

# HILGARDIA

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E. O. ESSIG

### WESTERN CELERY MOSAIC

HENRY H. P. SEVERIN and JULIUS H. FREITAG

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UNIVERSITY OF CALIFORNIA · BERKELEY, CALIFORNIA

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## APHIDS FEEDING ON CELERY IN CALIFORNIA<sup>1, 2</sup>

E. O. ESSIG<sup>3</sup>

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### INTRODUCTION

THE RÔLE OF APHIDS in the transmission of virus diseases of celery, *Apium graveolens* Linn., var. *dulce*, in California has attained considerable economic importance in recent years. The object of this paper is to furnish information as to the identity of the various species involved, the determination of which has been a difficult task. It has been especially complicated by the large number of different species discovered feeding on celery and by the fact that the species appear to be considerably altered, particularly in size, when reared in the greenhouse. Many of the species studied appear to be introduced, while others are undoubtedly indigenous. An abundance of wild umbelliferous plants, growing in all of the celery-producing sections of California, affords a continuous and ample food supply throughout the year. Certain of the aphids studied alternate from these hosts to willow, honeysuckle, and many other cultivated and wild plants. Carrots and celery are extensively grown as winter crops in many parts of California and aphids may be found upon them almost any time of the year. In view of the great abundance and wide distribu-

<sup>1</sup> Paper received for publication July 20, 1936; some notes on distribution and host range added in August, 1937.

<sup>2</sup> The drawings were made from funds received from the N.Y.A. and the W.P.A.

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tion of the many food plants, the commercial control of aphids to a degree that will prevent the losses to celery from the insect-borne plant virus diseases presents a most complex and difficult problem to solve.

### THE CELERY LEAF APHID

*Aphis apigraveolens* Essig n. sp.

The celery leaf aphid, *Aphis apigraveolens* (fig. 1), a new species, was first taken on celery at Venice, California, in June, 1935, by J. H. Freitag, who subsequently propagated it in the greenhouse at Berkeley on that plant. In December of the same year he also discovered it in the commercial celery fields of Milpitas.

The specimens studied for this account have all been reared under glass and may therefore be smaller than those which occur out of doors; for many species propagated in the greenhouse here at Berkeley have proved to be much smaller than those collected in the fields. This dwarfing may also occur when transferred to different hosts, so that it has not been definitely proved whether the diminution is due to greenhouse conditions or to the influence of the host or to both.

Frequently the coloration is also markedly altered when the aphids are thus artificially reared. It is to be expected that the measurements and color pattern may prove at variance in specimens occurring in the fields and on other hosts, if such are discovered.

*Apterous Viviparous Female*.—Very small, elongated, somewhat depressed, and pointed posteriorly. Color pale yellow with head and anterior portion of the body amber or orange and with the tips of the appendages dusky; a series of small green patches occurs along the sides of the abdomen, a small green median patch and a prominent, somewhat bilobed green band across the abdomen on the segment in front of the cornicles. This band is similar to that of *Aphis apii* Theobald and may lead to the confusion of the two species if a microscopic examination is not made. The antennae are shorter than the body, the lengths of the segments being: I, 0.04 mm; II, 0.05 mm; III, 0.24 mm; IV, 0.11 mm; V, 0.13 mm; VI, 0.30 (base, 0.10 mm, unguis, 0.20 mm); total 0.87 mm. There are no secondary sensoria. The lateral prothoracic tubercle is prominent. The legs are short and marked as illustrated (fig. 1). The cornicles are dark, short, nearly cylindrical or slightly tapering apically, usually somewhat enlarged near the tip, with a small flange, slightly recurved in many individuals, imbricated; length 0.15 mm. The cauda is dark, upcurved, with three or four pairs of curved hairs; length 0.20 mm.

Length of body, 1.30 mm; width, 0.70 mm.

*Alate Viviparous Female*.—The colors of the winged individual appear black and yellowish green to the unaided eye, but a close examination reveals the head, thorax, and appendages black as illustrated in figure 1. The abdomen is yellow or very pale green with darker-green markings much as noted in the apterous individual. In addition there are small, nearly circular, dusky or black spots arranged in two laterodorsal longitudinal rows, a small median patch and two rather large, irregular, dark, lateral patches, and a transverse dark line anterior to the cauda. The antennae are

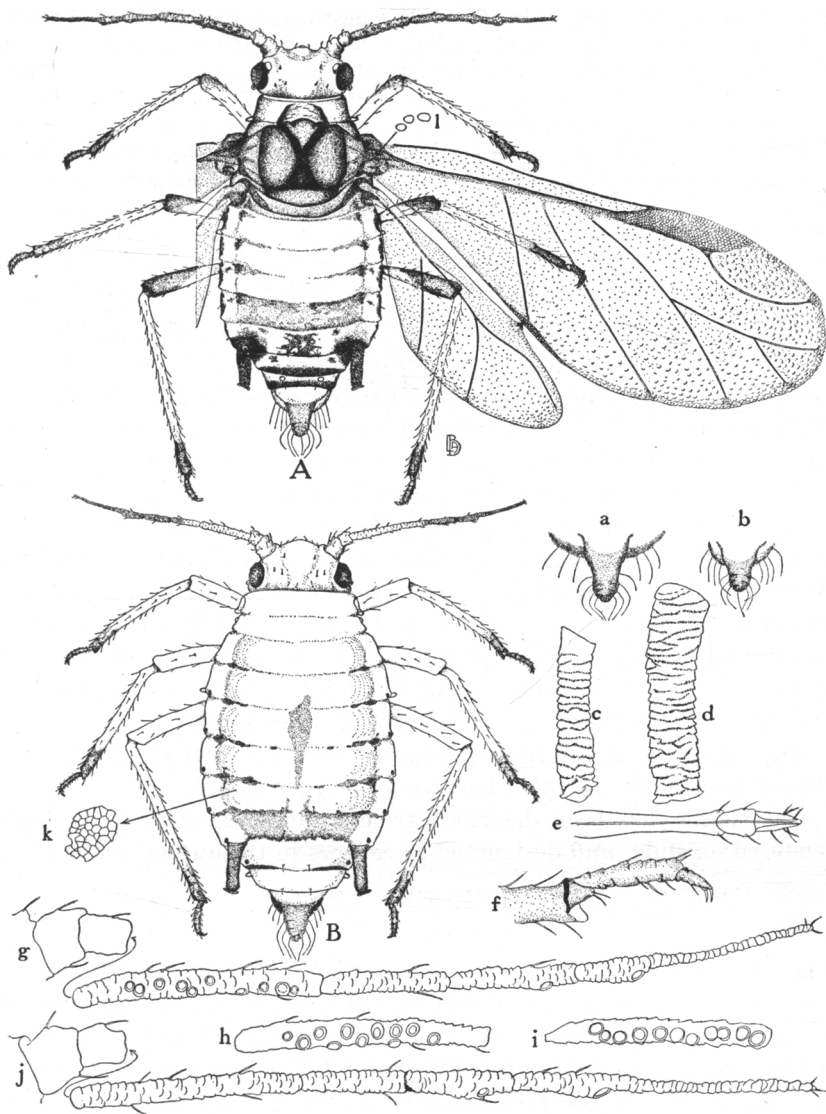


Fig. 1.—The celery leaf aphid, *Aphis apigraveolens* Essig. *A*, Adult winged female; *b*, cauda; *c*, cornicle; *g*, antenna; *h* and *i*, segment III of antennae showing different arrangements of sensoria; *l*, circular fenestras at the base of subcostal vein. *B*, Adult apterous female: *a*, cauda; *d*, cornicle; *e*, rostrum; *f*, tarsus; *j*, antenna; *k*, body reticulations; *l*, fenestras. All greatly enlarged.



shorter than the body and the lengths of the segments vary considerably in different individuals. Lengths of segments for a single average-sized specimen are: I, 0.05 mm; II, 0.06 mm; III, 0.25 mm; IV, 0.14 mm; V, 0.12 mm; VI, 0.30 mm (base, 0.10 mm, unguis, 0.20 mm); total 0.92 mm. In many individuals, V is equal to IV and in one instance noted it was longer. From 6 to 13 rather large, circular secondary sensoria are scattered or arranged in a row on segment III. Of fifty segments examined, the average number was 9.62 per segment. Only one segment had 6 and only one 13. The cornicles are similar to those of the apterous forms in color, shape, and imbrication, with a length of 0.18 mm. The length of cauda is 0.12 mm. The stigma of the fore wing is noticeably short and the second branch of the media is near the apical margin.

Length of the body, 1.25 mm; width, 0.48 mm; length of fore wing, 2 mm.

This species is likely to be confused with the celery aphid, *Aphis apii*, and the cotton or melon aphid, *Aphis gossypii*. In color it somewhat resembles the former, but mounted specimens are readily distinguished by the arrangement of the fewer sensoria on the antennae of the winged forms. From the latter it is separated by the color arrangements, by the uniformly larger number of secondary sensoria on antennal segment III of the winged forms, and by the peculiar form of the cornicles. It was thought to be one of the various forms of *A. gossypii*, but rearing tests in the greenhouse pointed to the contrary. These tests, owing to the lack of a wide variety of hosts, are by no means conclusive. The impossibility of definitely relegating this aphid to any known named species and the necessity for a definite cognomen by which it may be known in print are offered as justifications for describing it as a new species.

The celery leaf aphid feeds in compact colonies on the undersides of the leaves of celery. No other host has as yet been found.

The species has been described from a large series of individuals mounted on slides and designated as cotypes in the author's collection.

## THE CELERY APHID

*Aphis apii* Theobald<sup>4</sup>

The celery aphid, *Aphis apii* Theobald (fig. 2), is comparatively new to science and is as yet little known even to aphidologists. It varies from 1.0 to 2.7 mm in length and is usually bright green and luteolous in color, marked with black as illustrated in figure 2. The apterous forms occurring on celery are pale green to greenish yellow, with blue-green or a darker-green bilobed band across the dorsum of the abdomen between and in front of the bases of the cornicles. The colors may vary somewhat in intensity, but the markings are fairly constant. The apical portion of the antennae, the tips of the tibiae, the tarsi, and the cornicles are dusky or black.

The winged forms are similar in color, but the abdomen is usually

<sup>4</sup> See Theobald (1925, p. 42; 1926-1929, vol. 2, p. 182-83, fig. 81).

darker green. The head and thorax are shining black. The antennae and cornicles are black and the apical portions of the femora and tibiae, and all of the tarsi are dusky. The dorsal, darker-green, bilobed band is also noticeable on the abdomen.

