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A REVISION OF THE GENUS *WINTHEMIA* ROBINEAU-DESVOIDY IN AMERICA NORTH OF MEXICO (DIPTERA, TACHINIDAE)

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ABSTRACT

A systematic revision of the genus Winthemia *Robineau-Desvoidy, 1830 of America north of Mexico is presented. Twenty-five species are described, figured and keyed. Six new species are described:* andersoni, argentifrons, aurifrons, floridensis, sabroskyi *and* reinhardi. Winthemia antennalis *Coquillett does not belong in this genus and its correct placement has not been determined. Published biological information is summarized and new information on several species is added. Evolutionary trends in* Winthemia *are discussed, and critical morphological details are discussed and figured. The ecological data obtained so far support the observations of Townes (1962) who suggests that parasitoid insects are more commonly niche-specific than host-specific.*

INTRODUCTION

According to Reinhard (1931) flies of the genus *Winthemia* Robineau-Desvoidy probably had been reared more often in economic entomological studies than any other genus of tachinids. Some of the species of this complex are important biotic agents partially or wholly responsible for the homeostatic state of many agricultural and forest insect pests.

This genus is very common in the western hemisphere and has been recorded in all zoogeographical regions of the world.

Although forty years have passed since the publication of Reinhard's major contribution to the New World *Winthemia,* his paper has remained the key work for students of this group. The development of new techniques in the systematic studies of tachinids, and the need for more precise species determinations, prompted the author to present this revised treatment. During these past forty-years, many authors have contributed information on the hosts and distribution of many species of *Winthemia,* many of which need verification.

Adult specimens of *Winthemia* species exhibit considerable deceptive interresemblances and variation of structure and when these species are superficially examined, they cannot be distinguished easily. Reinhard

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(1931) refers to the group as "strikingly uniform in characters" and states "the females offer even fewer characters than the males and except in rare cases they cannot be separated with certainty from the opposite sex".

Coquillett (1897) found only four species of *Winthemia* occurring in America north of Mexico. Reinhard (1931) recognized twenty-one for that area. In the present revision twenty-five species are recorded of which six are described as new. The hosts of *Winthemia* species in the Nearctic region are listed mostly as armyworms, larvae of other noctuid moths, and to a lesser extent larvae of Sphingidae and Geometridae, many of which are major or minor pests of alfalfa, tobacco, grass, or are defoliators of forest trees.

According to Reinhard (1931) the so-called "red-tailed tachina fly" the important parasite of the armyworm commonly mentioned in the economic literature, was not *W. quadripustulata* but rather was *W. rufopicta*. For species with specialized larval feeding habits, it is understood that relying solely on morphological studies for species discrimination will not be adequate for either the field biologist or the economic entomologist. Field and experimental breeding studies would be of great importance in aiding one to solve the problems of species discrimination in *Winthemia* species, but until such studies are made it is hoped that this revision will serve both to aid those who desire more information and to stimulate others to undertake further experimental studies. The present revision is the fruit of two years of work as Graduate Research Assistant at the University of California, Riverside, under the direction of Dr. L. D. Anderson and Dr. Evert I. Schlinger. It has been slightly changed from a manuscript thesis of the same title, presented in December 1969 to the Department of Entomology of University of California, Riverside, in partial fulfillment of the requirements for the degree of Master of Sciences.

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Special thanks should be made to Dr. D. M. Wood, Canada Department of Agriculture, for making the extensive collection of *Winthemia* of that institution available, including the valuable specimens of Reinhard's collection which is now housed in that institution.

Through the courtesy of Dr. P. H. Arnaud, Jr, California Academy of Sciences, San Francisco, the entire collection of that institution was made available for study including the specimens from his private collection.

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MATERIAL AND METHODS

The material which made this revision possible, has been loaned by several institutions and private collections in North America whose names are listed at the end of this section.

Specimens were studied using a Bausch & Lomb binocular microscope. Drawings were made with aid of a Leitz camera lucida. Overall length was measured from the front of the head to the tip of abdomen.

The usual techniques of relaxing dried specimens in a moist chamber and dissecting the male genitalia afterwards too often resulted in damage to the specimen. Moreover, with this method the pollinosity patterns frequently became "greased" over in the relaxing chamber. A superior technique originally used by Dr. W. R. Thompson and gently communicated to me by Dr. D. M. Wood involved breaking off the unrelaxed abdomen from the dry specimen and boiling the whole structure. The attachment of the abdomen to the thorax is relatively weak in dried specimens, and by using a needle with slight upward pressure at the tip of the abdomen, the abdomen will separate easily from the thorax ven-

trally. Then the dorsal attachment can be severed by gently forcing the abdomen to one side in either a slight downward or upward direction. The abdomen almost invariably comes off whole, although the first sternite (syntergum 1 + 2) occasionally remains on the thorax. In making this separation, the needle or forceps was inserted beneath the edge of the fifth tergite or similar point to avoid breaking the bristle. When this was done carefully, minimal damage resulted. Since it was not uncommon for the abdomen to snap off completely with the first upward pressure, it was important to dip the needle in glue or water as a precautionary measure so that the abdomen could stick to it instead of catapulting into space. The whole abdomen was boiled gently in a solution containing ten percent sodium hydroxyde. Sometimes the air space in the abdomen will partially impede the action of the sodium solution, but the process can be facilitated by removing the softened abdomen from the solution to distilled water and tearing the membranes between the pre- and postabdomen. Fine pointed forceps are convenient for this, as the fifth tergite and postabdomen can be torn apart quite readly by grasping the edges adjacent to the membrane and pulling. It usually took a minute or two in a boiling solution to clear the abdomen after this operation. When the abdomen was cleared, it was removed to distilled water and the postabdomen and fifth sternite were separated from the remainder of the abdomen.

The preabdomen was washed in distilled water and dehydrated in glacial acetic acid. After a few minutes in this acid the sclerites were drained, and if they were collapsed, they were reshaped before the acid completely evaporated. The setal and pollinose patterns are hardly disturbed by this treatment. Drying directly from distilled water was less satisfactory, since the hair-like setae were more likely to mat than if dried from the acid. The abdomen could be reattached to the thorax by placing a minute drop of slow-drying glue on the original attachment of the thorax and sticking the abdomen to it. A polyvinyl alcohol, lactic acid, and water mixture was used for this glue since most commercial glues dried before the preabdomen could be manouvered into position.

The postabdominal parts are customarily stored in glycerine in microvials on the same pin with the specimen.

The following list of abbreviations was used in the text to indicate from which individual museums, collections or universities specimens were borrowed:

AU: Auburn University, Auburn, Alabama.
CAS: California Academy of Sciences, San Francisco, California.
CNC: Canadian National Collection, Entomology Research Institute, Canada Department of Agriculture, Ottawa, Canada.
CU: Cornell University, Ithaca, New York.
FNMH: Field Museum of Natural History, Chicago, Illinois.
ISC: Iowa State College, Ames, Iowa.
KU: University of Kansas, Lawrence, Kansas.
KSU: Kansas State University, Manhattan, Kansas.
LACM: Los Angeles County Museum, Los Angeles, California.
MCZ: Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

NCSU: North Carolina State University, Raleigh, North Carolina.
OSU: Ohio State University, Columbus, Ohio.
OSUC: Oregon State University, Corvallis, Oregon.
PHA: P. H. Arnaud Jr. Collection, San Francisco, California.
UA: University of Arkansas, Fayetteville, Arkansas.
UBC: University of British Columbia, Vancouver, B. C. Canada.
UCB: University of California, Berkeley, California.
UCD: University of California, Davis, California.
UCR: University of California, Riverside, California.
UI: University of Idaho, Moscow, Idaho.
UM: University of Minnesota, St. Paul, Minnesota.
USNM: United States National Museum, Smithsonian Institution, Washington, D. C.
UU: University of Utah, Salt Lake City, Utah.
UW: University of Wisconsin, Madison, Wisconsin.
WSU: Washington State University, Pullman, Washington.

LIFE HISTORY *WINTHEMIA* SPECIES

A complete review of the biology of *Winthemia* will not be attempted here and reference to more complete biological observations will be found in Allen (1925) and Marsh (1937). Some salient features of the biology will be mentioned, since there are indications that such features may be used to interpret more precisely the status of many species in this group.

Eggs

The duration of egg stage of *W. quadripustulata* varies from 1 to 12 days depending on the temperature. In Mississippi, the average duration is 5.1 days in late May, 2.2 in late August, and 2.8 days in middle September (Allen, 1925). Quaintance & Brues (1905) reported that eggs of *W. quadripustulata* hatched in 2 days and those of *W. cecropia* hatched in about 36 hours (Marsh, 1937).

Larva

Egg hatching and host entry are the same in both *W. quadripustulata* and *W. cecropia* (Allen, 1925 and Marsh, 1937). The larva emerged from a semicircular slit at the anterior end of the egg. With the posterior part of the body remaining in the egg shell and serving as a fulcrum, the larva cut a hole through the host integument and then slowly forced its way inside.

Development within the host

The presence of the first instar larva of *W. quadripustulata* within the body of the host stimulated the production of a brown, rigid respiratory funnel which was continuous with the breathing pore and in which the posterior end of the larva remained attached. The larva and funnel were largelly or wholly encapsulated in a spongy ball of pale, tumor-like tissue, apparently produced by the host reacting to the in-

vading parasite. The first instar larva moulted while still embedded in this sheath (Allen, 1925). The second instar larva of *W. quadripustulata* remained attached to the steadily enlarging funnel but eventually broke through and rapidly outgrew the encapsulating sheath. By the time the fat bodies of the host were much depleted, but the vital organs were not attached (Allen, 1925).

