom, and page 273, lines 7 and 14 from bottom, for *grahami* read *grahamii*.

Page 293, line 13 from bottom, for *elapsoidea* read *elapsoidens*.

Page 295, line 6, for *triangulum* read *triangulus*.

Page 309, lines 5 and 6 and line 3 from bottom, for *amœnus* read *amœna*.

Page 349, line 3 from bottom, for *A* read *W*.

Page 352, line 16, for *Icthyomorpha* read *Ichthyomorpha*.

Page 353, line 4 from bottom, for *Menopomida* read *Cryptobranchida*.

Page 366, line 16, and page 367, line 14 from bottom, for *erythronota* read *erythronotus*.

Page 367, line 8 from bottom, for *relations* read *relation*.

Page 371, line 11 from bottom, for *cingulata* read *cingulatatum*.

Page 378, line 7, dele period after prehension. S. Garman is authority for last sentence of paragraph only.

Page 385, line 4 from bottom, dele comma after its.

Page 410, line 18 from bottom, for *sublata* read *subulata*.

Page 411, line 11, for *bimabulata* read *bimaculata*.

Page 431, line 16 from bottom, for *mutica* read *muticus*.

Page 435, line 12 from bottom, for *querci* read *quercus*.

Page 441, line 19, for *Salamandra* read *salamandra*.

Page 451, line 14 from bottom, for *Auonophora* read *Aconophora*.

Page 486, line 4, for *limabta* read *limbata*.

Page 494, line 2 from bottom, and page 495, lines 13 and 16, for *lineatus* read *lineata*.

*See also pp. 478-481 of Article XIV.

ADDENDA AND ERRATA.

To complete the list of species recognized by Stål as belonging to this family, the following are appended, not from the belief that they belong here, but because there should be no hasty change made in the classification of the Homoptera until they have been more carefully studied.*

SUBFAMILY CENTROTINÆ, STÅL.

LXVI. TOLANIA, STÅL.

276. *T. OPPONENS*, Walk.

1858. *Centrotus opponens*. Walk. List Hom. B. M. Suppl. 159.

1862. *Tolania opponens*. Stål. Öf. Vet.-Akad. Förh. 491.

Hab.—Mex. (Walker).

LXVII. † ÆTHALION, LATR.

277. *A. GRATUS*, Walk.

1858. *Æthalion gratum*. Walk. List Hom. B. M. Suppl. 169.

1864. *Æthalion dilatatum*. Stål, Hem. Mex. 73, 450.

1869. *Æthalion gratus*. Stål, Bid. Memb. Kän. 299, 14.

Hab.—Mex. (Walker).

278. *A. NERVOSO-PUNCTATUS*, Sign.

1851. *Æthalion nervoso-punctatum*. Sign. Ann. Ent. Soc. France, Sér. 2, ix, 679, 14, pl. 14, fig. 10.

1858. *Æthalion nervoso-punctatum*. Walk. List Hom. B. M. Suppl. 168.

1869. *Æthalion nervoso-punctatus*. Stål. Bid. Memb. Kän. 299, 12.

Hab.—Mex. (Walker).

*None of the species mentioned here have a prolongation of the prothorax backward, and they rightfully belong with the Jassidæ.

† There are 68 instead of 67 genera represented in this catalogue, and 282 species instead of 278, XIV., 41, 42, 43, and 44 being duplicated.