This species is similar to *Aphis apigraveolens* n. sp., but has less orange and yellow in the color, fewer sensoria on the third antennal seg-

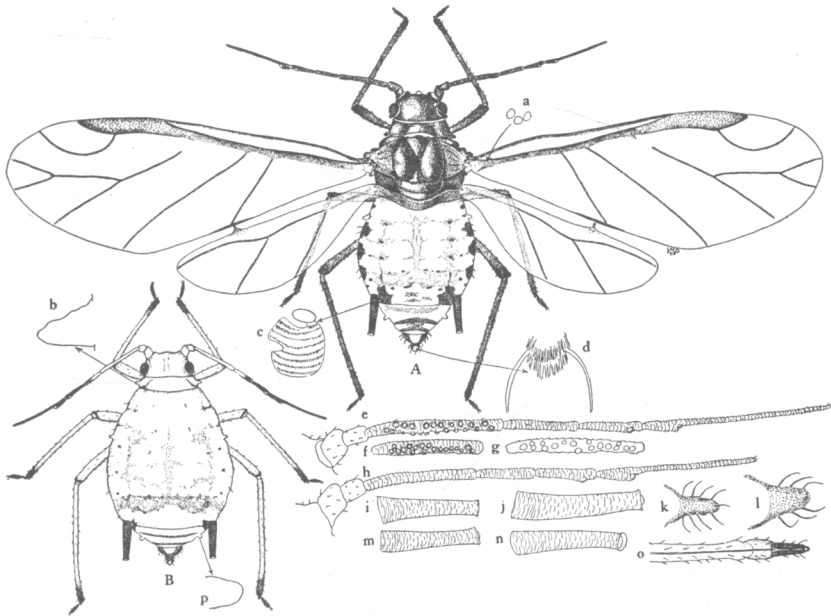


Fig. 2.—The celery aphid, *Aphis apii* Theobald. A, Adult winged female: a, fenestras; c, derm behind the bases of the cornicles; d, tip of cauda; e, antenna; f and g, antennal segment III, showing variation in the arrangement of the sensoria; i and m, cornicles; k, cauda; o, rostrum. B, Adult apterous female: b, prothoracic tubercle; h, antenna; j and n, cornicles; l, cauda; p, posterior abdominal tubercle. All greatly enlarged.

ment of the winged forms, shorter unguis of the last antennal segment, and darker cornicles.

The celery aphid occurs chiefly on the undersides of the leaves of the host plants. It has been reported from four localities in England by Theobald (1926–1929, vol. 2, p. 183).

In California the species was first discovered on shipments of celery from Gardena by H. H. P. Severin and J. H. Freitag, October 4, 1934. The next year it was noted on shipments from Compton and Venice. Severin and Freitag also collected it in the celery fields at Alviso, Chula Vista, Lomita, Malibu Beach, Milpitas, Mountain View, Palo Alto, San Fernando, and Seal Beach in 1935, and on sweet fennel, *Foeniculum*

*vulgare*, at Milpitas the same year. For two years they have reared it on celery in the greenhouse at Berkeley.

### THE RUSTY-BANDED APHID

*Aphis ferruginea-striata* Essig n. sp.

In August, 1934, Severin and Freitag collected an aphid on celery in Los Angeles and Mountain View, California, which was subsequently propagated on celery plants in the University greenhouse at Berkeley. The individuals thus reared were very small and the apterous forms were pale yellow, yellow-amber, green, or bluish green, slightly pulverulent, and with a conspicuous rusty-red band across the dorsum between and surrounding the bases of the cornicles. The winged forms differed only in the darker markings common to winged individuals. On the whole the species averaged little more than 1.25 mm in length. Because of the conspicuous band it has been called the rusty-banded aphid and named *Aphis ferruginea-striata*.

On September 14 and October 24, 1934, the writer collected a large series of what was truly a most interesting species, occurring in great numbers about the bases and in the leaf axils of the poison hemlock in Strawberry Canyon on the campus of the University of California, Berkeley. This aphid was large and robust, varying from 2 mm to 3 mm in length; it was pale amber and covered with fine whitish powdery wax that gave a decidedly gray aspect. Mature apterous forms were marked with a few dorsal spots and bands, whereas on the winged forms the head, antennae, thorax, legs, cornicles, and much of the dorsal area of the abdomen were dusky or black. All forms were also marked with the conspicuous rusty band which at once suggested that it might be identical with the species previously found feeding on celery by Severin and Freitag, and it is so considered in this paper.

The naming of this species presented many difficulties and a perusal of the literature did not reveal a solution to the problem. At first it was thought to be *Rhopalosiphum foeniculi* (Passerini), reported by Davidson (1910, p. 377) on the sweet fennel in the vicinity of Stanford University, California, in November, 1909, but no adequate description was given, and specimens have not been examined. This supposition was further strengthened by the fact that Theobald (1926-1929, vol. 2, p. 77-78), in referring to this species, makes this significant statement: "Passerini remarks that the alate female is sometimes rusty between the cornicles." This rusty band, together with the somewhat swollen cornicles, might seem to justify the above determination. However, in order to avoid a possible mistake, specimens were sent to specialists in America and in Europe, but without beneficial results.

On July 23, 1936, the writer discovered an aphid at the bases of the stalks, near and even under the surface of the ground, and in the leaf axils of the common wild parsnip, growing abundantly along the roadside near Newmarket, England. The species looked like the one taken on poison hemlock in California, with the exception that the rusty band was absent, but the size, shape, and habits appeared almost identical; and it was also attended by ants, which covered certain of the aphids near the bases of the plants in a similar manner. This English species was mounted and was identified as *Aphis subterranea* Walker (*Anuraphis*) (Theobald, 1926-1929, vol. 2, p. 277-81, figs. 128-30). Naturally the California species was thought to be this one and specimens of the latter were sent for. While there are important resemblances in size, shape, and habits, there are also some important differences which seem sufficient to warrant describing the California aphid as a new species.

*Apterous viviparous female.* (Fig. 3, B). Large, robust, slow-moving species. Color varying from amber to grayish brown, often with a reddish tinge, and with many small dark markings, as shown in the accompanying illustration (fig. 3, B). The eyes, legs, portions of the antennae, the cornicles, cauda, and anal plate are dusky. In the living forms there is a conspicuous rusty-red band between and surrounding the bases of the cornicles. The bodies are often covered with a whitish pulverulence, giving a decided grayish or frosted appearance. There is a pair of conspicuous lateral tubercles on the prothorax and pairs of smaller tubercles on the sides of most of the abdominal segments, and on the dorsum of the head, prothorax, and the 8th abdominal segment. The antennae are much less than half the length of the body and are dusky, except the base of segment III, which is pale. The lengths of the segments are: I, 0.07 mm; II, 0.06 mm; III, 0.32 mm; IV, 0.21 mm; V, 0.14 mm; VI, 0.37 mm (base, 0.08 mm; unguis, 0.29 mm); total 1.17 mm. There are no secondary sensoria on the antennae of any of the specimens examined. The rostrum extends to or slightly beyond the 2d coxae. The cornicles are very finely imbricated, dusky, widest at the base and nearly cylindrical, with the apical portion constricted and terminating in a flange which has a diameter smaller than that of the base. In some specimens these organs are somewhat swollen in the middle. The length is 0.25 mm; the width 0.05 mm. The cauda is rounded and about twice as broad as long. The anal plate is almost hemispherical and much wider than the base of the cauda.

Length of the body: 2.75 mm; width, 1.14 mm.

*Alate viviparous female* (fig. 3, A). The general color is the same as that of the apterous form, but much darker. The head and thoracic regions, eyes, antennae, legs, cornicles, cauda, anal plate, and the lateral and dorsal abdominal patches are all dusky or black as shown in figure 3, A. In cleared, mounted specimens, the apical portions of the cornicles appear paler than the bases. The antennae are considerably shorter than the body. The lengths of the segments are: I, 0.07 mm; II, 0.06 mm; III, 0.47 mm; IV, 0.28 mm; V, 0.15 mm; VI, 0.50 mm (base, 0.10 mm; unguis, 0.40 mm); total, 1.53 mm. Numerous circular secondary sensoria occur on the segments as follows: III, 64 to 75; IV, 13 to 26; and V, usually none, but rarely with 1 to 5. The sensoria are so crowded over the whole of segment III that they are extremely

difficult to count, so that these figures are only approximately correct. The fore wings are much longer than the body and have a well-defined stigma and strongly curved stigmal vein; the second branch of the media arises from about the middle of that vein. The cornicles are similar to those of the apterous forms, but are more constricted at the bases and somewhat swollen in the middle and terminate in a conspicuous

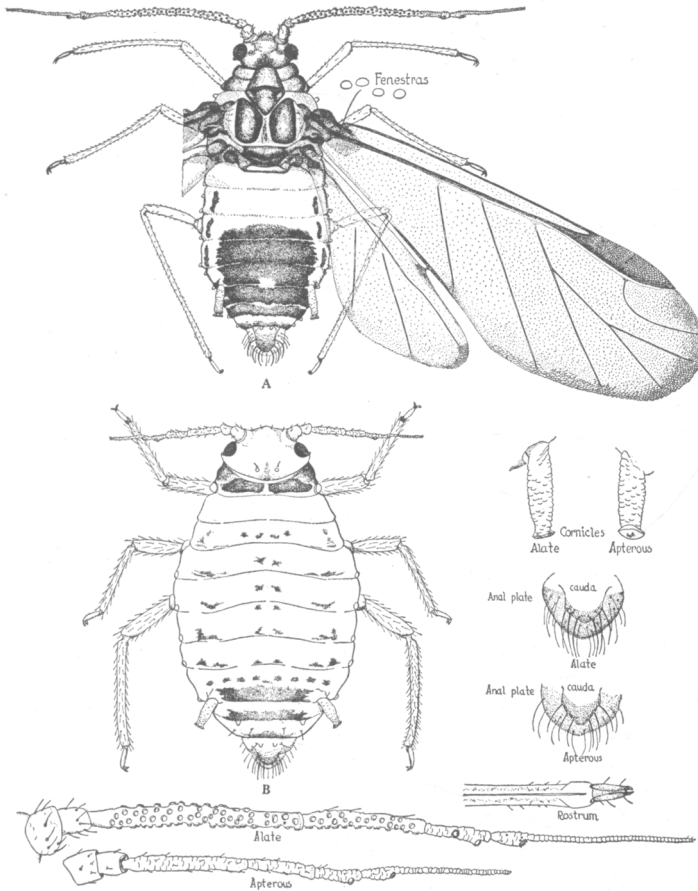


Fig. 3.—The rusty-banded aphid, *Aphis ferruginea-striata* Essig. *A*, Adult winged female; *B*, adult apterous female. Other parts are labeled. All greatly enlarged.

flange. The length is 0.24 mm; width, 0.04 mm. The cauda is longer than wide and approximately one-half the length of the cornicle. The anal plate is nearly twice the width of the base of the cauda and about the same length.