The host died when *W. quadripustulata* was in the third instar. When this occurred, the larva released itself from the tunnel, tore a large hole in the host integument and moved through the putrified semifluid body contents, but returned frequently to the hole for air. After absorving a large part of the host's body contents, the mature larva emerged through the hole (Allen, 1925). The duration of the entire larval period of *W. quadripustulata* averaged 5.0 days during May and 3.8 days during August (Allen, 1925).

Salt (1968) studied the resistence of insect parasites to the defense reactions of their host and discussed the mechanism, formation and physiological adaptations of the parasitic larvae toward the respiratory funnel. According to Salt (1968) many tachinid larvae, especially the 2nd and 3rd instars, are capable of exerting great physical resistance to encapsulation. The resistance is a curious adaptations whereby the parasite utilizes the host's efforts rather than by directly opposing them. The host mobilizes its blood cells to encapsulate the parasite, but, in opposition, the tachinid larva physically repulses the haemocytic cells and molds them into a funnel. Once its respiratory attachment has been secured to that sheath, the larva cannot be asphyxiated. The host's defense reaction in such cases is an advantage to the parasite favoring the later development. Quaintance & Brues (1905) reported that larvae of *W. quadripustulata* completed development within 3 days. Marsh (1937) reported that the larvae of *W. cecropia* completed development in 6 to 8 days and might crawl out immediately or remain for a time within the host. In the latter case the host completed at least part of its cocoon, crawled out and pupated in the soil. Quaintance & Brues (1905) reported that usually only one larva of *W. quadripustulata* reached maturity in a larva of *Heliothis zea* (Boddie) even though many eggs were laid on the host.

Site of pupation

Clausen (1940) reported that species of Tachinidae which parasitize free-feeding lepidopterous larvae usually enter the soil to pupate, while species parasitizing stalk-borers or leaf-rollers usually pupate within the burrow or leaf-roll. Allen (1925) observed that when mature larvae of *W. quadripustulata* emerged from the body of the host above ground, they burrowed into the soil; when emerging below the ground, they burrowed away from the host. The mature larvae form small vertical cells not more than 1 inch away from the cell of the host, and less than 1/4 inch below the soil surface and pupate with their anterior end oriented upwards. *W. cecropia* pupated 3 to 8 inches deep, depending on the soil moisture content (Marsh, 1937).

PUPA

The duration of the pupal period of *W. quadripustulata* is about 10 days during mid-summer and about 24 days in the overwintering generation which pupates in late March. The pupal period is approximately equal for both sexes (Allen, 1925; Quaintance & Brues, 1905).

ADULT

The adult muscoid flies emerge from the puparium by expanding its ptilinum, forcing apart the halves of the operculum. The fly works its way out through the soil by alternate expansion and retraction of the ptilinum, aided by the backwardly directed bristles of the head and thorax, and by using its legs (Clausen, 1940).

HABITAT

Allen (1925) found that the sexes of *W. quadripustulata* become more or less segregated at times. Adults collected at host infestations are largely, though seldom entirely, females. On several occasions during the summer, colonies of males were found whirling about over dry barren ground, alighting frequently on the barren soil or on nearby foliage. These colonies were usually less than 100 feet in diameter and were located under trees in the open, parklike woodlands and not associated with host infestation or food materials. Males of *W. cecropia* have been found associated with females in trees infested by larvae of *Hyalophora cecropia* (Marsh, 1937).

OVIPOSITION

Allen (1925) described the oviposition behavior of *W. quadripustulata* as follows; "the fly approaches the victim from the side, frequently prods it to evidence of life or possibly to ascertain which is the anterior end. It rarely walks over the host, but sidesteps alongside its body, always facing the caterpillar. The long extensile ovopositor is extended forward between the legs, until the tip end lies just beneath the oral cavity. The tip is then bent downwards and an egg quickly attached to the skin of the host. Usually the female remains by the side of the host for several minutes, depositing two, three or even more eggs, with short periods of rest between each deposition. In one case three eggs were deposited in two minutes".

While ovipositing the fly is almost oblivious to all except major disturbances. In one occasion in the field I approched slowly about 8 inches and took several photographs. Based on these photos fig. 92 was made.

Riley (1870 b) reported that the eggs are laid in groups of 4 to 5 on the back of the thoracic segments, and they were invariably deposited in a transverse direction to the longitudinal axis of the host. According to Clausen (1940) all the tachinids parasitizing Lepidoptera attack the larval stages of their host. *Winthemia* have never been observed to ovi-

posit on very young catterpillars but always on nearly mature larvae. For a number of tachinid parasites the moulting by the host could be a severe mortality factor, for if the eggs are placed on young caterpillars, they might moult before the eggs have had a chance to hatch and they would be cast off with the old skin. It seems highly probable, therefore, that some features of the oviposition behavior of the gravid female fly may be looked upon as an adaptation evolved to cope with this problem, since the last instar of the host usually will last long enough for the fly larva to hatch from the eggs. *W. cecropia* have oviposited a maximum of 76 and an average of 21 eggs per host on *Hyalophora cecropia* larvae (Marsh, 1937). The number of eggs laid by *W. quadripustulata* on the larva of *Spodoptera frugiperda* was usually 1 or 2, sometimes 3. When the flies were abundant, it was uncommon to find larvae individually having as many as 6 and a maximum of 12 eggs in their bodies (Luginbill, 1928).

The species in Townsend's "host ovipositing" group require only 2 to 4 days from mating to oviposition (Townsend, 1908). However, the period from the emergence of the *W. quadripustulata* adult to oviposition ranges from 6 to 12 days. Most of the females reared from insectary experiments continued to oviposit until their death (Allen, 1925).

The orientation to a certain region of the body forms an important element in the chain of reactions leading to oviposition. In the laboratory *W. quadripustulata* have deposited 73% of its eggs upon the thoracic segments I and II of *Prodenia eridania* caterpillars. If the caterpillars of *Spodoptera frugiperda* were parasitized by the same species, most of the eggs were found upon its thoracic segments (Chittenden, 1910). Riley (1880) mentioned the activities of the host against eggs attached to their cuticle. Several other authors have reported that the host attemped to dislodge the parasite eggs either due to "biting-off" by the host or by certain rubbing movement against the substratum. The preference of the thorax as the side for parasite eggs deposition is said to be an adaptation against such action. *Prodenia eridania* destroyed only 5.5% of the eggs of *Winthemia* attached to the thorax, but 37% of those that were deposited more caudally (Allen, 1929).

Food

Allen (1925) observed the feeding habits of many species of tachinids in Mississippi. According to Allen (1929), Tachinidae may be divided roughly into two groups on the basis of the food habits of the adult. The first includes those species which habitually visit flowers, and the second includes those which feed at non-floral nectaries or on deposits of honeydew. The difference of habits is correlated with a difference in the structure of the prosboscis. In general, species with a long proboscis would feed at blossoms, but species with a short proboscis would feed on honeydew and at the nectaries of plants. *Winthemia* species belong to the second group. Allen (1925) reported that *W. quadripustulata* feeds on the secretion of several species of aphids, at the nectaries and fruity stem of cowpeas, and less frequently, on the petioles of peach. It was not commonly atracted to flowers but had been taken

at blooms of *Euphorbia* sp. In the insectary, adults readily fed on diluted honey, mashed bananas, sugar water, and aphid honeydew. Females laid on eggs when fed only sugar water and honey, though living an apparently normal life, and laid infertile eggs when fed on aphid honeydew combined with other foods. Allen's (1925) failure in obtaining fertile eggs could be explained by the fact that he did not add a protein source to any of the diets.

Longevity

W. quadripustulata adults reared in the insectary lived 1 to 24 days with an average of 10.9 days. The average longevity of females was 1 day longer than for males (Allen, 1925).

Sex ratio and mating

The sex ratio of *W. quadripustulata* was found to be 1:1 (Allen, 1925). Clausen (1940) stated that in some species of tachinids there is a wide variation in the sex ratio at different seasons. In some multibrooded species, the females are more abundant in the fall.

Type of reproductive habit

On the basis of dissections of gravid females of a large series of tachinids, Townsend (1908) distinguished five types of reproductive habits: 1) host oviposition; 2) leaf oviposition; 3) supracutaneous host larviposition; 4) subcutaneous host oviposition; 5) leaf larviposition. Pantel (1910) presented a different classification, distinguishing 10 groups of reproductive habits based on the structure of the female reproductive system as well as the type of egg. *Winthemia* was placed in the type I by Pantel. This type is described as sticking a short, normally undeveloped, macrotype egg on the body of the host. The female uterus is short, straight, and broad with thick walls, has a strong posterior musculature facilitating oviposition, lacks the rich supply of trachea of the larviparous and other forms, and is not an organ of incubation. The number of ovarioles varies from 10 to 30, each having 4 to 6 egg chambers and about 15 vitelline-cells. The egg is very large and planoconvex; the shell splits along a line separating the dorsal and ventral surfaces. The larva immediately enters the host as it emerges, leaving its posterior extremity within the entrance hole as the primary intersegmental funnel develops around it (Pantel, 1910; Thompson, 1963).

Duration of the life cycle

W. quadripustulata completed its life cycle in a maximum of 18 days in mid-summer, spending 1 day as an egg, 3 as a larva, 8 as a pupa and 6 as an adult before oviposition. However, the usual duration of the life cycle during the warmer months is from 22 to 33 days (Allen, 1925).