The following additional localities have been obtained since this catalogue was put in the printer's hands:

For numbers 7, 8, 140, 177, 203, 204, 205, 206, 211, and *Aconophora lanceolata*, Fairm., Guatemala (*Henshaw*); 14, 27, and 142, Me. and Mass. (*Henshaw*); 15, Ia. (*Osborn*), N. Y. (*Van Duzee*); 19, Mich. (*Cook*), Pa. (*Rathvon*), Me. (*Henshaw*); 21, N. Y. (*Lintner*); 14, 19, 22, 27, 28, 41, 53, 65, 71, 76, 85, 96, 107, 131, 216, 223, 261, Neb. (*Barber*); 28, Mich. (*Cook*), Me., Fla., Tex., Calif., and B. C. (*Henshaw*); 34, 44, 66, 91, 116, 122, 132, and 145, Mich. (*Cook*); 41, B. C. (*Henshaw*), Nev. (*Hillman*); 43, Miss. (*Weed*), Mich. (*Cook*); 46, Mass. (*Henshaw*), Mich. (*Cook*); 52, Mich. (*Cook*), Ia. (*Osborn*), Va. and Md. (*Henshaw*); 55, Mich. (*Cook*), Pa. (*Rathvon*), Ia. ? (*Osborn*), Me. (*Henshaw*); 57, Ill. (*Goding*); 65, 68, 75 (recorded as *jugata* Uhler, which is a MS. name), 131, and 261, Ia. (*Osborn*); 67, Mich. (*Cook*), Mass. and Me. (*Henshaw*); 72, Mass. (*Henshaw*); 73, 83, and 85, Ia. ? (*Osborn*); 86, Mass. and Pa. (*Henshaw*); 95, Pa. (*Rathvon*); 97, and 119, Ia. (*Osborn*), Mich. (*Cook*); 114, Mich. (*Cook*), Tex. (*Henshaw*); 121, Pa. (*Henshaw*); 136, and 192, Va. (*Henshaw*); 137, N. Mex. (*Townsend*), Col. (*Gillette*); 138, Col. (*Goding*); 188, Va., Tex., and Vict. (*Henshaw*); 194, Mass., Tex., Calif., Vict. (*Henshaw*); 198, Cent. Am. (*Henshaw*); 217, Me. (*Henshaw*); 223, Mich. (*Cook*), Anticosti, Mass., Pa., Md., Va., D. C., Oregon, and Wash. (*Henshaw*); 248, Tex. (*Henshaw*).

Page 391, line 19, for *Entomolgique* read *Entomologique*.

Page 393, for No. 5 substitute as follows: *

P. DISPAR, Fabr.

1803. *Darnis dispar*. Fabr. Syst. Rhyng. 32, 23.

1836. *Entylia dispar*. Burm. Silb. Rev. iv, 182, 2.

1869. *Parmula dispar*. Stål, Hem. Fabr. ii, 29, 1.

Hab.—Mexico (*Goding*).

Page 397, between lines 12 and 13 from bottom insert as follows: 1893. *Entilia sinuata*. Rice, Insect Life, v, 243.

Page 399, line 7, after "one" insert *female*.

* *P. munda*, Walk, belongs to *Phanusa* (*Fide Fowler*)

Page 400, between lines 9 and 10 insert as follows: 1851. *Cyphonia rectispina*. Walk. List Hom. B. M. 597, 6; line 19, for *postfasciata* read *postfasciata*.

Page 401, line 4, for *bubalus* read *diceros*.

Page 402, at bottom of page add as follows:

1891. *Ceresa bubalus*. Fletcher, Rep. Ent. and Bot. Can. 191.

1892. *Ceresa bubalus*. Osb. Trans. Ia. Hort. Soc. 119, fig. 30.

1893. *Ceresa bubalus*. Osb. Fruit and Forest Tree Ins. 24, fig. 30.

Page 403, line 21, for the interrogation point substitute a period; between lines 2 and 3 from bottom insert as follows:

1892. *Ceresa taurina*. Osb. Trans. Ia. Hort. Soc. 119.

1893. *Ceresa taurina*. Osb. Fruit and Forest Tree Ins. 24.

Page 409, between lines 4 and 5 from bottom insert as follows: *Stictocephala gillettei*, ♂. Godg. Ent. News, iii, 200.

Page 411, line 2, for *nigripes*, Stål, read *munda*, Walk.; between lines 2 and 3 insert as follows: 1858. *Parmula munda*. Walk. List Hom. B. M. Suppl. 152; line 4, for Mex. (Stål), read Mex. and Guatemala (*Walk.*).