Length of body, 2.0 mm; width, 0.9 mm; length of fore wing, 3.3 mm.

Because of the small size of the specimens reared on celery in the greenhouse, the descriptions have been made from aphids taken on the



poison hemlock. The greenhouse forms on celery agree rather well in general characteristics, but are only about one-half as large and may have slightly fewer sensoria on the very small antennal segments of the winged forms.

*Aphis ferruginea-striata* n. sp. is perhaps nearest to *Aphis subterranea* Walker, but differs most strikingly in the absence of secondary sensoria on the antennae of the apterous forms, in having longer cornicles, somewhat shorter rostrum, and the presence of the rusty-red band in the living forms.

The description has been made from a large series of individuals mounted on slides and designated as cotypes in the collection of the author and those of several of his students.

According to Börner and Schilder (1932), *Aphis heraclei* Koch is a synonym of *A. subterranea* Walker. Specimens labeled *A. heraclei* Koch in the British Museum of Natural History are not at all like *A. subterranea* Walker. Attention should also be called to the fact that both *A. ferruginea-striata* and *A. subterranea* bear considerable resemblance in appearance and habits to *A. lappae* Koch, as described and figured by that author (Koch, 1854–1857, Heft 2. p. 50). His description, which is worthy of note, is as follows: “*Sie bewohnt die Klette [burdock] und hält sich nahe, auch etwas unter der Erde an den Achseln der Blattstiele der jungen Pflanzen auf. Man findet sie in grössern und kleinern Kolonien dicht beisammen sitzend.*” Since burdock is not closely related to the umbelliferous hosts of *Aphis ferruginea-striata* and *A. subterranea*, Koch's species may not be so closely allied as the description would seem to indicate. *Aphis angelicae* Koch, occurring on *Angelica sylvestris* in Europe, is also very closely related to all three of these species, but the exact relations of this particular aphid complex cannot be settled until Koch's species have been definitely established and comparisons made with them and possibly with other species also.

The known host and locality records are as follows:

Anise or dill, *Anethum graveolens*—Berkeley, California, by Essig and W. D. Riley  
Carrot—North Sacramento, California, by J. E. Spurlock; Europe  
Celery—Los Angeles, Berkeley, Mountain View, California, by Severin and Freitag  
Sweet fennel, *Foeniculum vulgare*—Berkeley, California, by Essig; Milpitas, California, by Freitag; Palo Alto, California, by W. M. Davidson; Europe  
Parsnip—Europe  
Parsley—Keyes, California, by Severin  
Poison hemlock, *Conium maculatum*—Milpitas and Alviso, California, by Severin and Freitag; Berkeley, California, by Essig; Europe

Severin and Freitag report collections of this species on celery plants in the celery-producing districts near Alviso, Chula Vista, Compton,

Lomita, Long Beach, Malibu Beach, Milpitas, Mountain View, Palo Alto, Redwood City, Seal Beach, Walteria, and West Sacramento. They have also taken it in celery shipments from Gardena and Venice.

On celery plants the aphids usually occur between the petioles near the base, sometimes below the surface of the soil. But when abundant they may also feed on the petioles and blades of the plants.

Colonies of aphids feeding about the bases of the plants in the fields are often partially covered with minute particles of soil by attending ants.

### THE COTTON OR MELON APHID

*Aphis gossypii* Glover

The cotton or melon aphid, *Aphis gossypii* Glover (fig. 4), has been a serious pest in this country since its discovery by Townend Glover in 1854. At first it was chiefly known as a cotton pest, but as knowledge about aphids accumulated, it was found to be an omnivorous feeder and a ravager of many crops. It is a relatively small species scarcely more than 1–2 mm long; on certain hosts like *Sedum* spp., growing in the open, and on celery raised in greenhouses, it may be scarcely half as large. In color it is variable. Some forms taken on catalpa in Fresno and on celery in the greenhouse at Berkeley are very yellow, whereas the normal color varies from yellowish green to dark olive-green or almost dull black. The apterous forms are usually somewhat mottled. The winged forms have dusky or black head, thorax, and cornicles, whereas most of the antennae and legs are pale. Specimens of what have been determined as this species, from many parts of the world, show an interesting variation in the number, size, and arrangement of the secondary sensoria on segment III of the antennae, as well as some marked differences in the cornicles and the cauda as shown in figure 4. Whether these differences represent mere variants or actually separate species has not yet been determined, but careful studies might well be made to determine more exactly the causes for such wide differentiation in this particular species.

The life history of this aphid in the cultivated areas of California appears to be very simple. Winged and apterous parthenogenetic viviparous females occur throughout the year. No true sexual forms have been observed here. During the winter months, propagation is slow, but as spring advances the aphids become numerous, and by summer they are scattered far and wide over all the fields and orchards. The winged migrants are carried by the prevailing winds for long distances so that newly planted crops are infested almost as soon as the plants appear above ground.

The cotton aphid is almost as omnivorous in its food habits as the green

peach aphid and accordingly attacks a long list of a wide variety of hosts<sup>5</sup> of which the following are the most important: amaranthus, asparagus, avocado, beans, beets, burdock, cantaloupe, catalpa, celery, *Cheno-*

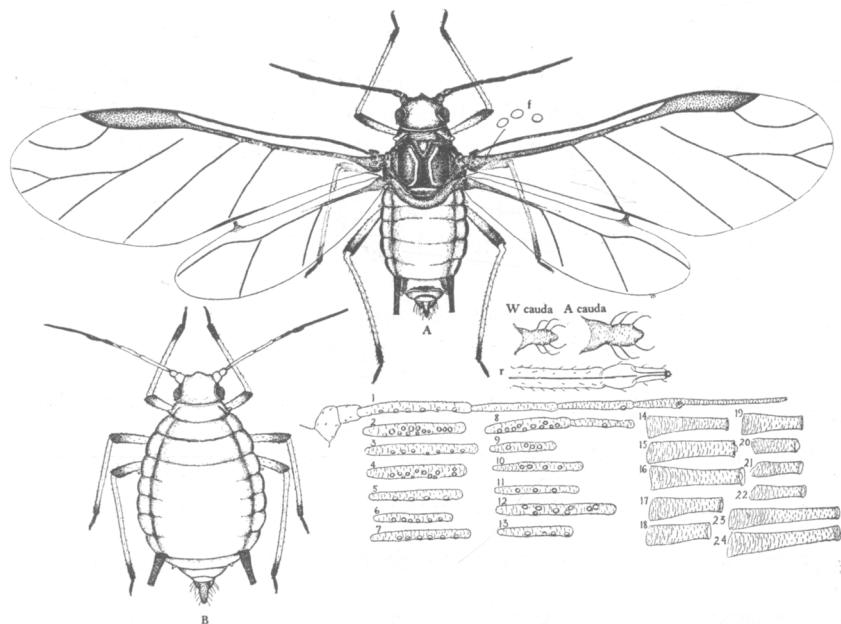


Fig. 4.—The cotton or melon aphid, *Aphis gossypii* Glover. *A*, Winged viviparous female; *B*, apterous viviparous female; *W cauda*, cauda of winged female; *A cauda*, cauda of apterous female; *f*, fenestras; *r*, rostrum. 1, Antenna of winged female on cotton, California. 2–13, Antennal segment III of winged female drawn to scale to show variation in number of secondary sensoria, and length: 2, on orange, California; 3, on cotton, California; 4, on cantaloupe, California; 5, on *Rhamnus*, California; 6, on sour sop, Florida; 7, on unnamed host, Japan; 8, on citrus, California; 9, on cotton, Mississippi; 10, on elm, New York; 11, on cotton, China; 12, on *Bidens*, South Rhodesia; 13, on cucurb, India; 14–24, types of cornicles drawn to same scale and showing variation to be found in the winged individuals: 14, on cotton, China; 15, on *Bidens*, South Rhodesia; 16, on milkweed, California; 17, on *Leucopis*, California; 18, on *Rhamnus*, California; 19, on elm, New York; 20, Japan; 21, cineraria, California; 22, on gardenia, Florida; 23, California; 24, on cotton, California. Antennal segment III as represented by 5, 9, 10, 11, and 13, appear identical with those in the European species *Aphis sedi* Kalténbach, which also occurs in California. All greatly enlarged.

*podium*, chrysanthemum, cineraria, citrus (grapefruit, lemon, orange, etc.), clover, coprosma, cotton, cucumber, dandelion, *Datura*, dock, dog-

<sup>5</sup> The most important lists of host plants are to be found as follows: J. Davidson (1925, p. 36); Essig (1911, p. 338–39; 1924, p. 241–42); Hall (1926, p. 19); Mimeur (1934, p. 29–30); Smith (1934, p. 115); Gillette and Palmer (1931–1934, vol. 25, p. 401); Swain (1919, p. 106); Takahashi (1921–1931, pt. 6, p. 6–13); Theobald (1926–1929, vol. 2, p. 144); Wilson and Vickery (1918, p. 84).

wood, *Echeveria*, eggplant, filaree, fuchsia, gardenia, hibiscus, hop, hydrangea, lilies, malva, milkweed, morning-glory, onion, pear, phacelia, plantain, poppy, portulaca, potato, pumpkin, Russian thistle, *Sedum*, shepherd's-purse, spinach, squash, strawberry, thistles, tomato, vetch, violet, and watermelon.

The members of this species usually occur in rather dense, and often very extensive, colonies and at times may completely cover and destroy the hosts. For this reason it has been found desirable to destroy the foci of early infestations to prevent subsequent spread in the case of cucurbits and some other cultivated crops.

This aphid is widely distributed throughout many parts of the world and has been definitely reported to occur in the following regions and countries:

Africa: Algeria, Anglo-Egyptian Sudan, Belgian Congo, British Togoland, Portuguese East Africa, Egypt, Eritrea, French West Africa, Italian Somaliland, Morocco, Nigeria, Nyasaland, Rhodesia, South Africa, Tanganyika Territory, and Uganda.

Asia: Armenia, Asiatic Russia, Astrakhan, Ceylon, China, Formosa, India, Japan, Malaya, Pescadores Islands, Transcaucasia, and Turkistan.

Europe: Crimea, Cyprus, Denmark, Germany, Great Britain, Italy, U. S. S. R., and Sweden.

North America: Bermuda, Canada, Central America, Mexico, United States, West Indies.

South America: Argentina, Brazil, British Guiana, Chile, Dutch Guiana, Paraguay, Peru.

Oceania and the Pacific: Australia, Dutch East Indies, Fiji, Hawaii, Philippine Islands, and Samoa.

In the United States this aphid appears to occur in practically every state, having been reported from every important geographical region within the country.