EFFECT OF *Winthemia* ON HOST POPULATION

Allen (1925) reviewed the literature on rates of parasitism by *W. quadripustulata.* Several authors have reported rates of parasitism of the armyworm as high as 90% in Missouri, 100% in one infestation in Virginia, 50 to 60% in New York. Allen (1925) reported rates of parasitism from 11 to 23% on southern armyworm in Mississippi. Parasitism of *Hyalophora cecropia* by *W. cecropia* was about 3% over a large area, but in a small area of 5 to 6 trees it sometimes reached nearly 100%. Parasitism was 6 times greater below the 15-foot tree level than above this level (Marsh, 1937).

IMMATURE STAGES OF *WINTHEMIA*

The immature stages of *Winthemia* have not been extensively investigated. Allen (1925), Nielsen (1913) and Thomson (1926) described the immature stages of a species identified as *W. quadripustulata.* Greene (1921) has figured and briefly described the puparium of a species he named as *W. quadripustulata.*

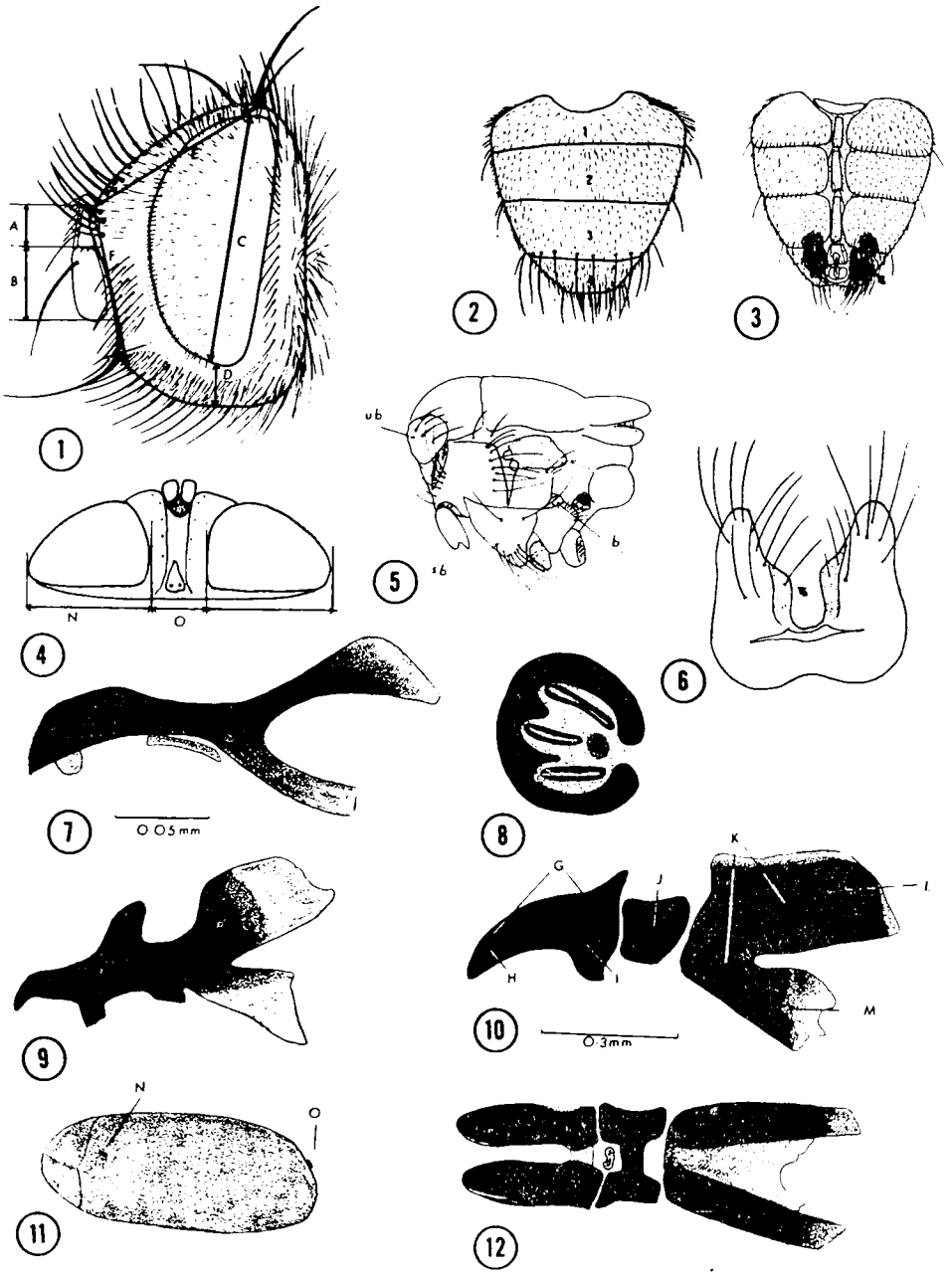
Since I have not been able to obtain living larvae to study the morphology and biology of the larval stages of *Winthemia,* the following descriptions apply to the eggs, cephalopharyngeal apparatus and puparium of *W. rufopicta.* The eggs were obtained by dissection of gravid females; the cephalopharyngeal apparatus of stages I and II were obtained by dissection from the skins of parasitized *Spodoptera frugiperda;* those of stage III were recovered from the anterior cap of the puparium.

Egg. The macrotype, oval, creamy white egg is normally undeveloped at the time of oviposition. In dorsal view it is oval, whereas in lateral view it is flattened ventrally and convex dorsally. The ventral surface, which is in contact with the host integument, is thinner and more flexible than the dorsal side. Egg length was 0.70 to 0.36 mm.

First instar cephalopharyngeal apparatus (fig. 7). The deeply sclerotized cephalopharyngeal apparatus is equipped anteriorly with a single mouth hook, bifurcating laterally, with each side being further divided into a dorsal and ventral wing. The mouth hook is very lightly serrate on its dorsal surface, smooth ventrally and slightly curved downward. Average length 0.17 mm.

Second instar cephalopharyngeal apparatus (fig. 9). The cephalopharyngeal apparatus is bilaterally symetrical without sutures between the oral, hypostomal and pharyngeal areas; the mouth hook is paired, sharply hooked and not serrate. The lateral pieces of the skeleton are joined ventrally by a sclerotized area starting at the base of the mouth hook and continuing into the hypostomal area. Average length: 0.75 mm.

Third instar cephalopharyngeal apparatus (figs. 10, 12). It is bilaterally symmetrical and distinctly divided into three regions: an oral part with a pair of slightly curved, nonserrate mouth hooks; a hypostomal part; and a pharyngeal part with both dorsal and ventral processes. Average length: 0.37 mm.



1, Head of *Winthemia,* in profile showing measurement points used for determining proportions of head structures (A, length of second antennal segment; B, length of third antennal segment; C, eye height; D, width of cheeks; E, frontal length; F, facial length). 2, Abdomen of *Winthemia* showing the segmentation, dorsal view. 3, *Idem,* ventral view, showing the "sexual patches" on third and fourth tergites. 4, Head of *Winthemia,* dorsal view, showing the measurement points (N, head width; 0, front width). 5, Thorax of *Winthemia,* lateral view (ub, humeral bristles; sb, sternopleural bristles; b, "barrete"). 6, Fifth sternite of *Winthemia.* 7, Cephalopharyngeal apparatus of first instar larvae. 8, Posterior spiracle of puparium. 9, Cephalopharyngeal apparatus of second instar larvae. 10, Cephalopharyngeal apparatus of third instar larvae (G, oral part; H, mouth-hooks; I, basal part; J, hypostomal part; K, pharyngeal part; L, dorsal process of the pharyngeal part). 11, Puparium, lateral (N, prothoracic spiracle; O, posterior spiracle). 12, Cephalopharyngeal apparatus of third instar larvae, ventral view.

Puparium (fig. 11). The puparium varied in length from 4.4 to 7.2 mm. (average of twelve specimens is 6.3 mm.); elliptical in shape with rounded ends and is reddish brown to dark brown in color. The anal opening is placed ventrally on the 10th segment. The anterior spiracular opening is small and obscure and is situated on the lateral surface of the third segment near its posterior margin. The prothoracic spiracles are protuberant, and the cornicles are well developed with many apical respiratory orifices; the posterior spiracles protrude from the posterior surface of the last segment and are slightly supraterminal and next to each other. The spiracular plates are circular or nearly so, each with three slits (fig. 8).

TAXONOMIC CHARACTERS AND TERMINOLOGY

Observed species characters of a structural nature are weakly developed in *Winthemia,* especially in the females. Consequently the problem of effective use of the extensive and complex chaetotaxy has been a major effort in the present study. The identity of most species must be confirmed from characters of the male genitalia, although several head characters are also useful. The works of Mesnil (1944) and Townsend (1908) have been used frequently in matters of structure and terminology, but in certain cases it has been advantageous to follow the terminology of Thompson (1963) rather than use the more conventional taxonomic designations. The specific characters of major taxonomic importance are discussed below.

Head. The relative proportions of certain head structures provide the most useful characters. The points of reference used for determining proportion of head structures are shown in fig. 1, using the following terms: *frontal length* the distance measured in direct line with the head seen in profile from the base of the inner vertical bristle to the lower basal point of the first antennal segment (E); *facial length,* the distance measured in direct line with the head seen in profile from the lower basal point of the first antennal segment to the base of the vibrissa (F).

