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ARTICLES I.-II.

ART. I. STUDIES OF THE LIFE HISTORY, HABITS, AND TAXONOMIC RELATIONS OF A NEW SPECIES OF OBEREA (OBEREA ULMICOLA CHITTENDEN).

ART. II. STUDIES OF THE HABITS AND DEVELOPMENT OF NEO-CERATA RHODOPHAGA COQUILLET.

BY

F. M. WEBSTER, M.S.

NATURAL HISTORY SURVEY

SEP 9 1969

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ERRATA AND ADDENDA.

- Page 55, line 15, for 1854 read 1855.
Page 55, line 16, for *Horticultural* read *State Agricultural*.
Page 60, in second table, Illinois, for 240 read 241.
Page 65, first line above foot-note, for *ventricosa* read *ligamentina*.
Page 72, line 9, for *imbecilis* read *imbecillis*.
Page 79, line 19, for *asperimus* read *asperrimus*.
Page 80, above *Quadrula rubiginosa* insert Section *Fusconaia* Simpson.
Page 76. The record of Calkins for *Margaritana margaritifera* is without doubt erroneous and should be eliminated. This species is not found in Illinois.
Page 95. *Pomatiopsis sheldonii* Pilsbry should read *Ammicola sheldonii* and should be transferred to the genus *Ammicola* on page 93.
Page 100. *Physa gyrina oleacea* Tryon is the immature stage of *Physa gyrina*.
Page 103. *Lymnaea tazewelliana* is a synonym of *Lymnaea parva*.
Page 105. *Lymnaea palustris michiganensis* is the immature form of *Lymnaea reflexa*.
Page 106. *Lymnaea reflexa iowensis* and *Lymnaea reflexa crystalensis* are synonyms of *Lymnaea reflexa*.
Page 112, line 6 from bottom, for *gouldi* read *gouldii*.
Page 114, line 5 from bottom, for *juxtigens* read *juxticens*.
Page 115, line 21, for *Witter* read *Walker*; line 23, *Polygyra sayii* Binney should be changed to *Polygyra sayana* Pilsbry.
Page 116, line 1. *Polygyra exoleta* Binney (1885) should be changed to *Polygyra zaleta* Binney (1837).
Page 117, line 11 from bottom, for *leai* read *leaii*; line 3 from bottom, *Polygyra monodon fraterna* is a good species and should read *Polygyra fraterna*.
Page 119, foot-note. A specimen of *alliaris* in the collection of Mr. Aldrich, received from Calkins, proves to be *draparnaldi*.
Page 121, line 3 from bottom, for *Champaign* read *Piatt*.
Page 122, line 12 from bottom, for *Pyramidula striatella* Anthony read *Pyramidula cronkkiti anthonyi* Pilsbry; line 4, for *Held* read *Hald*.
Page 123, for *Helicodiscus lineatus* Say read *Helicodiscus parallelus* Say.
Page 162, line 7, for *glandulosa* read *linearis*.
Page 171, line 17, for *riparia* read *vulpina*.
Page 176, line 8 from bottom, for *canadense* read *majus*.
Page 180, line 9, for *virginica* read *virginiana*.
Page 221, line 6 from bottom, for *rectangulus* read *rectangularis*.
Page 226, line 3, for *fasciatus* read *fasciata*.
Page 239, line 11, strike out Lake Co. entry.
Page 246, lines 6 and 7, and page 248, lines 1, 14, 20, and 23, for *Enothera* read *Onagra*.
Page 248, line 4, for *candida* Horn substitute n. sp.

Page 249, line 8 from bottom, for *Olethreutes dimidiana* Sodoff? read *Olethreutes separatana* Kearfott, and strike out parenthetical matter.

Page 251, line 7, for *grossa* read *thoracica*; line 21, for words preceding H. 6, read *Asilus rufipennis* Hine; line 18 from bottom, for words preceding H. 2, substitute *Asilus cacopilogus* Hine.

Page 253, line 8, for *Linn.* read *Emory*.

Page 257, line 15, for *pennsylvanicus* DeG. read *auricomus* Rob.