In California it is to be found abundantly from the Imperial Valley and San Diego to Oregon. In the warmer valleys—Imperial, San Fernando, San Joaquin, Salinas, and Sacramento—it may become exceedingly abundant and destructive, especially to melons and cotton in the spring and early summer.

### THE COW PARSNIP APHID

*Aphis heraclella* Davis  
(*Aphis heracleii* Cowen)<sup>6</sup>

The cow parsnip aphid, *Aphis heraclella* Davis (fig. 5), is medium-sized and dark green, often mottled with paler green or yellow, with dusky lateral and dorsal areas on the posterior dorsum of the abdomen; and the an-

<sup>6</sup> Since the name *Aphis heracleii* Cowen was preoccupied by the European species *Aphis heraclei* Koch 1854, the species was renamed *Aphis heraclella* by Davis (1919).

tennae, cornicles, cauda, and the greater part of the legs are dusky. The head and thorax of the winged forms are black, and there are more dorsal abdominal black patches in these forms than in the apterous forms. On the whole the species appears very dark olive-green or blackish. It is further characterized by the numerous sensoria on antennal segment III of the alates and by cylindrical or tapering cornicles, which are closely imbricated and flanged at the openings.

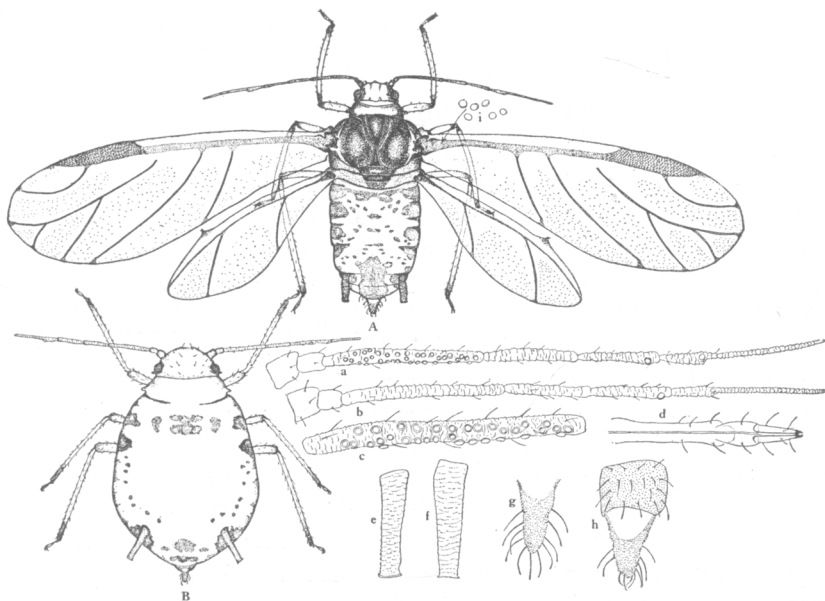


Fig. 5.—The cow parsnip aphid, *Aphis heraclella* Davis. A, Adult winged female: a, antenna; c, antennal segment III; g, cauda; i, fenestras. B, Adult apterous female: b, antenna; d, rostrum; f, cornicle; h, anal plate and cauda. All greatly enlarged.

This species was originally taken on cow parsnip at Fort Collins and described as *Aphis heracleii* by Cowen in 1895 (Gillette and Baker, 1895, p. 120). Gillette and Palmer (1931–1934, vol. 25, p. 406) have redescribed this species and state that it is “structurally indistinguishable from *A. helianthi* unless an apparent tendency to longer antennal joints and cornicles and darker-green coloration can be considered of sufficient value for separation.” Specimens collected on cow parsnip in California and Oregon and a small series from San Diego, California, on celery agree very well with the sunflower aphid, *A. helianthi* Monell.<sup>7</sup> This dis-

<sup>7</sup> For a good description and illustrations of this species see Gillette and Palmer (1931–1934, vol. 25, p. 402–4).



cussion, however, involves only the so-called *A. heraclella* Davis. As such it has been reported on the following hosts in the West :

*Angelica tomentosa*—Berkeley, California, by Essig  
 Celery—Colorado, by Gillette and Palmer; San Diego, California, by Essig  
 Cow parsnip, *Heracleum lanatum*—Colorado, by Cowen, Gillette and Palmer; Multnomah Falls, Oregon, by Essig  
*Heracleum Mantegazzianum*—Berkeley, California, by Essig  
 Parsnip—Colorado, by Gillette and Palmer  
 Umbelliferous plant—Scott's Valley, Lake County, California, by P. S. Schulthess  
 Water-hemlock, *Cicuta occidentalis*—Colorado, by Gillette and Palmer

So far it has been observed only once on celery in California.

## THE ERIGERON ROOT APHID

*Aphis middletonii* Thomas<sup>\*</sup>

For many years an aphid has been taken in considerable numbers on the roots of cultivated asters and a wide range of other plants in California. The species bears a close resemblance to the common corn root aphid, *Aphis maidi-radici* Forbes,<sup>9</sup> of the middle and eastern states, but has so far not been identified as that species. Rather it appears to agree more closely with the form described as *Aphis middletonii* by Thomas in 1879 (Thomas, 1879) and is commonly called the erigeron root aphid (fig. 6). Specimens of what now appear to be this species were first collected by the author on the leaves of mule fat, *Baccharis viminea*, at Santa Paula, California, August 15, 1911. No winged forms were taken, but the apterous specimens check with the species under consideration. Both winged and apterous forms were later taken in the same general area on the roots of cultivated China aster, *Callistephus hortensis*, and rough pigweed, *Amaranthus retroflexus*, on October 20, 1911. It was noted that the aster plants were seriously injured even though the aphid was very heavily parasitized by *Lysiphlebus testaceipes* (Cresson).

This aphid is first recognized by its subterranean and semisubterranean habits. It is primarily a root feeder, although it also occurs at the bases of the plants near the surface of the soil in greenhouses, as well as out of doors, and has been taken on the stems and foliage above the ground. It is normally yellowish green or dark olive-green, often with a frosted or pulverulent covering. This pulverulence is usually arranged like a network consisting of small 5-sided figures or reticulations. Mounted specimens rarely reveal these as fine lines on the exoskeleton;

<sup>\*</sup> The more important descriptions of this aphid are those of Thomas (1879, p. 99); Gillette and Palmer (1931-1934, vol. 25, p. 418-20); Oestlund (1887, p. 54-55); Swain (1919, p. 115-16); Vickery (1910, p. 113-18); and Williams (1910, p. 51-52).

<sup>9</sup> The confusion concerning this species and *Aphis middletonii* Thomas have been discussed by Vickery (1910) and by Hottes and Frison (1931, p. 203).

if stained, however, they show the network well. They are characteristic of the species and aid in its identification. The subterranean and greenhouse forms are much paler than those occurring out of doors about the bases of the plants. Mounted specimens are characterized by arrangement of the sensoria on the antennae of both the winged and apterous

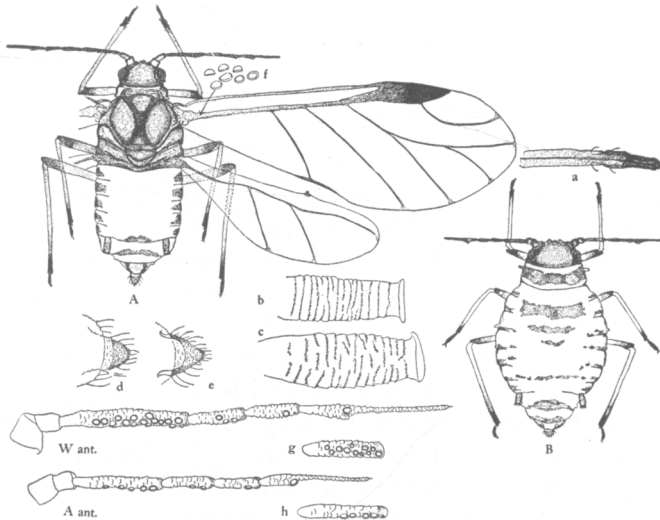


Fig. 6.—The erigeron root aphid, *Aphis middletonii* Thomas. *A*, Adult winged female: *W ant.*, antenna; *a*, rostrum; *b*, cornicle; *d*, cauda; *f*, fenestras; *g*, antennal segment III. *B*, Adult apterous female: *A ant.*, antenna; *c*, cornicle; *e*, cauda; *h*, antennal segment III. All greatly enlarged.

forms, by the rather short spur or unguis of the apical antennal segment, and by the short and cylindrical cornicles.

The erigeron root aphid has a rather scattered known distribution in North America. It has been reported from the states of California, Colorado, Illinois, Kansas, Minnesota, New York, North Carolina, North Dakota, Oklahoma, South Carolina, and Virginia. This range will undoubtedly be greatly extended as the insect becomes better known.

In California it has been taken by the writer in Ventura and Alameda counties, by R. R. McLean in San Diego County, by A. F. Swain in Riverside and Santa Clara counties, and by Severin and Freitag in Santa Clara and San Diego counties.

The host range of the erigeron root aphid is very extensive and, including hosts from all sources, is as follows: *Artemisia frigida*, artichoke (*Cynara Scolymus*), *Aster multiflorus*, *Aster subulatus*, avocado (above-

ground), bristly oxtongue, California buttercup, celery (aboveground), China aster, corn, cosmos, dahlia (?), daisy fleabane (*Erigeron ramosus*), dandelion, fleabane, flaxweed, goldenrod, *Helianthus pumilus*, horseradish, horseweed, milkweed, mule fat (aboveground), naked broom rape, ragweed, rough pigweed, *Senecio*, sheep sorrel, shepherd's-purse, sunflower, and tarweed.

### THE YELLOW WILLOW APHID

*Cavariella capreae* (Fabricius)<sup>10</sup>

(*Aphis capreae* Fabricius)

The yellow willow aphid, *Cavariella capreae* (Fabricius) (fig. 7), an Old World species, has now attained a rather wide distribution throughout the temperate regions and is an economic pest of considerable importance, especially on a number of the umbelliferous plants, although the primary host consists of various species of willow.