Page 412, between lines 11 and 12 from bottom insert as follows:

1892. *Thelia crataegi*. Osb. Trans. Ia. Hort. Soc. 119.

1893. *Thelia crataegi*. Osb. Fruit and Forest Tree Ins. 24.

Page 413, line 12 from bottom, and page 414, line 1, for *acuminata* read *acuminatus*.

Page 414, line 11, for *Hyphinae* read *Hyphinoë*.

Page 416, line 3 from bottom, for *Telamona* read *Membracis*.

Page 417, line 1, for 1841 read 1851.

Page 422, between lines 8 and 9 insert as follows: 1892. *Telamona mexicana?* Godg. Ent. News, iii, 108.

Page 424, line 9, for *top* read *tips*.

Page 425, line 6, dele "fig."; line 2 from bottom, for *galata* read *galeata*.

Page 427, line 4 from bottom, for *Membracis* read *Acutalis*.

Page 429, line 15, after "lower" insert *edge*.

Pages 435 and 436. *Note*.—An examination of the types shows that numbers 122 to 126 belong to *Cyrtolobus*.

Page 437. After the numbers 128, 129, and 130, for *A.* read *E.* *

Page 441, line 17 from bottom, for *V.* read *Amastris* †; line 4 from bottom, insert (?) before *V.*

Page 442, between lines 8 and 9 insert as follows: 1851. *Thelia expansa*. Walk. List. Hom. B. M. 563, 26; between lines 14 and 15 from bottom, insert as follows: *Thelia marmorata*. Walk. List. Hom. B. M. 555, 4.

Page 444, line 15 from bottom, after "scar" insert as follows: Apical cell much longer than in *marmorata*, the length exceeding the breadth more than twice, while in *marmorata* the cell is but a little longer than broad; line 14 from bottom, after "fuliginous" and "yellow" substitute semicolons for commas; line 7 from bottom, after "process," add as follows: in not being suddenly depressed a short distance before apex, in not having the median carina flat from this depression, and in being much more depressed anteriorly.

Page 445, line 8. *Note*.—Through the kindness of Rev. W. W. Fowler, of Lincoln, England, I have had the opportunity to examine Stål's type of the genus *Optilete*, and, as surmised, it proves to be a typical *marmorata*, Say. Between lines 16 and 17 from bottom insert as follows: 1851. *Hemiptycha longicornis*. Walk. List Hom. B. M. 569, 7.

Page 449, line 10 from bottom, *Note*.—Walker's *Darnis lineola* belongs to *Phacusa* (*Fide* Fowler).

Page 452, No. 181, for *prunitia*, Butler, read *hastata*, Stål (*Fide* Fowler).

* *Ashmeadea* being preoccupied, the name was changed to *Evaashmeadea*.

† A more careful study of the species places it in *Amastris*.

ARTICLE XII.—*Sixth Contribution to a Knowledge of the Life History of certain Little-known Aphididae**. By CLARENCE M. WEED.

THE CORN ROOT APHIS. (*Aphis maidis* (?) Fitch.)

The literature and life history of the corn plant louse were discussed at length in 1884 by Professor H. Garman†, who showed that at that time nothing definite was known concerning the time or place of development of the sexed forms, the connection between the root and aërial forms, or the manner in which the insect passes the winter. In the article cited the author adds nothing of importance to our knowledge of either of these points, though the conjecture is made "that the lice hibernated as alate viviparous females."