Page 261, Note 6. *Melanoplus macneilli* is very probably *M. fluviatilis* Brun.

Page 262, Note 9. Dr. Bergroth writes that *Nabis elongatus* is preoccupied. The original is *elogantus* in the check list. Comparison with long-winged *vicarius* is desirable before re-naming it.

Page 309, in table, for 59 read 57, and for 743 read 741.

Page 310, in table, for 59 read 57.

Page 314, line 5, for 1587 read 481; line 16, after *stubble* insert *meadows*; line 17, after *pastures* strike out *and meadows*, and after 1500 strike out *each*.

Page 315, last line, for 553 read 481.

Page 362, line 7 from bottom, for *longa* read *parvilamellata*.

Page 373. As a second entry in synonymy insert as follows:

1854. *Nothrus bistriatus*, Nicolet, *Acariens des Environs de Paris*, p. 397, Pl. VII., Fig. 7.

Page 376, line 13 from bottom, for *Oribata* read *Oribates*.

Page 378, line 1, for XXV. read XXXV.

Page 384, after line 5 insert as follows:

N. bipilis Hermann. Mem. Apt., p. 95.

In moss, Arcola and Parker, Ill.

Page 384, line 5 from bottom, for *pyrostigma* read *pyrostigmata*.

Page 386, after line 11 from bottom insert as follows:

H. bistriata Nicolet. *Acariens des Environs de Paris*, p. 397, Pl. VII., Fig. 7.

Under logs and in moss, Urbana and Arcola, Ill.

Page 388, line 12, for *sphærum* read *sphærule*.

ARTICLE II.—*Studies of the Habits and Development of Neocerata rhodophaga* Coquillett. BY F. M. WEBSTER.

About the year 1897, in the vicinity of Chicago, Illinois, certain varieties of roses grown under glass, notably the Meteor, were attacked by great numbers of minute cecidomyian larvæ which destroyed the terminal leaf and blossom buds. In the greenhouses of one extensive rose-grower, the injury was so severe as to render the production of the Meteor unprofitable, and he stopped growing it for a time, until the pest seemed to have disappeared. Strangely enough, another grower, whose houses were separated from those of the first only by a narrow alley, did not at that time suffer at all from the ravages of the insect, but continued to grow the Meteor in his rose-houses without difficulty until sometime after, when he, too, began to experience severe losses on account of its depredations. The species was not definitely determined at that time, and it is impossible in the light of later investigations to say with certainty whether or not more than one was engaged in these attacks. Since then, however, a number of extensive rose-growers about Chicago have been obliged to abandon the growing of this particular variety of rose on account of its extreme liability to attack from these larvæ.

In 1900, Mr. D. W. Coquillett published a paper* reporting similar injuries to roses grown under glass in New Jersey in 1886 and 1889; New York in 1890; Washington, D. C., in 1891, 1894, and 1896; Boston in 1894; and Chicago, as has been stated, in 1897. In this paper, Mr. Coquillett describes a new species, *Diplosis rosivora*, and a new genus and species, *Neocerata rhodophaga*, both of which were reared from larvæ attacking roses in this manner in Washington, D. C. The author says that the larvæ of the former species—those of the latter being unknown to him—“are of a white color when young, but become

*Bull. 22, N. S., Div. Ent., U. S. Dept. Agr., pp. 44-48.

orange-red in the latter part of their periods". Elsewhere in his paper he tells us that these larvæ are entirely devoid of the the so-called "breast-bone", and in still another place expresses the suspicion that the species was originally a native of some tropical region, as they were not known to attack roses in the open air. Summarizing this information, then, we have a peculiar injury to roses, especially to the Meteor, a variety originating in Europe, occurring in widely different localities, due to two species of insects, working to all appearances precisely alike, and reared from infested plants growing in Washington. Apparently the same species was sent to the U. S. Department of Agriculture from Cleveland, Ohio, in 1903.