The general color is yellow of varying shades, but individuals or whole colonies may be distinctly green. The apterous forms are usually immaculate. The winged forms are marked with black as shown in figure 7. The most characteristic features of this aphid are: the dorsal tubercle at the posterior end of the abdomen above the cauda, which in the apterous forms is a pointed prolongation of the abdomen, and in the alates a very small tubercle, scarcely noticeable; the short unguis of the last antennal segment; and the somewhat swollen cornicles, which are rather like those of the green peach aphid.<sup>11</sup>

This species has been reported from Denmark, France, Belgium, Germany, Great Britain, Holland, Latvia, and Sweden in Europe; in Argentina, South America; and in the United States. In this country it probably has a much wider distribution than the published records indicate because it has so often been confused with other closely related species. In Colorado and California it is well known in a number of localities. In California it was first reported from willow at Berkeley by W. T. Clarke in 1903. Since then it has been taken on that host in many localities from San Diego to Newcastle. Severin and Freitag first took it from celery in shipments from Gardena, Lomita, and Venice in 1935. During that year they either collected it in the celery fields of or in shipments from Bassett, Chula Vista, Compton, Costa Mesa, East Whittier, Hawthorne, Malibu

<sup>10</sup> This aphid has been referred to the genera *Hyadaphis*, *Rhopalosiphum*, and *Siphocoryne* and has often been confused with a related species, *Cavariella pastinacae* (Linn.), which has also been treated under the various generic terms listed above.

<sup>11</sup> More complete descriptions of the yellow willow aphid may be found in the works of Gillette (1918, p. 93-94), Gillette and Palmer (1931-1934, vol. 25, p. 466-67), and Theobald (1926-1929, vol. 2, p. 5-10).

Beach, Moneta, Montalvo, Mountain View, Rosecrans, San Fernando, Santa Ana, Sawtelle, Seal Beach, Talbert, and WALTERIA.

The yellow willow aphid feeds chiefly on willows and umbelliferous plants. The more important hosts are: *Angelica* spp., anise or dill (*Aneethum graveolens*), *Apium nodiflorum*, *Archangelica officinalis*, *Berula*

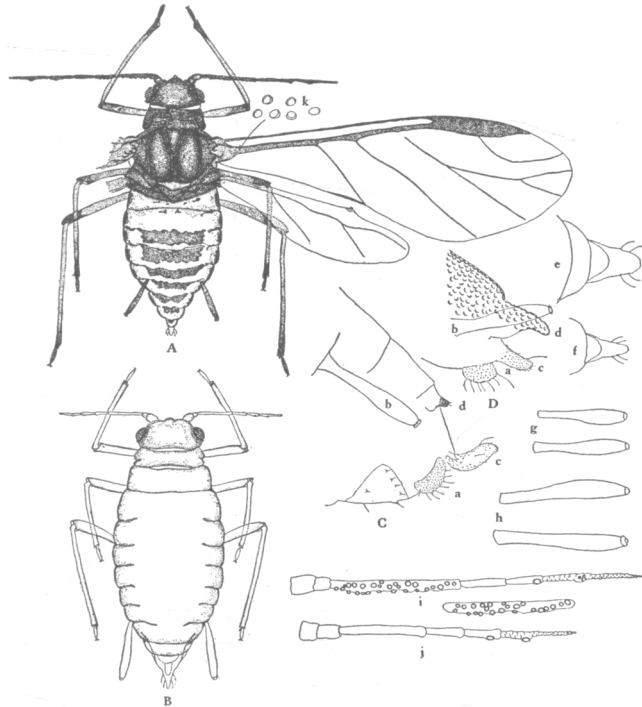


Fig. 7.—The yellow willow aphid, *Cavariella capreae* (Fabricius). A, Adult winged female: e, cauda; g, cornicles; i, antenna, k, fenestras at base of subcostal vein. B, Adult apterous female: f, cauda; h, cornicles; j, antenna. C and D, Posterior end of abdomen, C of winged, and D of apterous female: a, anal plate; b, cornicle; c, cauda; d, dorsal caudal tubercle. All greatly enlarged.

*erecta*, carrot, *Carum* spp., celery, *Chaerophyllum* spp., *Cicuta* spp., *Coreopsis* sp., cow parsnip, goutweed (*Aegopodium Podagraria*), *Heraacleum Spondylium*, *Ligusticum Porteri*, *Liatris* sp., parsley, parsnip, *Peucedanum* spp., and willows. In northern Europe, this aphid is widely distributed on willow and is found in the floral heads of the common wild parsnip along the highways, especially in England. *Aphis subterranea* Walker, a species not found in North America, may also occur on wild parsnip in Europe.

THE LILY APHID<sup>12</sup>

*Myzus circumflexus* (Buckton)  
(*Siphonophora circumflexa* Buckton)<sup>13</sup>  
(*Myzus vincae* Gillette)<sup>14</sup>

The lily aphid, *Myzus circumflexus* (Buckton) (fig. 8), is next to the green peach aphid in importance in northern Europe as a vector of plant virus diseases. It was introduced into the United States and Argentina and according to Davis (1914, p. 121) it "was first reported in this country by Mr. F. A. Sirrine" in New York, where it has become very widely distributed.

It is a rather large, robust, pale-green or yellow aphid, the apterous forms immaculate or with distinct dark markings on the dorsum as illustrated, and the winged forms with a considerable portion of the body black. The dark dorsal patches on the abdomen and the rather short, smooth, black-tipped cornicles are good superficial diagnostic characters. The lily aphid is most likely to be confused with the foxglove aphid, which it very much resembles in color and markings, but from which it may be distinguished by the dorsal markings of the apterous forms and the shorter cornicles, which lack the apical reticulations so pronounced in the foxglove aphid. Figure 8 will serve to separate mounted specimens.

The general distribution of the lily aphid includes Belgium, Great Britain and Ireland, Latvia, Sweden, Switzerland, and northern Europe generally, United States, Argentina, Hawaii, Morocco, and Sumatra.

In the United States it has been reported in California, Colorado, Connecticut, Illinois, Kansas, New York, Oregon, and South Dakota, but it probably has a much wider distribution.

In California it has been collected in the following places: Berkeley, by Essig, A. F. Swain, G. O. Shinji, Freitag, Severin, and K. Wilson; Los Angeles, by A. F. Swain; Pomona, by Essig; San Diego, by A. F. Swain; San Francisco, by G. O. Shinji and E. Walther; Stanford University, by W. M. Davidson, H. Morrison, and A. F. Swain.

The lily aphid, while it shows a fondness for liliaceous plants, is an omnivorous feeder, and attacks a wide variety of hosts. It usually occurs

<sup>12</sup> The more important references to literature on this species are: J. Davidson (1925, p. 21-22), Davis (1914, p. 121-22), Essig (1924, p. 252), Gillette (1908, p. 19-20, pl. I, figs. 4-8), Gillette and Palmer (1931-1934, vol. 27, p. 202, fig. 289), Hottes and Frison (1931, p. 335-36), Mimeur (1934, p. 38-39), Smith (1934, p. 111, fig. 16), Swain (1919, p. 74-75, fig. 175), Theobald (1926-1929, vol. 1, p. 331-34, fig. 177), Werder (1931, p. 52), and Wilson and Vickery (1918, p. 57).

<sup>13</sup> See Buckton (1876-1883, vol. 1, p. 130-32, pl. XIII).

<sup>14</sup> See Gillette (1908, p. 19-20, pl. I, figs. 4-8).



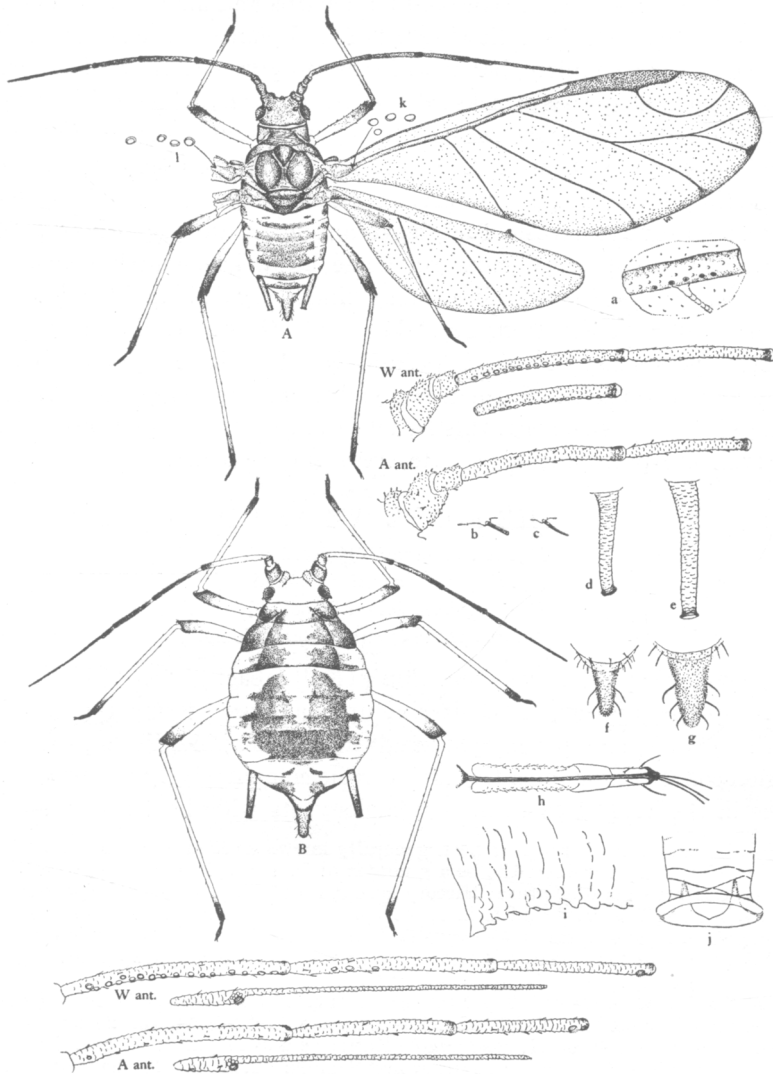


Fig. 8.—The lily aphid, *Myzus circumflexus* (Buckton). *A*, Adult winged female: *a*, section of the costal vein showing fenestralike areas; *d*, cornicle; *f*, cauda; *k* and *l*, fenestras near the base of the subcostal vein; *W ant.*, antennae. *B*, Adult apterous female: *A ant.*, antennae; *b* and *c*, setae on segments I and III of antenna; *e*, cornicle; *g*, cauda; *h*, rostrum; *i*, basal margin of cornicle; *j*, tip of cornicle. All greatly enlarged.

in dense colonies on the leaves and tender tips and may do considerable damage to the host. The following list of food plants, although extensive, is by no means complete, but it will serve to give some idea of the wide range which the species attacks: alisma, *Alopecurus*, anemone, *Antholyza refracta*, *Anthurium*, *Artemisia*, *Arum*, asparagus, aster, barley, California buckeye, California laurel, calla, ceanothus, celery, *Cerastium*, cineraria, clover, columbine, crocus, currant, cyclamen, dahlia, dock, elder, fig, foxglove, freesia, fuchsia, geranium, gladiolus (corms), golden glow, goldenrod, hedge mustard, horse bean, iris, marsh pennywort (*Hydrocotyle proliфера*), lilies (many kinds), *Lycium*, maidenhair fern, meadow foxtail, nasturtium, nightshade, oats, *Orchis*, oxalis, pansy, pentstemon, persimmon, *Physalis peruviana*, plantain, *Polymnia*, potato, ranunculus, schizanthus, senecio, sisymbrium, snowberry, sparaxis, spiraea, stachys, *Steironema*, thistle, tobacco, tomato, tulip, *Vinca*, violet, Virginia creeper, wallflower, watercress, and watsonia.