In the autumn of 1885, however, Prof. Garman found a single colony of oviparous females on the roots of corn in an enclosed frame, and has described this form together with eggs obtained from the abdomen by dissection‡. Hence at the beginning of the season of 1887 there remained to be determined, (1) whether the species normally hibernates in the egg state, (2) when and where the eggs are laid, (3) the time of appear-

* The previous contributions of this series have been published as follows: first, "Psyche," Vol. V., pp. 123-134; second, "Psyche," Vol. V., pp. 208-210; third, Bulletin Ohio Agricultural Experiment Station, Second Series, Vol. I., pp. 148-152; fourth, Bulletin Ohio Agricultural Experiment Station, Technical Series, Vol. I., pp. 111-120; fifth, "Insect Life," Vol. III., pp. 285-293.

The investigations on which the present article is based were made in 1887 during my connection with the Illinois State Laboratory of Natural History, under the direction of Professor Forbes, to whom I am indebted for the opportunity of publishing them at the present time. The article was written in December, 1887, and is now printed in its original form.

C. M. W.

Hanover, New Hampshire, April, 1891.

† 14th Rept. St. Ent. Ill., pp. 23-33.

‡ Misc. Essays on Economic Entomology, 1886, pp. 46-48.

ance of the male, and (4) what connection, if any, exists between the form on the roots and that on the leaves. The observations given below answer the first three of these queries, but I am not at present able to give any definite results concerning the obscure subject of the origin and fate of the aerial form.

FIELD OBSERVATIONS.

The first observations during 1887 were made in an oats field, on the University farm, that was last year planted to corn and abundantly infested with corn root lice. Two hours were spent, April 21, in searching the formicaries of the common brown ant (*Lasius alienus*) and of a larger red ant which was quite abundant, but neither plant lice nor their eggs were found. The *Lasius* were burrowing about the young oats plants, which had been up a week. April 25 I repeated the search, and found a mass of about fifty plant-lice eggs slightly below the soil surface in a *Lasius* nest. They were mostly green and nearly ready to hatch, and some of them put in a dry vial disclosed several young lice the following day. On April 29 another lot of aphid eggs, together with young lice, were found in another nest of *Lasius alienus* in the same field.

The young lice were on the radicles of the sprouting seeds of smartweed (*Polygonum incarnatum*) and *Setaria*, the earth about which had been mined by the ants. On May 4 larval lice were abundant on the plants just mentioned, always attended by ants. The majority of them were about half grown, but no adults were seen. By May 16 the stem-mothers had become adult, given birth to young, and largely disappeared, though a few were still present. The prevailing form then in the field was the young of the second generation, a few of which had become pupæ (of the winged form), but no winged adults were seen. Ten days later the corn lice had, so far as I could judge after an hour and a half of diligent search, completely disappeared from the field.

The second field under observation had been in corn for years and was again planted to corn last spring. I first examined it April 29 (before it had been plowed), when young

lice were found abundant under the care of the ants on the young sprouts of *Setaria* and *Polygonum*. The following day a part of the field was plowed and larval aphides were found again in the nests of *Lasius*. On May 6, in a part of the field not yet plowed, half-grown specimens were found in an ant's nest. By May 21 the lice had been mostly transferred from the *Setaria* and smartweed to the young corn roots. Some stem-mothers were yet present, and a few wingless adults of the second generation were seen, but the great majority of the lice were the young of this latter form (i. e., those born from the stem-mothers). Two days later a large number of these had become adult, some of them winged but most wingless, and a large number of pupæ of the winged form were present, as were also a few stem-mothers. At this time the ants were mining about the corn plants all over the field, evidently preparing for the reception of the winged migrants, but as yet very few of these mined hills contained lice. June 1 all stages of the second and third generations were common throughout the field, many of the specimens being winged. On the 27th of the same month, however, only wingless adults and larvæ were found. No further observations were made in this field until October 10, when both wingless viviparous and oviparous forms were abundant, the most of the lice being young of the oviparous form. A week later the oviparous adults were most abundant, and the viviparous ones were scarce. Many of the oviparous adults were wandering around among the *Lasius* galleries apparently unmolested by the ants, which behaved very differently toward them from the way they act toward the viviparous forms earlier in the season. I watched repeatedly to see the ants pick one of the oviparous lice up when the nest was disturbed, but without success. In large ant colonies the oviparous forms had often wandered some distance from the corn roots.