On May 16, 1903, a firm located in the vicinity of Chicago, engaged in growing roses extensively under glass, advised the State Entomologist of serious trouble among their Meteors, evidently due to a minute white worm which attacked the buds and destroyed them. Early in June, Mr. C. A. Hart, being in that vicinity, visited the premises by Dr. Forbes's direction, and brought some of the affected buds to the office. The larvæ found in them were very small, white, except those seemingly full grown which were tinged with orange, and the so-called "breast-bone" was clearly present.

The matter was now placed in my hands for investigation, and on June 11, acting under instructions, I visited the rose-houses containing the injured plants. Larvæ were found in the young rosebuds of both leaf and blossom, but more abundantly in the latter, and also eggs, which, from their position in these buds, indicated that they were those of the same species as the larvæ. Several very minute female midge-like flies were also taken, seemingly in the act of ovipositing in the blossom buds.

SPECIES DIFFERS FROM THOSE PREVIOUSLY DESCRIBED.

The larvæ found in the rosebuds did not agree with those described by Mr. Coquillett, but, like those brought home by Mr. Hart, possessed the "breast-bone", and the older individuals were not an orange-red color, but slightly tinged with orange with-

out any clearly defined pattern to the coloration. The adult flies afterwards reared from these larvæ did not entirely agree with either of the species described by Mr. Coquillett, but proved to be the same as those observed in the act of ovipositing in the buds. Moreover, from larvæ inhabiting the buds at this time I reared adults which, ovipositing in other buds on plants provided them, gave me eggs like those previously observed, as well as larvæ, pupæ, and adults, afterwards reared from these eggs. Clearly, I was dealing with a species whose larvæ inhabited rosebuds in the same manner as those described from Washington. Specimens have since been submitted to the noted British dipterologist, Mr. F. V. Theobald, who reported upon them as follows:

“I have made a number of careful preparations of the rose cecidomyid. The female you sent previously had the antennæ broken. But for the antennæ, they exactly answer to *Cecidomyia rosarum* Hardy. I feel quite sure they are all Coquillett's *Neocerata rhodophaga* (Bull. 22, N. S., Div. Ent., U. S. Dept. Agr., p. 47. 1900). The males are all 9-jointed in regard to the antennæ, and exactly answer Coquillett's description. I mounted some twenty females, and found the antennal joints vary from 9 to 11, so the character of his genus (which is certainly a good one) in regard to antennal joints must be modified. There is no doubt that antennal joints vary in cecidomyids, especially in the female sex. In one I found an evidence of transition between 10 and 11 joints. All the males, some fifteen, had the same genitalia and 9-jointed antennæ. The globular second joint is very characteristic. Note also the marked lepidopterous scale in this species.”

While the normal antenna of the female is shown in Plate III, i, and is certainly 10-jointed, with an occasional indication of 11 joints, as stated by Mr. Theobald, the terminal joint being prolonged and constricted but without distinct articulation, yet there is a wider variation than was observed by him. In one case a female was found with a 6-jointed antenna on one side, joints 3 and 4 being fused, with the terminal joint fully twice the ordi-

nary length, while the other antenna consisted of 9 joints, the terminal one seeming to consist of two fused together. Another female had 9-jointed antennæ, but again the terminal joint was fully twice the normal length, with the same appearance of two joints being fused as is exhibited where there are 10, and a constriction as if indicating an 11th joint, while still another female had 9-jointed antennæ, with an indication of a tenth. The males all have 9-jointed antennæ. It will thus be observed that the female does not agree with Mr. Coquillett's description of this species. Hardy described *Dichelomyia* (*Cecidomyia*) *rosarum* as having 14-jointed antennæ, so our species does not fit his description, though, as stated by Mr. Theobald, aside from the number of antennal joints there is no perceivable difference between them. We have shown that the number of joints in the female antennæ of the American species is too variable to be considered a specific character. Are not those of Hardy's species equally variable, and did he not describe a variation instead of the normal? How far can the number of antennal joints be relied upon in separating the species of *Cecidomyiide*? These are questions that I am unable to answer, but they have a decidedly important relation to the solution of the problem of the specific identity of the insect under consideration.