### THE FOXGLOVE APHID

*Myzus convolvuli* (Kaltenbach)<sup>15</sup>

(*Myzus pseudosolani* Theobald)<sup>16</sup>

(*Macrosiphum solani* Theobald)<sup>17</sup>

(*Macrosiphum aucubae* Bartholomew)<sup>18</sup>

The foxglove aphid, *Myzus convolvuli* (Kaltenbach) (figs. 9, 10), an unusual species, appears to be entering upon a career of synonymy similar to that of the green peach aphid and the potato aphid. Perhaps the confusion concerning its identity is due to its comparatively recent appearance in the field of economic entomology, its wide host range, and its

<sup>15</sup> This species has heretofore been generally known as *Myzus pseudosolani* Theobald, which is now considered to be a synonym of it. The writer has also examined at the British Museum of Natural History specimens of *M. pseudosolani* Theobald and *M. mercurialis* Theobald and is in agreement with Frederick Laing in considering them also to be synonyms of *M. convolvuli* Kalt. *M. caledonii* Kalt., as described by Theobald, is also very near, but not yet positively fixed as a synonym. *M. duffieldii* Theobald is considered to be distinct by Laing.

Theobald (1926-1929, vol. 3, p. 338) relegated his *Myzus pseudosolani* to a synonym of *M. solani* (Kalt.), to which Hille Ris Lambers (1933-1934, vol. 2) agreed. The latter author also placed *M. convolvuli* (Kalt.) as a synonym of *M. solani* (Kalt.), both in the genus *Aulacorthum*. Börner and Schilder (1932, p. 628) have offered the following synonymy: "*M.* (spelled *Macrosiphon* in text) *convolvuli* Kalt. (*vincae* Walk., *solani* Kalt., *pseudosolani* Theobald)."

If this idea is accepted, then *M. solani* (Kalt.) (Kaltenbach, 1843, p. 15, *Aphis*) should have priority over *M. convolvuli* (Kalt.) (Kaltenbach, 1843, p. 40-41, *Aphis*) because the former preceded the latter in the pagination. Neither of these Kaltenbach species are now positively known.

<sup>16</sup> Theobald (1922a, p. 8, figs. 6-7).

<sup>17</sup> Theobald (1913, pt. II, p. 127-28, fig. 39; 1926, p. 313-15, figs. 164-65); Smith (1934, p. 112, fig. 18).

<sup>18</sup> Bartholomew (1932, p. 723-25, pl. II, figs. 17-20).

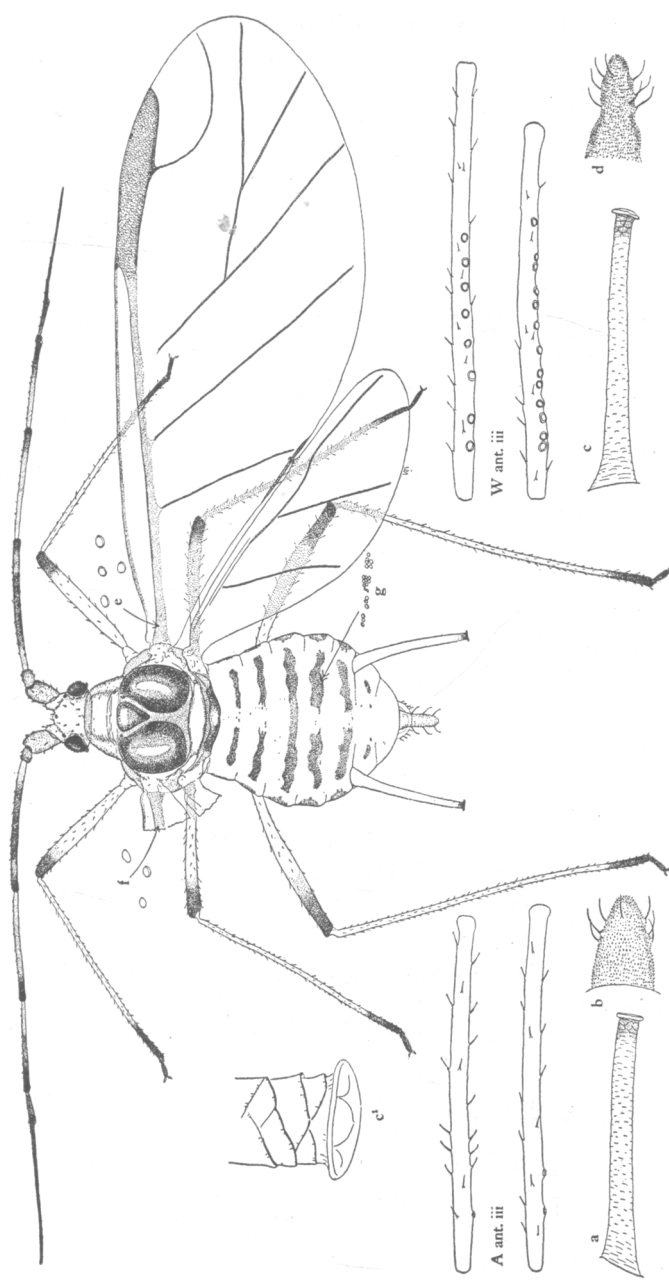


Fig. 9.—The foxglove aphid, *Myzus convolvuli* (Kaltenbach), adult winged female: *W ant.*, antennal segment III; *c*, cornicle, *c'*, tip of cornicle; *d*, cauda; *e* and *f*, fenestras; *g*, gland pores as arranged in the dark transverse bands on the dorsum of the abdomen. *A ant.*, antennal segment III of apterous female; *a*, cornicle of apterous female; *b*, cauda of apterous female.

similarity to the lily aphid and related species. Although described as *Myzus psuedosolani* by Theobald in 1922, this species had first been considered by him to be *Macrosiphum solani* from its habit of feeding on the potato. Since its first discovery in Europe, it has been reported from a number of localities in Great Britain, but always on potato.

The recorded history of this species in the United States is interesting and begins with the collection of specimens on peas at San Jose, California, in 1912<sup>19</sup> by Edith M. Patch, who later received specimens found on Easter lily under glass from Canada in 1916, and collected it from a large number of host plants at Orono, Maine, in 1922–1925. After a thorough study of the species in Maine, Patch (1928) published a bulletin on the biology and host plants of the insect. Her list of all known food plants includes 72 species and 31 families. The foxglove, *Digitalis purpurea*, on which the aphid deposits the overwintering eggs, is considered to be the primary host in Maine; and the numerous other plants, upon which it feeds during the summer, are indicated as secondary hosts.

This aphid was later discovered in Colorado, and the writer has specimens collected on *Helichrysum* at Fort Collins by C. P. Gillette, September 3, 1925, and on potato at the same place by M. A. Palmer, April 4, 1930. Gillette and Palmer (1931–1934, vol. 27, p. 206) have also since found it feeding on the leaves of cineraria, gladiolus, *Helichrysum*, *Leonotis Leonurus*, lettuce, potato, and tomato at Fort Collins.

P. S. Bartholomew collected what appears to be this same aphid on the leaves of aucuba at Stanford University, California, April 12, 1930, which he described as *Macrosiphum aucubae* (Bartholomew, 1932).

Since then the writer has collected the same species in large numbers on the undersides of the leaves of *Aucuba japonica* on the campus of the University of California at Berkeley and at Stanford University.

The foxglove aphid is a fairly large species measuring from 2.0 to 2.5 mm in length. The apterous forms are robust, shining, pale whitish, yellowish green, or bright green, immaculate, except that in some individuals there are two darker-green patches, one at the base of each cornicle. The extreme apexes of antennal segments III to V are black, as is also most of segment VI, the apexes of the femora and tibiae, all of the tarsi, and the extreme apex of the cornicles.

The winged forms vary from yellowish to green and are variously marked with black as indicated in figure 9, A. The broken transverse bands on the dorsum of the abdomen and the black-tipped cornicles are characteristic. The most conspicuous anatomical character is the short

<sup>19</sup> The writer collected and mounted specimens from *Livistona chinensis* at Ventura, California, in 1910, but did not determine the species until recently.

imbricated area at the tips of the rather long, cylindrical, and somewhat tapering cornicles, which have conspicuous flanged openings. The lateral pigmented areas on the abdomen reveal groups of circular glandlike bodies which appear to be normal in the winged forms and may be of value in recognizing the species.

The colonies are sometimes very large. The individuals have a clever

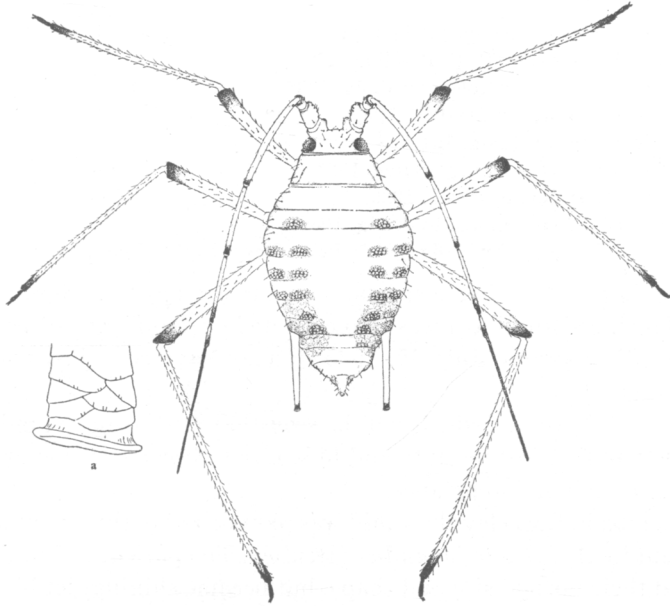


Fig. 10.—The foxglove aphid, *Myzus convolvuli* (Kaltenbach), adult apterous female: a, tip of cornicle. Other details are shown in figure 9.

way of standing head down, exuding a drop of honeydew, and then kicking it off with the hind legs, an operation not previously observed by the writer.