Thorax. The number, position and length of bristles on the thorax are characters considered to be of generic importance in Tachinidae. Usually these bristles are characters quite uniform and are not useful as specific characters. Because bristles are used so frequently in the classification of these flies the word "bristles" is usually omitted in descriptive works (e.g. "acrosticals" stands for acrostical bristles). Walton (1913), studying large series of *W. rufopicta* (misidentified as *W. quadripustulata*) reared from an armyworm in Washington D.C., reported a wide variation in the number of sternopleurals in relation to the size of the specimens. Usually there are three pairs of lateral scutellars in *Winthemia,* but in a series of twelve specimens of *W. occidentis* reared from geometrid caterpillars it was called to my attention by Sabrosky *(in litt.)* that some small specimens had only two pairs. Sometime the median pair of the 3-pair set was smaller. The reduction in size of the first intra-alar postsutural was observed in males of *W.*

datanae; and on some specimens these bristles were absent. The thoracic stripes referred to in the descriptions of *Winthemia* species were observed when light strikes thorax from posterior angle. These described stripes appeared dark under this illumination. The manner in which the thorax was illuminated was critical since the appearance of the striped pattern changed with the changing incidence and direction of the illumination. Since host size may influence parasite size and possibly the size and number of bristles and chaetotaxy, these characters should be used with discretion in the separation of species. The main characters of the thorax used in this work are shown in fig. 5.

Abdomen. The abdomen consists of five distinct observable segments including the reduced postabdominal segments. The tergal plates (tergites) of the first two segments are more or less fused together, and for taxonomic purposes are usually counted as a single tergite. The vestiture, chaetotaxy, pollinosity and ground color can be useful specific characters, but often they vary intraspecifically and must be used cautiously. In the males, the vestiture on the venter of abdominal segments III and IV may assume a characteristic pattern forming densely matted patches of hairs, the so-called "sexual patches" of authors which provide useful specific characters.

Legs. The leg chaetotaxy is of great importance in discriminating species of *Winthemia.* The exact position of a bristle, or a row of bristles or hairs must be accurately determined in accordance with the generally accepted terminology. With the knees flexed, the plane in which the center- line of the femur and tibia lie separates the dorsal and ventral bristles. The anterior and posterior bristles are perpendicular to the center-line of the femur and tibia lie separates the dorsal and venthe plane and the terms used for the intermediate positions, namely anterodorsal, anteroventral, posterodorsal and posteroventral are self-ex-planatory. Mesnil (1944) has discussed the application of this character to the systematics of the Tachinidae. Also, the shape of tarsal segments is quite characterist in some species and affords useful diagnostic characters.

Genitalia. The morphology of the postabdominal segments of *Winthemia* was described in detail by Thompson (1963), and I shall discuss only the sclerites which are most important for taxonomic purposes. These are: the *inner forceps,* a paired sclerite found at the proximal end of the male postabdomen (IF); the *outer forceps,* a paired sclerite placed laterally to the inner forceps (OF). The shape, vestiture and comparative length of these two structures are the most important features (figs. 55, 56). The male aedeagus (fig. 60) and the female genitalia are not useful as specific characters because of their similarities.

EVOLUTIONARY TRENDS IN *WINTHEMIA*

The following terms are based on the terminology of Hennig (1965) "plesiomorph" to denote a character, a species or a group, which did change or evolved but slightly during a considerable lapse of time;

and "apomorph" to denote a character which made considerable changes in evolution. It is the author's intent to limit the use of these terms to comparative morphological considerations. This study is not intended to establish a phylogeny even though there are trends that suggest phylogenetic lines of relationships. Comparative morphological studies in the genus *Winthemia* show the following evolutionary trends:

Ciliation of tibia vs. ventral patches of matted hairs. I have attempted to consider the origin and development of these two structures in a broad context with special emphasis on the funcional aspects of the structures. In symplesiomorphic species (e.g., *andersoni* sp. n., *borealis*) the hind tibia presents a generalized type of chaetotaxy, which is common to many Tachinidae. In such species the anterodorsal row of bristles of the hind tibia is well spaced, irregular in size and provided with long bristle near the middle of the row; in intermediate conditions (e.g. *quadripustulata*) the anterodorsal cilia tend to be more numerous or less uniform in size. The long anterodorsal bristle found in the first type tends to be reduced in size and in *rufopicta* is reduced to the same size as the other cilia. In the apomorphic condition found in *montana, citheroniae, aurifrons,* etc., the anterodorsal cilia tend to be short, flattened, and closely placed.

The increasing ciliation is highly correlated with the development of abdominal hair-patches and is interpreted here to function as a comb for the abdominal hairs at the tip of the abdomen as can be seen in the displaying of the "cleaning behavior". The origin and development of these structures are interpreted as follows: in symplesiomorphic groups the long hairs at the tip of the abdomen functioned as a cleaning apparatus for the tibia and vice versa. This adaptative condition, although it cannot be unequivocally proven, apparently has led towards the evolvement of more specialized and complex formation of dense matted hairs to perform a more efficient cleaning action. These patches of matted hairs on the venter of segments III and IV are found only in males and evolved independently in species in a number of tachinid genera, mostly in the subfamily Goniinae. The hairs at the tip of the abdomen, are in most cases densely grouped in a plesiomorphic condition; such hairs are long, thin and relatively well distributed. In intermediate steps the hairs tend to be thinner and denser (e.g., *rufopicta*), and in *montana* they are matted, forming the so-called "sexual patches". An apomorphic situation is found in *citheroniae* where the patches extend along the venter of segments III and IV (see fig. 93).

Tarsal segments. The last segment in *Winthemia* evolved into two extreme specializations. In *okefenokeensis* the intermediate segments became obliquely expanded and flattened. In the neotropical species such as *latimana,* the last tarsal segment of females is extremely enlarged and flattened. Since in the muscoid flies the tarsus contains important chemoreceptor organs, it is visualized here that the evolution towards the enlargements of certain tarsal surfaces would enhance the chemosensorial perception of these flies.

SYSTEMATICS

No universally accepted classification is available for the higher categories of the Tachinidae, but the work of Mesnil (1944) on the Palearctic fauna has indicated the lines on which a world classification can be produced and does render some order out of the chaos created by Townsend on the supposed tribal groups elaborated in his Manual of Myiology (Townsend, 1934-1942). Significant progress in the tribal classification of the North American Tachinidae was recently achieved by Sabrosky & Arnaud (1965) in their work in the North American Diptera Catalogue. The definition of satisfactory tribes in the vast complex of the Goniinae is an extremely difficult subject and a workable diagnosis will have to be based on aggregates of many characters taken together. This author follows Thompson (1963) and Sabrosky & Arnaud (1965) in recognizing the tribe Winthemiini as distinct. This group was originally proposed by Townsend (1913) as Winthemiae, but he did not recognize it as valid in his subsequent papers as he placed the *Winthemia* in the tribe Sturmiini. Mesnil (1939 a) characterized this group as a subsection of his Salmaciinae (= Goniinae), and van Emden (1954), Herting (1960) and others have concurred subsequently with this idea.

Tribe Winthemiini

Winthemiae Townsend, 1913: 52.
Winthemiini; Mesnil, 1939a: 25, 26, 31; 1939b: 323.

Diagnosis. Goniinae, with the following combination of characters: ocellars proclinate (sometimes absent); upper front with reclinate frontals; parafrontalia often pilose; notopleurals rarely more than two; vibrissae almost always at the level of mouth or below; eyes thickly pilose; proboscis short; palpi normal in size; humeri with five bristles (three outer and two inner); prealar bristles long and strong, longer than first dorsocentral postsutural; "barrete" pilose (see fig. 5); two or rarely three sternopleurals; apical scutellars present, sometimes weak; abdominal tergites I (syntergum 1 + 2) excavate on hind margin; female with an elongate, retractile, telescopic ovopositor; reproductive system of group I of Pantel (1910), described as sticking the short, macrotype, usually undeveloped egg on the body of the host.

Within the Nearctic fauna, 7 genera and 33 species have been recognized as belonging to this tribe (see Sabrosky & Arnaud, 1965).

Genus **Winthemia** Robineau-Desvoidy

Winthemia Robineau-Desvoidy, 1830: 173 (Type- species, *Tachina variegata* Meigen; by designation of Robineau-Desvoidy, 1863: 207); Coquillett, 1897: 224 (notes); Adams *in* Williston, 1908: 375; Aldrich, 1905: 473; Tothill, 1912: 1 (table of species); Allen, 1925 (biology); Reinhard, 1931: 2 (Revision of American species); Mesnil, 1949: 85 (Palearctic species); Thompson, 1963: 961

(Trinidad species); Sabrosky & Arnaud, 1965 (catalogue of Nearctic species).

Microtrichomodes Macquart, 1846: 160. Type-species, *Microtrichomodes analis* Macquart (mon.).

Masipoda Brauer & Bergenstamm, 1889: 162 (1889: 94). [Type-species, *Masipoda geminata* Brauer & Bergenstamm (orig. des. as gen. n., sp. n.)].

Trisisyropa Townsend, 1916a. [Type-species, *Trisisyropa vesiculata* Townsend (orig. des.)].

Okea Townsend, 1916b: 74. [Type-species, *Winthemia okefenokeensis* Smith (orig. des.)].

Neowinthemia Townsend, 1919: 583. [Type-species, *Neowinthemia abdominalis* Townsend (orig. des.)].

Okeopsis Townsend, 1927: 267. [Type-species, *Okeopsis palpalis* Townsend (orig. des.)].

Hemimasipoda Townsend, 1927: 267. [Type-species, *Hemimasipoda brasiliensis* Townsend (orig. des.)].

Prowinthemia Townsend, 1928: 151. [Type-species, *Prowinthemia paraguayensis* Townsend (orig. des.)].