In a field, as yet unplowed, that had been in corn the year previous I found (April 30) two separate masses of plant louse eggs in one nest of *Lasius alienus*. Many of the eggs had evidently already hatched, for there were numbers of young lice on the sprouting *Setaria* and smartweed.

In an oats field (following corn) on the University farm larval corn lice were found abundant May 4 on the roots of *Setaria* in an ant's nest.

In a field of corn on sod ground I noticed, May 31, that the ants were very busy mining about the young corn plants and evidently preparing for the reception of the winged migrants. In two hills I found single specimens of the winged corn root louse which had not yet begun to establish colonies. I picked one of these up and put it down by another hill where the ants were at work. Almost immediately a *Lasius* found it, felt of it with the antennæ, then grasped the base of the plant louse's wings with its jaws and carried it below.

I also found May 19 in a field northwest of Champaign (corn following corn) many adult viviparous females with young about them. The same day, on a neighboring farm, a winged corn louse was found on one of the upper roots of a corn plant (corn following sod). The ants had mined a considerable opening along the side of the stalk through which the louse must have entered. In the same field at the same time two wingless viviparous females were found at some distance from any corn field.

In a field of fodder corn (on corn ground) on the University farm wingless adults of the second or possibly third generation were abundant May 25. A single winged specimen was seen.

Winged and wingless lice were common on roots of corn in certain fields at Rankin, Vermilion county, July 1.

In a field in Urbana wingless root lice were abundant in hills of corn August 19, and infested hills were easily found.

During October and the early part of November I found the oviparous females repeatedly in various fields about Urbana.

BREEDING CAGE RESULTS.

On April 25 a mass of aphid eggs found in a nest of *Lasius alienus* in a last year's corn field were transferred to a breeding cage. The following day several lice had hatched. One of these was isolated on a corn root, and moulted for the

first time May 2 and for the second time May 5. Unfortunately it died May 7, but it had become large enough to be recognized as a corn root louse.

In the nest where the above eggs were found were two very small plant lice, presumably hatched from the same lot of eggs as those mentioned above. These were placed (April 25) in a glass tube on a corn root, and I succeeded in bringing one of them to maturity, but the other died shortly after being transferred. The one that developed proved to be a corn root louse, and from it seven larvæ were born between May 9 and 15, at which latter date it died.

On April 29 I collected in the field several partially grown corn root lice on roots of *Setaria* and smartweed and placed them in a vial with earth and a *Setaria* sprout. May 4 one of the lice had apparently become adult, and it was transferred to a corn root inside a glass tube. May 5 it had fastened its beak in the root but no young had appeared; its markings were becoming more distinct. The following day a young louse was born about noon. The next morning (May 7, at 8 a.m.) no more young had been brought forth, but twenty-four hours later three more had appeared. The larvæ continued to be born until the 15th, when twelve had been brought forth, at which time the adult died.

Two of the young born from this stem-mother were brought to maturity, and curiously enough one of them was winged and the other apterous. The former, presumably one of those born May 6 or 7, became a pupa May 15 and did not again moult until May 19, when it became a full fledged adult. It was kept in the tube until May 22, but it brought forth no young up to that time, and did not insert its beak in the corn root, being apparently anxious to escape.

The wingless specimen was taken out of the tube where it was born, May 8, when it was not over a day old. It passed its last moult May 19, and the first larva was born from it May 21. Another was born the next day, when the observations ceased.