For a complete list of food plants, Patch (1928, p. 54–57) should be consulted. The list is too long to be included here. The most important hosts listed by her are: amaranthus, *Ambrosia*, apple, buttercup, calla lily, celery, chickweed, chrysanthemum, cinquefoil, clover, columbine, cudweed, dock, Easter lily, evening primrose, foxglove, gladiolus, golden-rod, groundsel, hawthorn, Jerusalem cherry, lamb's-quarters (*Chenopodium album*), mullein, orange hawkweed, pansy, pea, plantain, potato, purslane, shepherd's-purse, sow thistle, strawberry, tansy, verbena, and



violet. In California the species has become widely distributed, especially along the northern coast, and has been collected on the following plants:

- Aucuba—Stanford University, by Bartholomew, 1930, Essig, 1935; Berkeley, by Essig, 1935, 1936  
 Bush monkey flower, *Diplacus aurantiacus*—Niles, by Essig, 1935  
*Carum*—Berkeley, by C. F. Roesling, 1923  
 Celery—Berkeley in greenhouse, by Freitag, 1935, very small specimens collected at Venice  
 Cestrum—Berkeley, by Essig, 1935, 1936, and W. D. Riley, 1935, 1936  
 Columbine—Berkeley, by C. F. Roesling, 1923  
*Euphorbia Lathyrus*—Berkeley, by Essig, 1936  
*Iris*—Berkeley, by Elwyn Daybell, 1936  
*Latania*—Ventura, by Essig, 1910  
 Milkweed—Berkeley, by C. F. Roesling, 1923  
*Pentstemon*—Berkeley, by Essig, 1929  
*Stachys bullata*—Pepperwood, by Essig, 1936  
*Vinca major*—Berkeley, by Essig, 1936; Point Reyes Light House, by Essig, 1936

The writer took a winged specimen on the wing at Fort Seward, 1936. A single-winged specimen was also collected on *Lonicera involucrata* at Everett, Washington, July 17, 1935. It may have been just resting on that plant.

From the above records, it will be seen that the foxglove aphid has a wide distribution in this state and bids fair to become an insect of considerable economic importance.

On aucuba in Berkeley the aphid was parasitized to the extent of about 2 per cent by *Aphelinus jucundus* (Brullé). The parasitized individuals retained their normal size and shape, but became shining, jet black.

### THE GREEN PEACH APHID<sup>20</sup>

*Myzus persicae* (Sulzer)  
 (*Aphis persicae* Sulzer)  
 [*Rhopalosiphum persicae* (Sulzer)]

The green peach aphid, *Myzus persicae* (Sulzer) (fig. 11), appears to be the most important aphid known as an agent in the dissemination of plant diseases and bids fair to become the insect most injurious to agricultural crops in many parts of the world. It enters extensively into all economic entomological literature and is responsible for distributing more plant viruses over wide areas than any other insect so far recorded.

Fortunately, this aphid is sufficiently distinct anatomically to make its identity fairly certain and easy, so that it has not generally been confused with a lot of other species, as have so many less characteristic aphids. It is of ordinary size, and yellow, green, or pinkish in color, all

<sup>20</sup> This insect has also been called the spinach aphid.

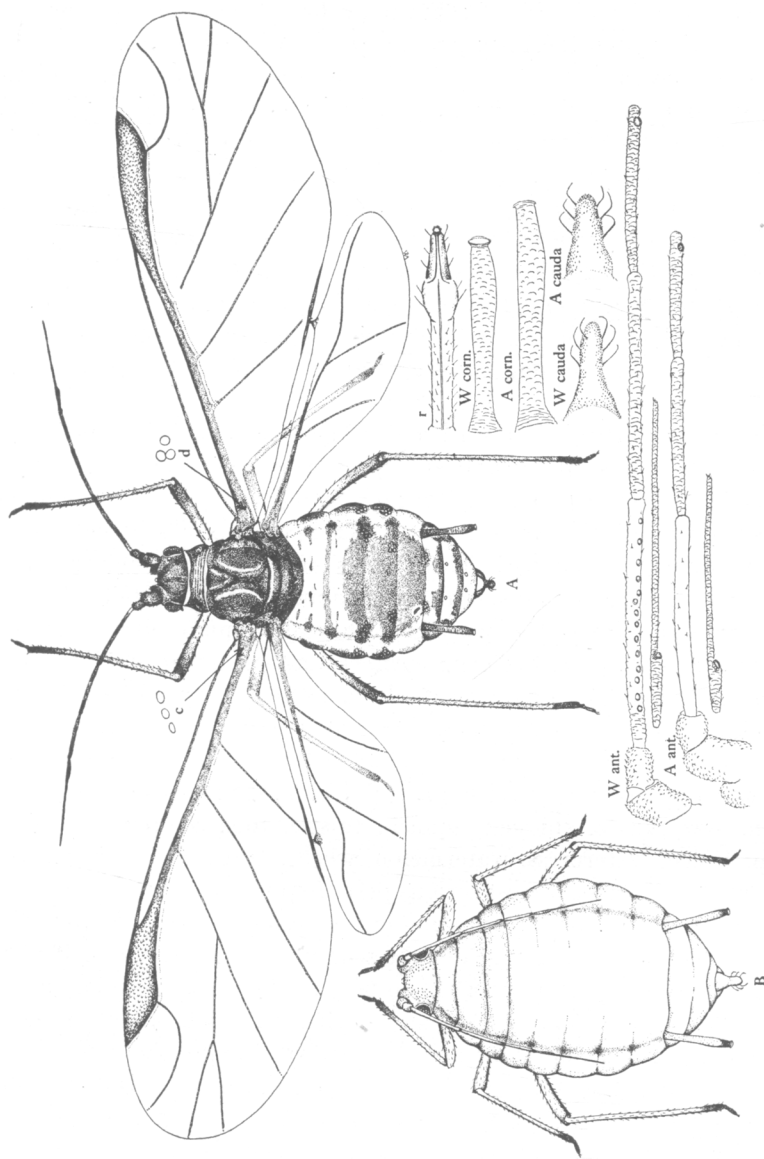


Fig. 11.—The green peach aphid, *Myzus persicae* (Sulzer). A, Adult winged female; c and d, fenestras on fore wings; r, rostrum; W ant., antenna; W corn., cornicle; W cauda, cauda. B, Adult apterous female; A ant., antenna; A cauda, cauda. All greatly enlarged.

of these forms often occurring in the same colony. The wingless forms are without markings on the body proper. In the winged forms, the head, appendages, much of the thorax, and a conspicuous dorsal abdominal blotch and small lateral patches, are dusky or black. The third antennal segment of the winged form has a row of circular sensoria; and the cornicles are somewhat swollen, as shown in figure 11.

The life history of this aphid in California appears very simple. So far neither eggs nor true sexual males and females have been noted. The apterous and winged migrant viviparous females abound throughout the entire year over much of the state, and even in midwinter all forms and stages in development may be observed on many of its normal hosts. During the year eight or ten broods appear, which give rise to great numbers of individuals.

From the vast array of literature dealing with this insect, one could list hundreds of host plants and numerous, extensive, and widely separated habitats. In this paper only the more important hosts<sup>21</sup> are included for California and the western states, where the species is commonly and abundantly distributed. These hosts are: abutilon, amaranthus, *Amsinckia*, apple, asparagus, bean, beet, cabbage, calla, cantaloupe, carnation, catalpa, celery, *Chenopodium*, chrysanthemum, citrus (grapefruit, lemon, orange, etc.), clover, corn, cotton, cucumber, dahlia, dock, eggplant, English ivy, foxglove, fuchsia, lettuce, grape, lilies, malva, marigold, milkweed, muskmelon, mustard, nasturtium, nettle, onion, oxalis, parsley, peach, pear, pepper, plum, potato, prickly lettuce, prune, pumpkin, puncture vine, radish, rape, *Sanicula*, shepherd's-purse, snapdragon, sow thistle, spinach, squash, thistle, tobacco, tomato, tulip, turnip, *Vinca*, watercress, watermelon, wheat. During the winter and early spring it is often a most serious pest of spinach.

The green peach aphid may occur in few numbers scattered over the host as is the case during much of the season on many crops, or it may congregate in sufficient numbers to destroy the leaves and tender shoots completely. On spinach, lettuce, and similar succulent plants it may become exceedingly abundant and destructive. During the winter and especially in the early spring, when it may be numerous, it is commonly destroyed in great numbers by fungus diseases. During spring, summer, and autumn, insect predators and parasites thin out its ranks, but hardly reduce its numbers to the extent of affording control.

<sup>21</sup> Important lists of hosts of *Myzus persicae* (Sulzer) are as follows: Essig (1911, p. 600; 1917, p. 331-32; 1924, p. 253); J. Davidson (1925, p. 60); Hall (1926, p. 41-42); Mimeur (1934, p. 39); Swain (1919, p. 85); Wilson and Vickery (1918, p. 125-26); Theobald (1926-1929), vol. 1, p. 322-24); Smith (1937, p. 538-42; 1934, p. 109. Also see index.).

This aphid is one of the most widely distributed species known and occurs over much of the entire world. It undoubtedly inhabits many areas not reported as yet, but it has actually been observed in the following countries:

Africa: Egypt, Morocco, Nyasaland, Rhodesia, South Africa, Tanganyika.

Asia: Ceylon, China, India, Japan, Palestine, Transcaucasia.

Europe: Czechoslovakia, Denmark, France, Germany, Great Britain, Holland, Italy, Jugoslavia, Norway, U. S. S. R., Switzerland.

North America: Bermuda, Canada, Guatemala, United States, West Indies (Jamaica and Puerto Rico).

South America: Argentina, Uruguay.

Oceania and the Pacific: Australia, East Indies (Java and Sumatra), New Zealand.

In the United States this aphid appears to have been reported from every state.

In California its distribution is confined chiefly to the cultivated areas, which indicates that it may have been introduced, although this is by no means certain. There are definite records from a great many localities throughout the entire state. Severin and Freitag collected it in the celery fields at Milpitas, December 19, 1935, and have reared it on celery in the greenhouse at Berkeley since that time.

### THE HONEYSUCKLE APHID

*Rhopalosiphum melliferum* (Hottes)

(*Aphis xylostei* Schrank)

(*Rhopalosiphum xylostei* Koch)

(*Siphocoryne conii* Davidson)

[*Hyadaphis xylostei* (Schrank)]

(*Hyadaphis mellifera* Hottes)

The honeysuckle aphid, *Rhopalosiphum melliferum* (Hottes) (fig. 12), would certainly occupy a more prominent place in entomological literature if it had not so often been confused with the parsnip aphid, *Cavariella pastinacae* (Linn.)<sup>22</sup> and other related species. It was originally described as *Aphis xylostei* in Europe by Schrank as early as 1801 (Schrank, 1801, p. 107-8). For over a hundred years it has been shuffled into the various genera: *Aphis*, *Siphocoryne*, *Hyadaphis*, and *Rhopalosiphum*, without a permanent resting place in any of them.