Promasipoda Townsend, 1934: 399. [Type-species, *Promasipoda pinguis* Townsend (orig. des.)].

NOMENCLATORIAL NOTES

The generic synonymy given here is only for the American taxa. The type of *Winthemia* R.-D. is *Tachina variegata* Meigen. *Musca variegata* Fabricius, one of the species originally included, was subsequently designated as type by Robineau-Desvoidy (1863: 207). However, *Musca variegata* was not described by Fabricius but by Meigen as *Tachina variegata* (*cf.* Meigen, 1824: 256). Robineau-Desvoidy in 1830 and 1863 made references to *Tachina variegata* Meigen, leaving no doubt as to the species he intended to be the type-species.

Reinhard (1931) stated that since *Tachina variegata* Meigen is equal to *Musca quadripustulata* Fabricius, the latter, also an originally included species, should become the type-species. This procedure of designating the type-species however is not in accordance with the International Code of Zoological Nomenclature. Similarly Mesnil (1949) did not accept the type designation of Robineau-Desvoidy (1863) as valid and designated *Musca quadripustulata* as type-species of *Winthemia*. Recently Sabrosky & Arnaud (1965), stricktly following the I. C. Z. N. rules, maintain *W. variegata* as the type-species.

I have had the opportunity to examine in the U.S. National Museum, Washington, D.C. the types of *Okea, Neowinthemia, Trisisyropa* and *Promasipoda* and confirm their placement and synonyms.

Generic characters. Head wider than high; semicircular to subcuneiform, though subquadrate or subrhombic; postcranial regions slightly concave, moderately bulging below; facial length usually longer than frontal length; thickly pilose eyes reaching below level of vibrissae in profile; clypeus nearly flush, usually rather shallow, no facial carina; epistoma short; facialia covered with short hairs; inner verticals well differentiated; outer verticals weak, sometimes no longer than the postverticals; vibrissae noticeably shorter than the oral margin axis; proboscis short and stout, no longer than head height; labella large; rostrum developed; palpi slender, clavate, swollen terminally in females and more or less bare; antenna placed above the middle of eyes; first antennal segment very short; second elongate; third 1 to 1 1/2 times the length of second; arista usually thin, a little thickened on the basal 1/3; basal joint short; frontal row of bristles often doubled, diverging below base of antennae and extending to apex of the second antennal segment; two orbitals in female none in males; ocellars proclinate, divaricate, or absent.

Thorax narrower than head; mesonotum longer than broad with a well differentated suture; humerus with 5 bristles in two rows (3 outer and 2 inner); acrosticals 3:3; dorsocentrals, 3:4 (except in *andersoni,* n. sp.); posthumeral 2 or 3; intra-alar 3; hypopleurals 6 to 8; sternopleurals 1:1, rarely 2:1; scutellum with three laterals, one small decussate apical and one pair of discals; prosternum finely haired, or bearing one or more bristles at sides.

Legs slender; mid tibia with a stout anterodorsal bristle near middle; hind tibia with a row of anterodorsal bristles, usually with one longer bristle near the middle of the row; claws and pulvilli usually elongate in male, short in female.

Wings hyaline, ordinary in shape; fourth vein without stump at bend, the last section curved inward; first posterior cell open before wing tip; third vein with few hairs at base; costa spine very short or absent.

Abdomen short ovate; intermediate segments without discal bristles; first with or without a pair of median marginals; second usually bearing a pair (two or more are usually found in some species); third with a marginal row of about ten bristles; fourth with two irregular rows near the tip; internal lobe of male fifth sternite with a sclerotized notch (fig. 6). Male genitalia small, retracted, with the usual inner and outer forceps; *distiphallus* directly connected to the *basiphallus* by a dorsal bridge; *aedeagus* of the "type I" of the classification of Verbeke (1963) with a elongate *spinus* and two pairs of parameres. Female genitalia in a form of a long tube, normally retracted, but which can be extended forward between the legs during the oviposition; apex of cerci and postgenital plates visible when retracted; composed of segments VI, VII and VIII; segment VI with hairs near apex of both tergite and sternites; segments VII and VIII with small hairs on the sternites only; each segment sclerotized toward apex and separated from the preceding segment by a membranous area.

KEY TO SPECIES OF *WINTHEMIA* IN AMERICA NORTH OF MEXICO

MALES

The characters used in preparation of this key were based on the study of a large number of specimens except in the cases of rare species. In view of the extensive morphological variation peculiar to this group it is expected that some discrepances will be found while using this key. Males are unknown for *polita, vesiculata, intonsa* and *sabroskyi.*

1. No differentiated ventral hair patches on abdominal tergite III and IV although the hairs are closer together than in other areas 2
   One or two ventral hair patches 18

2. Dorsocentrals 3:4; parafacialia covered with thin hairs 3
   Dorsocentrals 3:3; parafacialia covered with strong bristly hairs ..... *andersoni,* sp. n.

3. Prosternum with fine hairs on sides 4
   Prosternum with one or more bristles on sides; abdomen broadly reddish ..... *deilephilae*

4. Front claws and pulvilli elongated, exceeding the length of last tarsal segment 5

   Front claws and pulvilli short, at least equal to or not exceeding the combined lengths of last two tarsal segments; abdomen black at sides; venter af abdominal tergites III and IV with dense long hairs but not forming definite patches .. *cecropia*

5. Parafrontalia yellow to golden pollinose 6
   Parafrontalia plumbeous, gray to pale grayish yellow pollinose 13

6. Calypteres testaceous, tinged with brown on inner borders; last three abdominal segments thickly golden pollinose .... *abdominalis*
   Calypteres white, opaque; last three abdominal segments gray pollinose 7

7. Mesonotum polished black, lightly dusted with thin changeable pollen; dorsal stripes indistinct, abdomen broadly reddish on sides, thinly gray pollinose ..... *occidentis*

   Mesonotum overall difuselly pollinose, not polished, dorsal stripes distinct 8

8. Hind tibia with an anterodorsal row of slender, well spaced bristles (fig. 78) ..... *borealis*
   Hind tibia with an anterodorsal row of dense closely placed cilia 9

9. Abdominal terga IV and V ventrally with moderatelly dense aggregations of long hairs, appearing as dark patches but not sharply bounded ..... *manducae*
Abdominal terga IV and V, ventrally with regularly spaced hairs, not suggesting a patchlike aggregation 10

10. Mid tibia only with a median anterodorsal bristle, rarely a weak bristly hair proximad of it; large species (9 to 14 mm) ... 11
Mid tibia usually with one or more short bristles proximad of the long median anterodorsal bristle; small to medium sized species (7 to 9 mm) 12

11. Parafacialia golden pollinose ..... *aurifrons*, sp. n.
Parafacialia grayish to yellow pollinose ..... *datanae*

12. Outer forceps in profile, hardly at all narrowed apically, the tips subtruncate (fig. 70); medium sized species (8 to 9 mm) ..... *texana*
Outer forceps in profile tapering outward to blunt rounded tips; small species (6 to 10 mm) ..... *sinuata*

13. Mid tibia with a stout anterodorsal bristle near middle and one or more small ones just above it 14
Mid tibia with one stout anterodorsal bristle 15

14. Ocellars fine but well differentiated from the ocellar triangle pile; outer forceps in profile as in fig. 72, tapering outward to blunt rounded tips ..... *argentifrons*
Ocellars normal in size, outer forceps in profile (fig. 67) tapering outward to a blunt rounded tip; slightly constricted on apex ..... *reinhardi*, sp. n.

15. Hind tibia with an even row of anterodorsal bristles, sometimes with one long bristle near middle of the row; abdomen with one to three pairs of median marginals on segment II .... *quadripustulata*
Hind tibia evenly ciliated; abdomen usually without median marginals on segment II 16

16. Front broad, prominent below; cheeks in profile at least one-eighth of eye height 17
Front greatly narrowed above; 0.16 of head width, not prominent below; cheeks almost linear in profile ..... *rufopicta*

17. Legs reddish; mesonotum with a narrow stripe between the intra-alar and dorsocentral presuturals; thoracic stripes faintly visible after suture ..... *duplicata*

Legs black; mesonotum with broad stripes between the intra-alar and dorsocentral presuturals; thoracic stripes distinctly visible after suture ..... *rufonotata*

18. Intermediate segments of tarsi normal 19
Intermediate segments of front tarsi conspicuously flattened and obliquely expanded ..... *okefenokeensis*

19. Two ventral hair patches on tergites III and IV 20
One ventral hair patch on tergite III 22

20. Parafacialia covered with scattered pale hairs; abdominal segment II with or without one pair of median marginals 21
Parafacialia covered with long and fine hairs; robust species .... *citheroniae*

21. Inner forceps very slender, tapering from base to tip, feebly keeled near base; outer forceps near equal in length of inner ones .. .. *intermedia*
Inner forceps of normal width and on basal two-thirds sharply keeled; outer forceps about one-half the length of inner ones ..... *imitator*

22. Ocellars very weak, almost indistinct from the ocellar triangle pile; femora orange yellow ..... *floridensis,* sp. n.
Ocellars normally developed; femora brown to black ... *montana*

FEMALES

Females of the species of *Winthemia* are often very alike and offer few really satisfatory key characters; the following key should help in distinguishing the species for which the females are known, but must be used with caution.

1. Scutellum with three lateral bristles 2
Scutellum with two laterals bristles ..... *intonsa*

2. Prosternum with fine hairs only on sides 3
Prosternum bearing one or more bristles on sides; abdomen largely reddish ..... *deilephilae*

3. Dorsocentrals 3:4; parafacialia usually pilose, sometimes with black coarse hairs 4
Dorsocentrals 3:3; parafacialia thickly ciliated .. *andersoni,* sp. n.