June 14 a hill of corn in the field which showed evidence of the presence of *Lasius alienus* was stocked with corn root lice. The lice were placed about the burrows of the ants and

were almost immediately carried below. A gauze-covered frame was placed over the plants. July 5 the leaves of the plants were examined for aerial corn lice, but none were found. The frame was replaced and was not again taken off until October 20, when the leaves of the plants were carefully examined for aphides, but no traces of them were found. On the roots, however, there were numbers of oviparous corn lice with a few wingless viviparous ones and several males — a form which had never before been discovered. There was also a single winged viviparous root louse and a pupa of the same form. All were put in a watch glass over night, and the next morning one of the males was observed *in copula* with an oviparous female, thus establishing the sex of the former beyond a doubt. The pupa had also moulted and become a winged louse; and several of the oviparous females had laid yellow eggs. The fully developed oviparous forms were mostly of a peculiar yellowish pink color, probably due partially at least to the eggs within the abdomen. Many of the young lice in this corn hill were sucking the juices from the roots, which still had a little sap left in them; but most of the adults were wandering about in the galleries of the ant colony.

This experiment proved beyond reasonable doubt that the life cycle of the root form of *Aphis maidis* can be completed without the appearance of the aerial form. To determine whether there ever is any connection between the two forms will require more work.

SUMMARY.

Assuming for the present that there is no connection between the root and aerial forms of *Aphis maidis*, we are justified in the light of these observations in summarizing the life history of the former as follows (starting with the hibernating eggs in the nests of ants):

During the first warm days of spring, usually before the ground is plowed, there hatch from the eggs small greenish lice that are transferred by the ants to the roots and radicles of *Setaria* and *Polygonum*, where they are carefully tended by the ants. In about a fortnight these young have become adult stem-mothers ("*Pseudogyna fundatrix*") and give birth to quite a

number of young. In the mean while the ground has probably been plowed, and some crop sowed. In case this crop is corn the ants transfer the lice to the corn roots; but if it is oats or wheat they may continue to rear the lice on *Setaria* and *Polygonum*. The young from these stem-mothers become adult in about a fortnight, and some of them are apterous and others winged. The winged specimens fly to other hills either in the same or neighboring fields, where the ants are waiting to receive them and proceed to establish colonies. Whether in ground not planted to corn more of this second generation become winged than where corn is present, or not, I cannot say; nor do we know how long the lice can continue to develop on *Setaria* and *Polygonum*. This second generation bring forth viviparous young (mostly wingless); and generations of viviparous females continue to develop on corn roots throughout the summer. In autumn the true sexes are produced (both being apterous), and the eggs are deposited by the oviparous females in the mines of the ant colonies. These eggs are cared for by the ants through the winter, and the young lice that hatch from them in spring are provided for as described above.

DESCRIPTION.

Wingless male.—Body 1.4 mm. long; 7 mm. wide. Antennæ .9 mm. long; cornicles, .08 mm. long; cauda .05 mm. long.

Body flattened; sides nearly parallel between middle coxæ and cornicles; behind cornicles tapering rapidly to cauda; narrowing in front of middle legs. Greenish black with a glaucous bloom; head above black; dorsum of prothorax with a narrow black transverse band; dorsum of mesothorax with a similar wider band, dorsum of metathorax with a narrow band not extending to the margins,—all indistinct and in some lights not distinguishable. Eyes black; antennæ, legs, and cornicles blackish. Caudal segments of abdomen with indistinct transverse dark bands. Ventral surface of thorax blackish, of abdomen dark green with black patch at caudal extremity. Cauda hirsute. Margins of abdomen wavy. Legs long, hairy. Antennæ robust; joint I swollen; II about equal to I in length, but smaller; III longer than I and II; IV and V subequal, IV slightly longer; VI slightly longer than V, and VII about

equal to VI, short for a filament. Cornicles short, slightly swollen, surface rough. Rostrum robust, reaching middle of posterior coxæ.

Described from two living specimens taken in nest of *Lasius alienus* about corn roots, October 21, 1887. One seen *in copula* with oviparous female.

Egg. Length, 7 mm; width, 3 mm. Yellow when first laid, becoming black during winter and changing to green just before hatching in spring.

Described from many specimens, some of which were obtained in breeding cages October 20-22, 1887.