In California the species first came to notice in 1909 when it was collected on the flower stalks and leaves of poison hemlock in the vicinity of Stanford University by W. M. Davidson (1909, p. 304), who described it as a new species, *Siphocoryne conii*. Later recognizing it as the European species named by Schrank, he relegated it as a synonym of *Siphocoryne xylostei* in 1914 (W. M. Davidson, 1914, p. 134), which he had

<sup>22</sup> Gillette (1911, p. 322-23) has fully discussed it as *Rhopalosiphum pastinacae* (Linn.).

already found curling the leaves of honeysuckle at Palo Alto some four years previously (Davidson, 1910, p. 377). In studying the species more recently, F. C. Hottes discovered that the name *Aphis xylostei* of Schrank had been preoccupied by *Aphis*<sup>23</sup> *xylostei* of De Geer, and he

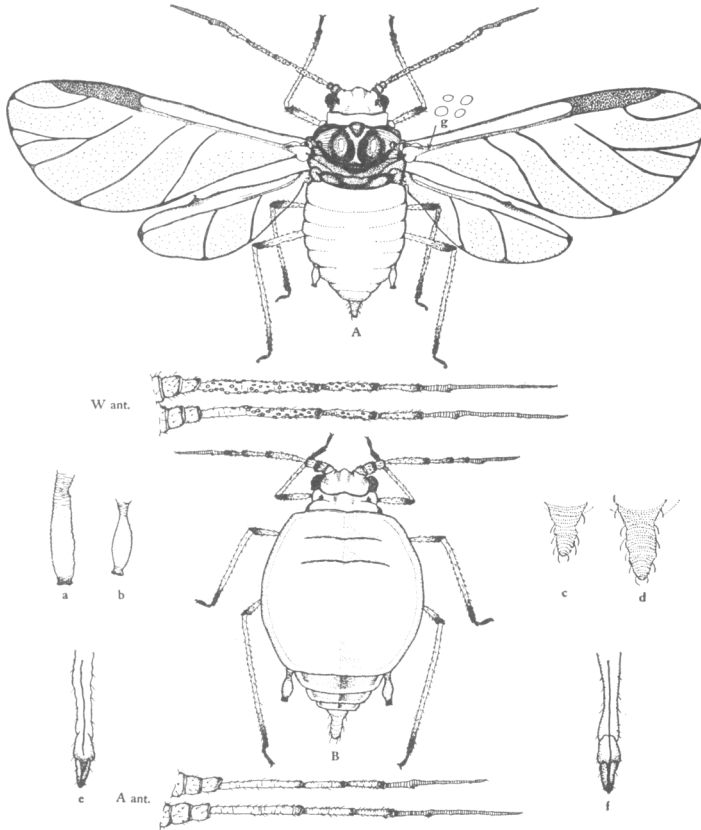


Fig. 12.—The honeysuckle aphid, *Rhopalosiphum melliferum* (Hottes). A, Adult winged female: W ant., antennae; b, cornicle; c, cauda; e, rostrum; g, fenestra. B, Adult apterous female: A ant., antennae; a, cornicle; d, cauda; f, rostrum. All greatly enlarged.

therefore renamed it *Hyadaphis mellifera* (Hottes, 1930, p. 184), which in 1931 was redefined as *Rhopalosiphum melliferum* (Hottes) by Hottes and Frison (1931, p. 238), by which name it is now known.

The species is subject to considerable variation in size. All specimens received from east of the Rocky Mountains taken on both the primary and secondary hosts appear to be very much smaller than the specimens received from Colorado and those collected in California. Living forms

<sup>23</sup> Now *Prociphilus xylostei* (De Geer).

reared on celery in the University greenhouse by Severin and Freitag present a most unusual spectacle. They are about one-fourth the size of normal individuals occurring in nature and appear like tiny replicas of the outdoor forms. That a species might be so altered by a change in environment and possibly also food scarcely seemed possible, and the writer would have been inclined to treat it as a distinct species, if other aphidologists, who examined mounted specimens, had not pronounced these small individuals to be *Rhopalosiphum melliferum*. Specimens collected on poison hemlock appear to reach the maximum development in size, the winged forms attaining a length of 2.0 mm, and the apterous forms 2.5 mm. The average length is approximately 1.5 mm to 2.0 mm, respectively.

The color also is variable. Those occurring on honeysuckle in California are striking in color, being uniform pale green covered with a fine whitish pulverulence as if frosted, and with conspicuous black head, antennae, thorax (in winged forms), legs, cornicles, anal plate, and genital plate, as indicated in figure 12. Davidson (1909, vol. 2, p. 304) refers to the color as bright green and Gillette and Palmer (1931-1934, vol. 25, p. 484) describe Colorado forms as "pale yellowish brown in alatae [winged forms], pale yellowish in apterae; all appendages dusky." Forms infesting poison hemlock in California are very dark olive-green and appear almost black as they occur in compact colonies in the flower umbels. Under greenhouse conditions, the general color is pale yellowish green with the various appendages faintly dusky.

Aside from the striking color combinations, the honeysuckle aphid may also be distinguished by the large numbers of secondary sensoria on antennal segments III and IV of the alates and by the peculiar, smooth cornicles, which are nearly straight along the outer margins and distinctly swollen along the inner. In some individuals the cornicles are noticeably recurved.

The species usually occurs in dense colonies. On the honeysuckle and snowberry, they infest chiefly the tips of the new growth and cause a curling of the leaves; on the poison hemlock, they are most conspicuous in the flower heads or umbels; while on celery, parsley, parsnip, and other plants, they occur on the undersides of the leaves. Since wild honeysuckle and umbelliferous plants occur abundantly in this state, the aphid is also probably widely distributed.

The distribution of this insect is very imperfectly known. Hottes and Frison (1931, p. 238) refer to it as a cosmopolitan species. In Europe it has been reported from Belgium, France, Germany, and Great Britain. In the United States reports have been noted or specimens received from

California, Colorado, Illinois, Indiana, Missouri, New York, and South Carolina. It no doubt also occurs in other states.

The primary or winter hosts consist of many species and varieties of honeysuckle (*Lonicera* spp.) and snowberry (*Symphoricarpos* spp.); and the secondary or summer hosts are chiefly umbelliferous plants. The host records for all regions include, in addition to the above: *Berula erecta*, *Carex* spp., celery, *Cicuta*, *Comioselinum chinense*, *Cryptotaenia canadensis*, *Heracleum lanatum*, parsley, parsnip, and poison hemlock.

The known host and locality records for California possessed by the writer are:

Celery—Berkeley (in greenhouse), by Severin and Freitag, 1935, 1936.

Honeysuckle (cultivated and native)—Claremont, by Essig, 1909; Walnut Creek, by W. M. Davidson, 1913; Berkeley, by Essig, 1915, 1916, 1935; Garberville, by Essig, 1935; Fort Seward, by Essig, 1935; Inverness, by Essig, 1936; Arcadia, by Michelbacher, 1926.

Poison hemlock—Stanford University, by W. M. Davidson, 1909; San Jose, by W. M. Davidson, 1911; Berkeley, by Essig, 1935; Alvarado, by Essig, 1935.

Snowberry—Niles Canyon and Livermore, by Essig, 1935.

#### OTHER APHIDS ATTACKING CELERY

*The African Celery Aphid.*—The African celery aphid, *Aphis apiifolia* (Theobald) (*Anuraphis*), has been taken on celery in Egypt (Theobald, 1922*b*, p. 59), on celery in Morocco (Mimeur, 1934, p. 23), and on celery and sweet fennel (*Foeniculum vulgare*) in Egypt (Hall, 1926, p. 8). It has never been reported from this country.

*The Dock Aphid.*—The dock aphid, *Aphis rumicis* Linn., a very common and general feeder, was collected on celery at Milpitas, California, by Freitag on December 19, 1935. It has not been reared on celery.

*The Tulip Aphid.*—The tulip aphid, *Aphis tulipae* (B.d.Fonsc.), is a common species in California and is especially abundant on the rhizomes in storage, at the bases of growing plants, and under the leaf sheaths of all kinds of garden irises. It also occurs on tulip, gladiolus, scilla, crocus, chinodoxa, and on the roots of carrot and parsley (Theobald, 1926–1929, vol. 2, p. 241). Ogilvie (1927) reports it as feeding at the bases of carrot and celery in Bermuda.

*The Green Apple Aphid.*—The green apple aphid, *Aphis pomi* De Geer, has been reported on celery in Florida by Cole (1926). Although abundant in California on many hosts, it has not been taken on celery.

*Hall's Celery Aphid.*—Hall's celery aphid, *Hyadaphis apii* Hall, has been reported on celery in Egypt by Hall (1926, p. 20) and on the same host in Morocco by Mimeur (1934, p. 18–19).

*Theobald's Celery Aphid.*—Theobald's celery aphid, *Cavariella theo-*

*baldi* (Gillette), has been reported as taken from celery in Colorado by Gillette and Palmer (1932, p. 468-69).

*The Wild Lettuce Aphid.*—The wild lettuce aphid, *Myzus lactucae* (Schränk), has been listed from celery in Illinois by Hottes and Frison (1931, p. 339).

#### SUMMARY

In California aphids are playing an important rôle in the transmission of virus diseases of celery and are thereby causing considerable financial loss to the producers of that crop. To date eleven species on celery in this state may be considered as potential pests. They are: (1) the celery leaf aphid, *Aphis apigraveolens* Essig n. sp.; (2) the celery aphid, *Aphis apii* Theobald; (3) the rusty-banded aphid, *Aphis ferruginea-striata* Essig n. sp.; (4) the cotton or melon aphid, *Aphis gossypii* Glover; (5) the cow parsnip aphid, *Aphis heraclella* Davis; (6) the erigeron root aphid, *Aphis middletonii* Thomas; (7) the yellow willow aphid, *Cavariella capreae* (Fab.); (8) the lily aphid, *Myzus circumflexus* (Buckt.); (9) the foxglove aphid, *Myzus convolvuli* (Kaltenbach); (10) the green peach aphid, *Myzus persicae* (Sulzer); and (11) the honeysuckle aphid, *Rhopalosiphum melliferum* (Hottes). The dock aphid, *Aphis rumicis* Linn., was also taken once on celery in California, but has not been reared on that plant. The majority of these are undoubtedly introduced species.

Nearly all of them have a number of hosts. The cotton or melon aphid, the lily aphid, the green peach aphid, and the foxglove aphid have many and varied hosts.

All of these species appear to reproduce parthenogenetically continuously during the entire year, although there is a noticeable reduction of individuals during the winter months.



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