4. Apical segment of the front tarsi normal, not swollen 5
Apical segment of the front tarsi somewhat swollen; front and face gray pollinose ..... *okefenokeensis*

5. Apex of scutellum and tip of anal segment usually yellow to red 6
Scutellum and abdomen wholly black, the latter highly polished ..... *polita*

6. Front and dorsal surface of thorax and abdomen usually white to gray pollinose 7
Front and dorsal surface of thorax and abdomen thickly golden pollinose; small species ..... *sabroskyi,* sp. n.

7. Mid tibia with a single stout anterodorsal bristle near middle .. 8
Mid tibia with a stout anterodorsal bristle near middle and one or more smaller ones just above it 11

8. Hind tibia with an uneven row of anterodorsal bristles with a long bristle near middle of row 9
Hind tibia thickly and evenly ciliated, sometimes with one long bristle near middle of row; cheeks almost linear in profile (commonest species in eastern USA) ..... *rufopicta*

9. Parafacialia spersely covered with short hairs; total length 7,5 to 8 mm 10
Parafacialia densely covered with fine hairs; total length 10 to 11 mm ..... *citheroniae*

10. Parafacialia golden to yellow pollinose; mesonotum black, dusted with thin gray pollen, tinged with brown on middle ..... *occidentis*
Parafacialia usually yellow to pale yellow pollinose; mesonotum dusted with thick whitish pollen (Common in eastern USA) ..... *sinuata*

11. Abdominal segment I without median marginals; segment II with or without one pair of median marginals 12
Abdominal segment I with a long pair of median marginals; segment II with one or more pairs of median marginals 16

12. Mesonotum dusted with thin cinereous pollen; thoracic stripes often poorly defined 13
Mesonotum thickly whitish gray pollinose; thoracic stripes widely separated and distinct ..... *intermedia*

13. Parafrontalia pale yellow to golden pollinose; abdomen usually black or not distinctly reddish on sides 14
Parafrontalia blackish above, becoming gray pollinose below; abdomen broadly reddish on sides ..... *texana*

14. Robust species; abdomen black, sub-shiny, indistinctly reddish on sides, dusted with rather thin gray pollen 15
Slender shining black species; abdominal segments II and III black polished silvery pollinose on basal third to half, the inner margins shining black ..... *vesiculata*

15. Parafacialia with rather coarse black hairs near middle .. *cecropia*
Parafacialia sparsely to moderately clothed with slender black hairs ..... *datanae*

16. Parafrontalia cinereous pollinose, sometimes tinged with yellow; parafacialia thickly pilose ..... *quadripustulata*
Parafrontalia golden pollinose; parafacialia sparsely clothed with short and coarse hairs below ..... *borealis*

Winthemia abdominalis (Townsend)
(Figs. 19, 44, 61, 81)

Neowinthemia abdominalis Townsend, 1919: 583. (Type locality, Dixie Landing, Virginia) (USNM no. 22254).

Diagnosis. This species can be recognized by the following combination of characters: mesonotum polished black with thin brownish pollen on middle; last three abdominal segments thickly covered with dense golden pollen; calypteres opaque, testaceous on the inner margin.

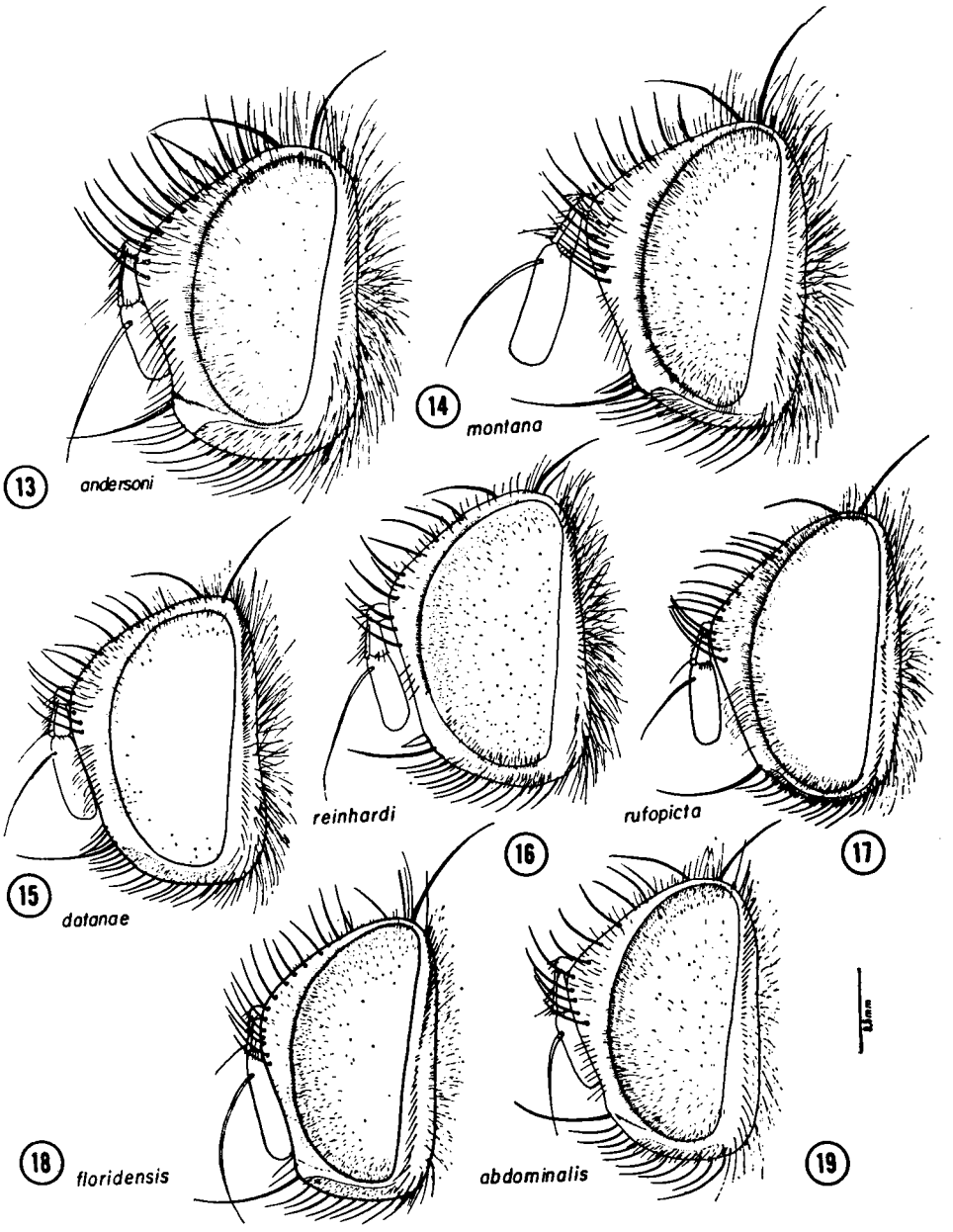
Male. Front 0.21 of the head width, hardly widening to about the middle, thence rapidly to bases of antennae; facial length 0.90 of the frontal length; parafrontalia yellow to golden pollinose, fading out upwards, becoming black toward the vertex; median stripe brownish black; inner verticals moderately strong, outer ones very small; frontals about twelve, extending opposite to apex of second antennal segment, uppermost bristles small, decussate, placed well before the apex of ocellar triangle; parafacialia gray pollinose tinged with yellow on upper portion, clothed with small black hairs; antennae black, apex of second and base of third segment red; the latter less than twice as long as second segment; arista black, slightly thickened on basal two-fifths; palpi infuscated, becoming brown or yellow towards the tips; cheeks gray pollinose, about one-seventh of the eye height.

Thorax black; postalar callus and scutellum infuscated; mesonotum lightly dusted with brownish pollen on middle; calypteres opaque testaceous, infuscated on inner margin.

Legs brown to black; mid tibia with only one long anterodorsal bristle near middle; hind tibia densely and evenly ciliated (fig. 81); claws and pulvilli elongated.

Abdomen brown; broadly reddish on sides, with a black median stripe extending from the base of segment II to the apex of IV; last three segments densely golden pollinose; segment II with dorsal cine-

reous spot on side; segment I and II without median marginals; segment III with a marginal row of about eight bristles; segment IV covered with small bristles irregularly placed; venter without defined patches of matted hairs. Inner and outer forceps as in fig. 44.



13-19, Head of *Winthemia* spp., males, lateral view.

Total length (1 ♂): 12 mm.

Recorded distribution. USA (Connecticut, Georgia, Ohio, Pennsylvania and Virginia).

New distribution records. Pennsylvania, Lehigh Gap, July 5, 1906 (USNM).

Winthemia andersoni, sp. n.

(Figs. 13, 43, 69, 73)

Diagnosis. This species is readily distinguished from all *Winthemia* species by having the parafacialia thickly clothed with long bristly hairs (fig. 13); mesonotum covered with long, thin, erect hairs; dorsocentrals 3:3.

Male. Front at vertex 0.28 of the head width (average of ten specimens); facial length 0.85 of the frontal length; parafrontalia black in ground color, protruding below, dusted with silvery pollen and covered with long thin hairs; frontals in two rows, the inner with twelve to fourteen bristles arising at the level of second antennal segment and stopping before the ocellar triangle, the outer one with about five bristles irregularly placed usually ending at the level of dorsal margin of lunula; frontal vitta reddish brown, wider than one parafacialia at the base; ocellars long, slightly divergent; outer verticals one-third as long as the inner verticals; antennae black; third segment about twice the length of second; arista black, thickened in the basal half; parafacialia concolorous with parafrontalia; covered with long, robust bristle-like hairs; vibrissae longer and decussated; oral margins thickly covered with long and robust bristles; cheeks black, silvery white pollinose, entirely covered with long hairs and measuring one-sixth of the eye height (fig. 13).