The larvæ from which all my material was reared, closely correspond with the description given by Hardy, but unfortunately he could not say whether it was his *C. rosarum* or *C. rhodophila* that developed from them.

HABITS OF THE BRITISH SPECIES.

The habits of *Dichelomyia rosarum* are given in "Die Rosenschädlinge," p. 272, by Friedrich Richter v. Binnenthal; and by Rübsaamen, in "Biologisches Centralblatt," Vol. XIX., Nos. 16, 17, and 18. Mr. Theobald informs me that he has found it attacking roses in England, both in rose-houses and in the open. In the open, it attacks the dogrose, *Rosa canina* Linn., the commonest rose in Britain, which grows rapidly and luxuriantly in hedges, thickets, and various dry places in every part of the country. "The gall is formed by the edges of the leaflet

rising above the midrib until they approximate and a thin-walled hollow pod is formed. The galls may be sought for during the months from June to October. The larvæ pupate in the ground, the imagines emerging in about six days after pupation."* The galls on the leaves are certainly more conspicuous than are the effects of the American species in this country, in rose-houses. The species winters in the pupal stage.

HABITS OF THE AMERICAN SPECIES.

I have never seen the larvæ attacking the native wild roses, even about Chicago, though, in the near vicinity of infested rose-houses, I have found them in buds of a variety known as the Bride, growing in the open air. The manner of hibernation in our species is not well understood, but in the rose-houses there is no injury done by the larvæ from late October until late the following May. A thorough inspection of large rose-houses about Chicago, November 18-20, did not reveal a single larva or adult, even where serious damage had been wrought a few months before, and an inspection made on January 29, 1904, also failed to reveal their presence.

In the rose-houses, the larvæ attack the Meteor, Wooton, Bride, Madame Chatenay, La France, Ivory, and Golden Gate, but are far more fatal to the first than to any other variety. The insect first appears in such rose-houses as are old and more or less open on account of cracks and crevices, or else in such as are new and tight, requiring much ventilation. In the case previously referred to, where only an alley separated infested from uninfested premises, the uninfested houses were given the least possible ventilation consistent with the growth of the roses, while those infested were more generally ventilated. Later on, these conditions were reversed, and the situation as to insects changed also, the premises that had before escaped being now overrun.

An experienced foreman in the employ of a firm of extensive rose-growers whose premises were infested with this midge, informed me that the insect first attracted his attention by at-

*"British Vegetable Galls," by Edward T. Connold, p. 206, Plate 87.

tacking those buds that were highest up and nearest to the glass, and that the larvæ were only to be found in such buds as were in close proximity to the glass, those situated lower down not being at all affected, thus indicating that one rose-house may become infested from another by adults, and not necessarily from the introduction of infested plants. From the fact that there are but few larvæ present up to the month of May, but that they increase in number during the summer and altogether disappear in late October, it would seem that they follow very closely the habits of the British species.

The eggs are deposited either in the unfolding leaf buds or under the sepals of the blossom buds, the latter position seemingly being preferred by the females where there is an opportunity for selection. In case the former is chosen, the eggs are deftly inserted in the conduplicated leaves between what would, later on, constitute the upper surfaces of the two halves of the unfolded leaf. The maggots appear to fasten the edges together with some viscous matter, thus forming a sort of pod within which they attain their larval growth. If there are few larvæ, their effect is to cause more or less prominent swellings on what would later become the lower surface of the leaf; if there are many larvæ in the leaf, it simply becomes distorted and discolored and dies, leaving the affected parts as illustrated in Plate III, a. In case of blossom buds, the effort of the female seems to be to place her eggs as far under and near the base of the sepal as possible, but there does not appear to be any regularity either in their exact position or numbers. Occasionally they will be found stuck in the sutures separating the sepals. The ovipositor of the female is capable of great extension, and I have observed it to be curved, coiled, and twisted in her efforts to push it under the closely adhering sepal of a very young bud. Frequently, after this has been accomplished she is unable to extricate it, and dies attached to the bud. In one case I found two females on a single bud, they having apparently perished in this manner. Nevertheless, the females seem to be strikingly attached to their labor of ovipositing, as, in a propagating

house where there were thousands of young plants with but few blossom buds, if they were driven from one of these they would fly but a few inches away and soon return. They are exceedingly minute, and obscure while on the wing, having much the appearance of floating particles of dust.