Thorax polished black, dusted with thin gray pollen and clothed with fine, erect hairs; mesonotum with four conspicuous black stripes from back view; scutellum black at the base, reddish in the distal, three-fourths; prosternum with few hairs laterally; calypteres opaque, white.

Legs black, elongate; mid tibia with an irregular row of eight anterodorsal bristles, with a long bristle near middle; hind tibia with a row of long uneven and well spaced anterodorsal bristles and a long bristle near middle (fig. 73); wings hyaline, veins darkened at bases.

Abdomen black, elongated, indistinctly reddish laterally and on the apex of segment IV, covered with long erect hairs and dusted with thin gray pollen; segment I with a pair of long median marginals; segment II usually with one or two pairs of median marginals; segment III with a row of ten marginals; segment IV with two rows of irregular discals at the distal two-thirds; venter of abdomen covered with long thin bristles. Genitalia as in figs. 43 and 69.

Total length: 7 to 11 mm (average of 10 males: 9.5 mm).

Female. Front at vertex 0.34 of the head width; facial length 0.75 of the frontal length; parafrontalia black, dusted with thin pale pollen,

bearing long black hairs, more abundant toward apex; ocellars long and widely divergent; verticals and orbitals very strong; antennae black, third segment 2.5 times longer than the second; parafacialia whitish-gray pollinose, thickly clothed with bristle-like hairs; cheeks gray pollinose; sparsely clothed with long hairs, one-seventh of the eye height; palpi yellow, darkened at bases.

Thorax black, dusted with thin gray pollen; mesonotum with four distinct narrow stripes before and five behind suture; dorsocentrals 3:3; scutellum yellow except on narrow base, dusted with thin gray pollen; calypteres opaque.

Legs brown to black; mid tibia with a stout anterodorsal bristle near middle and two or three smaller ones just above; hind tibia with a well spaced row of anterodorsal bristles and a long bristle below middle.

Abdomen black, anal segment red on distal two-thirds, dusted with thin gray changeable pollen; segment I with a well developed pair of median marginals; segment II with a long and stout pair of median marginals; segment III with a marginal row of ten bristles; segment IV with several irregular rows of long bristle-like hairs.

Total length: 8 to 11 mm.

It is a pleasure to name this species after Dr. Lauren D. Anderson, Professor of Entomology, University of California, Riverside, who helped in many ways to make the completion of this revision possible.

Distribution. USA (northern California, Arizona).

Holotype male. Samuel Spr., Napa Co., *California,* July 8, 1955 (CNC); 2 ♂, Bitterwater, 5 mi. S. San Benito Co., *California,* March 30, 1959 (P. H. Arnaud, PAC); 4 ♂, Stanford University, California, April 23, 1948 (P. H. Arnaud, PAC); 1 ♂, Bryson, California, April 27, 1917 (E. P. van Duzee, USNM); 1 ♂, Glennville, Kern Co., *California,* October 22, 1950 (R. M. Bohart, UCD); 1 ♂, Mt. Diablo, *California,* April 28, 1929 (CNC); 1 ♂, Berkeley, *California* (P. D. Hurd, UCB); 1 ♂, Sunnyside Canyon, Huachaca Mts., *Arizona,* July 9, 1940 (CNC).

Winthemia argentifrons, sp. n.
(Figs. 26, 46, 72, 83)

Diagnosis. This species is distinguished by the plumbeus pollinose parafrontalia. Resembles and seems to be closely related to *texana* but differs by the fine occelars and by the sparsely pilose parafacialia.

Male. Front 0.25 of the head width (average of three specimens); facial length 0.68 of the frontal length; parafrontalia gray to plumbeus pollinose toward vertex, moderately haired; parafacialia gray pollinose, moderately haired and bearing a few bristles outside the frontals; inner verticals moderately strong, parallel; outer ones equal the ocellars in

size; ocellars fine, the triangle densely covered with erect black hairs; uppermost frontals reduced in size and stopping before triangle, the rows extending to base of third antennal segment; sides of face silvery pollinose, with few scattered and inconspicuous black hairs on inner margins; antennae black, base of third segment obscurely reddish, 0.52 the length of second; arista about the size of antennae, strongly thickened on the basal third; cheeks gray pollinose, in profile one-tenth of the eye height (fig. 26); palpi yellow, more or less infuscated basally.

Thorax black, gray pollinose; mesonotum with four broad distinct black stripes in front and five behind the suture; scutellum red, dusted with whitish gray pollen; calypteres opaque, white.

Legs black; mid tibia with one stout anterodorsal bristle near middle and two smaller bristles just basal of middle; hind tibia evenly ciliated (fig. 83); front claws and pulvilli equal the combined length of last two tarsal segments.

Abdomen largely red, covered with gray pollen; segments I and II without median marginals; segment III with a marginal row of five to six bristles; segment IV covered with erect bristle-like hairs in front and bearing a row of strong bristles before the apex; venter of segments III and IV rather thickly pilose; but the hairs are not confined to patches with sharply limited; inner forceps slightly tapering to apical third; rather sharply tapering toward apex; outer forceps yellow, shorter than inner with broadly rounded tips (figs. 46, 72).

Total length: 9 mm (average of 4 specimens).

Female. Unknown.

Holotype male. Maxwell, *New Mexico,* 1916 (G. M. Barber, MCZ); Paratypes: 1 ♂, Little Gobi Res., Pottawatomie Co., *Kansas,* July 13, 1953 (H. E. Evans, KU); 1 ♂, Tucson, *Arizona,* October 1, 1957 (G. D. Butler, CNC).

Winthemia aurifrons, sp. n.

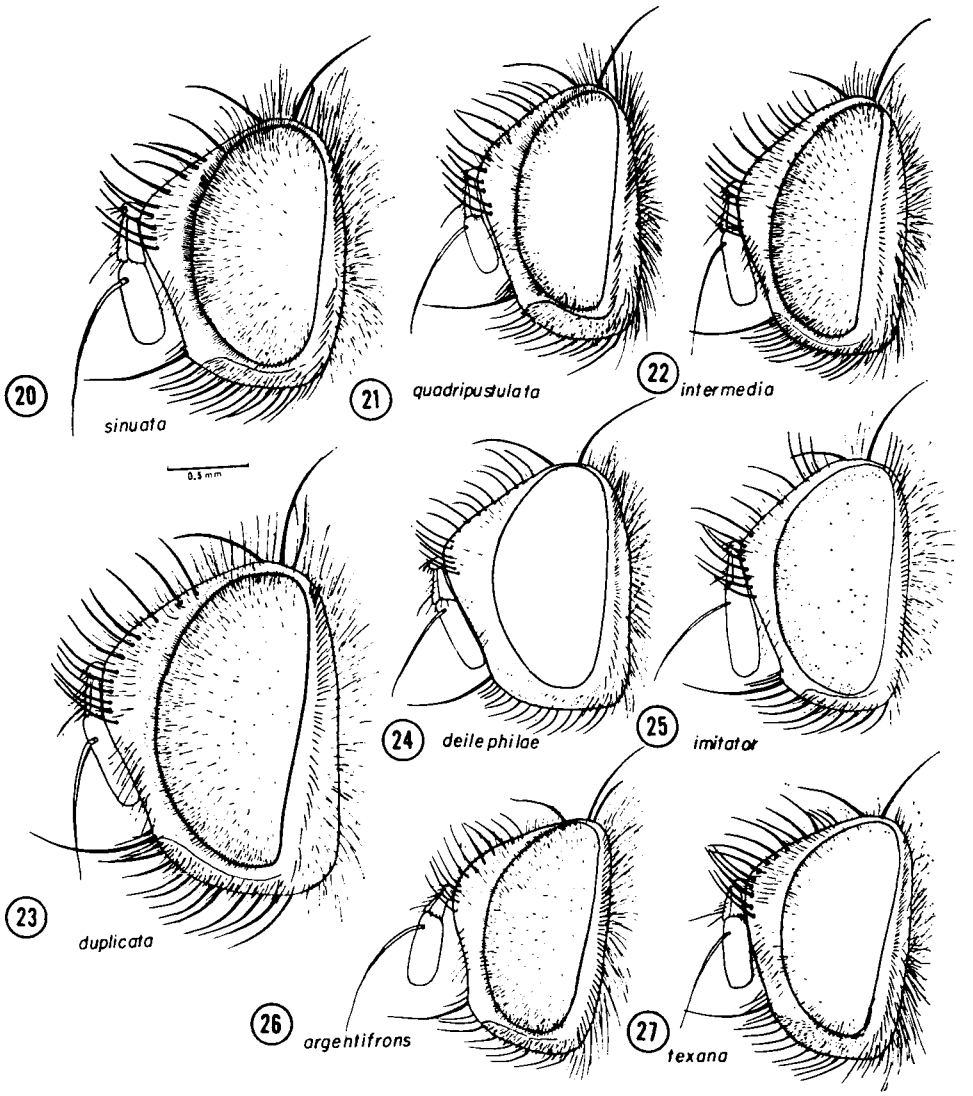
(Figs. 34, 54)

Diagnosis. Robust in build like *datanae* but distinguishable in the male by the shape of the genitalia and by the golden parafrontalia and parafacialia.