While the larvæ are at first usually well covered by the, sepals and folded leaves, if excessively abundant they will, later swarm out and over the outer surface, especially of the blossom buds, finally leaving them in the condition indicated in the plate.

DESCRIPTION.

Egg (Pl. III., b).—Length, 0.32 mm.; width, 0.075 mm. Smooth, orange color with tinge of yellow, elongated ovoid, with one end but slightly obtuse.

When placed under the sepals, the eggs are often slightly bent or otherwise distorted, but when deposited on the surface or in the folded leaves, this does not occur. They have a vague resemblance to the hair-glands of the buds, and might be mistaken for these by the careless observer. The egg period is two days.

Larva (Pl. III., c, d).—The newly hatched larva is but little larger than the egg from which it emerged, and much the same color. Later it becomes nearly white, but when approaching maturity it takes on a reddish tinge, without definite pattern in its coloration, except that the lateral margins remain white. The amount of color varies with individuals, but none are wholly orange. The length of a fully grown larva is 1.8 mm.; width, 0.45 mm.; widest at middle, obtuse and tuberculated on the posterior segment, tubercles with minute apical spine, surface finely granulated, lateral margins distinctly compressed, attenuated anteriorly, breast-bone distinct, a conspicuous black spot on upper side and showing through to the under side indistinctly, just in front of breast-bone. Antennæ short, not extending beyond the body.

When fully grown the larvæ crawl out and drop to the ground, and I have observed as many as twenty-five in a single

blossom bud. They are very tenacious of life. Those Mr. Hart secured some days after removal from the buds and placed in 80 per cent. alcohol at 11:25 a.m., were still active at 2:40 p. m., and lived for some time in the 95 per cent. alcohol in which I then submerged them, but at 3:50 p. m. seemed to be dead. Infested rose plants were fumigated with hydrocyanic acid gas, in one case one tenth, and in another fifteen hundredths of a gram of potassium cyanide being used to each cubic foot of space. The plants were subjected to the gas for fifteen minutes in both cases, with the result that only the larvæ that were exposed were killed, while such as were protected by the sepals were not affected. The same treatment killed flies (in from twenty to thirty seconds), plant-lice, and beetles. On descending into the ground the larva constructs an almost transparent cocoon—presumably the product of exudation—sufficiently viscid to stick to surrounding particles of sand or dirt, and becoming sufficiently tough to retain its contents. Within this the larva remains two days, some of the time in a curved position, when it passes into the pupa state. The larval period, including two days in the cocoon, is seven days. That moisture has little influence on the development of the insect is shown by the fact that pupation in this case was continued in sand thoroughly saturated with water.

Pupa (Plate III., e, f).—Length, 1.6 mm.; width, 0.53, mm. Color, at first as in the full grown larva, later the eyes are red and the general color of the body more reddish-yellow, but at the time of emerging from the cocoon the eyes are black, the antennæ and legs nearly black, and the head and prothorax dusky. On the dorsal abdominal area is a median red space, widest at base, diminishing to the sixth segment. On all of the segments except the first is a transverse spinulose ridge near the anterior dorsal margin, less marked on the second segment and increasing in size to the eighth, which is sculptured somewhat as in the larva. Ventral surface without spinulose ridges. Anal segment much smaller than seventh, which is slightly smaller than sixth. Bases of antennæ produced, with

the usual pair of bristles just behind them, while the two large, pointed respiratory tubes protrude through the cocoon, as though utilized by the pupa in making its way forth. Pupal period, six days.

On making its way from the cocoon to the surface of the ground, the pupa travels by the aid of the spinulose ridges on the back. One under observation, which had pupated in water in a watch-glass, crawled to the rim and traveled three times around the edge entirely on its back; and another, which emerged under a bell-glass, traveled for a distance of six inches, also on its back, over the moistened inner surface of the glass.

Adult (Pl. III., g, h).—"Antennæ in both sexes slightly shorter than the head and thorax taken together, nine-jointed; joint 1 obconical, 2 globular, wider than any of the others; joints 3 to 8 only slightly longer than wide, subsessile, the hairs very sparse, not arranged in whorls; joint 9 almost twice as long as 8, slightly constricted near the middle. Wings hyaline, bare except along the hind margin near the base and on the veins, which are sparsely bristly, rather densely bristly along the first half of the costa, interspersed with flattened bristles; the first vein lies very close to the costa, which it joins slightly before the middle of the wing; third vein evenly arcuate, joining the costa far before the extreme apex of the wing, this distance almost equaling one-half of the greatest width of the wing, the extreme base of this vein, where it joins the first vein, very indistinct; fifth vein indistinct toward its apex, forked at its last fourth, the anterior fork reaching the hind margin a short distance basally of the tip of the third vein. First tarsal joint less than one-half as long as the second, claws of tarsi simple. Color of alcoholic specimens yellow, the head and thorax tinged with brown. Length, 1 to 1.25 mm." (Coquillett.*)

NATIVITY OF THE INSECT.

In the light of the foregoing it will be seen that our rose-attacking insect is not a native species, else it would certainly

*Bull. 22, N. S., Div. Ent., U. S. Dept. Agr., p. 47.

have attracted attention by its appearance in roses in the open air, and its gradual occurrence farther and farther inland does not imply an American origin.

It affects the most seriously a species of rose that requires a very warm, yet ventilated environment, and which, indeed, is one of the most difficult varieties to grow successfully in this country, besides being of European origin. In England and Europe there is also a rose-attacking insect which can only be separated anatomically from our species by the number of antennal joints, a character known to be somewhat variable. The habits of the two are very much alike, except that in Britain the larvæ affect the leaf buds and not the blossom buds, both in the rose-houses and in the open air. Our species attacks roses only in rose-houses, largely confining its ravages to the blossom buds, but when attacking the leaf buds affects them as does the English species. In Britain, and in the open air, the wild, or dogrose, though it grows rapidly, can not certainly make as rapid growth as does the Meteor in our rose-houses, where all the ingenuity of the grower is centered on producing the most rapid and vigorous growth possible. It is doubtful if the American species could, under these conditions, develop in any considerable numbers in the leaf buds, as the growth of the buds is so accelerated by artificial conditions that there is not time for the larvæ to develop within them before they become too much expanded and too tough to admit of the larvæ affecting them. The blossom bud, being of a slower development, affords a longer time for the larvæ to mature, and, besides, presents food of a different character from that of a leaf bud.

To sum up the whole discussion, then, it is not now possible to regard our American species as the same as that occurring in England and Europe, known as *Dichelomyia rosarum* Hardy, but that it is closely allied to that species can not be doubted. We must wait for future studies to show us whether our Americanized form has sufficiently developed to admit of its being separated as a new genus and species.

I have held to Mr. Coquillett's specific name because it is

very convenient whereby to designate our American insect, and time, which sooner or later will settle these problems, will put the question to rest, perhaps by proving that his new genus and species is entirely distinct. At present, we know too little of these insects to go beyond this.

EXPLANATION OF PLATE.

PLATE III.

The Rose Midge, *Neocerata rhodophaga* Coquillett: a, illustrating effect of larvæ on blossom and leaf buds; b, egg; c, newly hatched larva; d, fully grown larva; e, immature pupa in cocoon, dorsal view; f, immature pupa in cocoon, lateral view; g, adult male; h, adult female; i, normal antenna of female.

Figures a, b, c, and d, Plate I., and b, c, d, e, f, g, h, and i, Plate III., all greatly enlarged; Figure e, Plate I., and Plate II., all about natural size; Figure a, Plate III., reduced. All figures drawn from life by Miss Charlotte M. Pinkerton, under author's supervision.

Articles I. and II. issued Feb. 26, 1904.



The Rose Midge (*Neocerata rhodophaga* Coquillett) and injured plant.