Male. Front 0.21 of the head width (average of six specimens) front rather prominent below; frontal vitta brown; parafrontalia golden pollinose, more or less blackish and subshining before vertex, densely clothed with black hairs; parafacialia concolorous with the front, conspicuously black-haired; outer verticals about the size of post-ocellars; ocellars present; frontals thirteen in number, directed inward and extending to apex of triangle; antennae black, second segment 0.56 of length of third; arista smaller than antennae, basal third moderately thickened; palpi yellow, beset with numerous black hairs; cheeks gray

pollinose clothed with fine black hairs and measuring one-seventh of the eye-height.

Thorax black, gray pollinose; mesonotum dusted with thin gray pollen and marked with five narrow black stripes often poorly defined, the outer ones interrupted at sutures and the median one indistinct in front; scutellum red except on narrow base, covered with thin gray pollen; calypteres opaque.



20-27, Head of *Winthemia* spp., males, lateral view.

Legs black, mid tibia with one large anterodorsal bristle near middle; hind tibia thickly ciliated; front claws and pulvilli equal the combined length of last two tarsal segments.

Abdomen black, the sides reddish; anal segment yellow except on basal half; last three segments almost wholly covered with thin gray pollen, the hairs fine and depressed, except on anal segment; basal segment without any median marginals; segment III with a marginal row; segment IV bearing erect bristle-like hairs near base and stronger bristles at apex; venter of segment IV without defined patches of dense hairs. Genitalia as in figs. 34 and 54.

Total length: 10 to 12 mm.

Female. Unknown.

Distribution. USA (northern California, New Mexico). CANADA (Alberta, British Columbia and Ontario).

Holotype male. 5 mi. E. Woodland, Yolo Co., *California,* Sept. 29, 1957 (ex *Smerinthus cerisyi*), (J. Powell, CAS). Paratypes: 1 ♂, Jemez Spr., *New Mexico,* Aug. 1, 1941 (R. H. Beamer, CU). CANADA. *Alberta:* 1 ♂, Waterton, July 11, 1923 (E. H. Strickland, CNC); 1 ♂, *British Columbia,* Feb. 17, 1954 (reared from *Paonias myops*) (CNC); 1 ♂, from Ottawa, Ontario (CNC).

Winthemia borealis Reinhard
(Figs. 33, 78)

Winthemia borealis Reinhard, 1931: 27. (Type locality, Trancona, Manitoba, CANADA) (AMNH); Raizene, 1952: 74 (host recs.); Sangean, 1956: 554 (recs. in British Columbia).

Diagnosis. This species is characterized by the following combination of characters: sides of abdomen wholly black; segment IV bright orange-yellow; parafrontalia golden pollinose; abdominal segments I with a small pair of median marginals; segment II with two pairs.

Male. Front at vertex 0.21 of head width; parafrontalia and ocellar triangle golden yellow pollinose, covered with scattered long hairs outside the frontals; facial length 0.85 of the frontal length; frontals twelve in numbers, long, but not strong, with three to five bristles below base of antennae, upper bristles elongate; outer verticals vestigial, one half as long as ocellars; ocellars strongly proclinate; frontal vitta reddish brown; parafacialia whitish, appearing yellowish under certain angles of light; antennae black, third segment less than twice the length; arista black, slightly thickened on proximal third; cheeks black, silvery pollinose, one seventh of eye height; palpi yellow becoming brownish at base, with stiff black hairs on ventral and lateral surfaces. (Fig. 33).

Thorax black in ground color, ash-gray pollinose; scutellum broadly reddish, dusted with gray pollen, bearing the usual three laterals, one discal and one long apical pair of bristles; calypteres white.

Legs black, mid tibia with one stout anterodorsal bristle near middle; hind tibia ciliate, the bristles not closely placed, one bristle near middle longer than those in rows; claws and pulvilli short as long as last tarsal segment.

Abdomen black, the sides and apex reddish yellow, last three segments with ash gray pollen; segment I with a long pair of median marginals; segment II with one or two pairs of median marginals; segment III with a marginal row of ten bristles; segment IV covered with long irregularly spaced bristles on distal two-thirds; venter without any defined patches of matted hairs; genitalia with the inner forceps blackish, tapering uniformly to an elongated and divided tip; outer forceps yellow.

Total length: 8 to 10 mm.

Female. Front protruding, at vertex 0.32 (average of six specimens) of head width; parafrontalia golden pollinose, the pollen thinner toward vertex, moderatly covered with long hairs outside the frontals; parafacialia golden pollinose on the upper three-fourths, the lower one-fourth silvery pollinose, clothed with long pale hairs; antennae black or dark brown; third segment 2.5 length of second; cheeks gray pollinose clothed with long, sparse black hairs; palpi yellow, a little swollen toward the tips. Mid tibia with a long anterodorsal bristle below middle and one or two smaller just above; hind tibia unevenly ciliated with a long bristle on the row near middle. Abdomen yellow in ground collor, tip of segment IV orange yellow; segment II with a pair of strong suberect median marginals; abdominal hairs depressed.

Total length: 8 to 10 mm.

Recorded distribution. USA (Oregon). CANADA (British Columbia, Manitoba to Nova Scotia).

New distribution records. USA, *Oregon:* Haines, June 10, 1931 (J. Nottingham, KU); North Powder, June 13, 1913 (J. Nottingham, KU); *Wisconsin:* no specific locality, June 7, 1950 (J. P. Eastwood, PAC). CANADA. *Alberta:* Eisenhower Jct., B. W. Pk., July 25, 1962 (K. C. Herrman, CNC). *British Columbia:* 6 mi. W. Terrace, 220', June 20, 1960 (B. Henning, CNC). *Manitoba:* Gillan, Aug. 12, 1950 (J. F. McAlpine, CNC). *Ontario:* Ottawa, ex phalaenid larvae, July 19, 1944 (F.I.S. 1944, CNC); Macdiamio, June 24, 1922 (N. K. Bigelow, CNC). *Quebec:* mi. 61, Rte. 58, La Verendrye, Prov. Pk., Aug. 21, 1965 (D. M. Wood, CNC).

Winthemia cecropia (Riley)
(Figs. 28, 38, 55, 77)

Exorista cecropia Riley, 1870a: 101 (short description; treated as a variety of *E. militaris* Walsh) (Type locality, Illinois).
Exorista leucaniae Kirkpatrick var. — Riley, 1870b: 108-109 (descr.).
Winthemia cecropia; Reinhard, 1931: 34; Sabrosky, 1948: 63 (nomencl.); Raizene, 1952: 15 (Ontario recs.).
Exorista platysamiae Townsend, 1892: 288 (type locality, New York).

Diagnosis. This species is closely related to *W. citheroniae* but is differentiated from that species mainly by the absence of densely matted patches of hairs ventrally on tergites III and IV; parafacialia covered with coarse hairs and by the relatively broad front (0.29 of head width).

Male. Front at vertex 0.29 of head width (average of four specimens); facial length 0.77 of the frontal length; parafrontalia and ocellar triangle yellow to golden pollinose, beset with long, dense hairs; frontals fifteen in number, the upper one small and slender; inner verticals robust, parallel and reclinate; outer verticals one-half as large as the inner ones; ocellars strong; frontal vitta reddish brown; parafacialia pale yellow, bearing rather coarse hairs near middle; antennae black; third segment 0.52 of the length of second; arista reddish, slightly thickened near base; palpi yellow; cheeks gray pollinose covered with dense black hairs and measuring one-seventh of the eye height (fig. 28).

Thorax black except for the brown to reddish postalar callus and apical half of scutellum; mesonotum covered with thin cinereous pollen, except for five narrow black stripes, the median stripe very indistinct before suture becoming wider behind suture; scutellum with thin gray pollen; calypteres opaque, white.

Legs black; mid tibia with a large and two smaller anterodorsal bristles near middle; hind tibia evenly ciliated (fig. 75).

Abdomen black, the sides reddish, covered with gray pollen; hairs on intermediate segments fine and depressed; anal segment red, covered with erect bristle-like hairs near base, with strong bristles near the hind margin; segments I and II without median marginals; segment III with a marginal row of seven; venter of segment IV densely haired with matted patches, but poorly defined; genitalia with a long and curved inner forceps (figs. 38 and 55).

Total length: 10 to 12 mm.

Female. Front at vertex 0.35 of the head width; facial length 0.76 of the frontal length; parafrontalia golden pollinose, clothed with long hairs outside the frontals; two pairs of orbitals and verticals present; ocellars strongly divergent; parafacialia gray pollinose, covered with coarse black hairs on inner half; cheeks gray pollinose, densely covered with fine hairs; mid tibia with a strong anterodorsal bristle near middle and two smaller ones just above; hind tibia subciliate, with uneven strong bristles; claws and pulvilli short, about the length of fourth tarsal segment. Abdomen with a pair of strong suberect, median marginals on segment II; abdominal hairs depressed.

Total length: 10 to 12 mm.

Recorded distribution. USA (Connecticut, Illinois, Kansas, Michigan and New York). Canada (Ontario).

New distribution records. USA. *California:* Giant Forest, June 28, 1929 (R. H. Beamer, KU). *Kansas:* Riley Co., Oct. 4 (J. B. Norton, KSU). *Ohio:* Amherst, July 1933 (H. J. Reinhard, CNC). *Wisconsin:*

Milwaukee, ex *H. cecropia,* May 2, 1967 (J. Martins, UW). *Iowa:* Sioux City, May 10, 1930, ex *Samia cecropia,* (UM). CANADA. *Alberta:* Grand Prairie, ex *Celerio gallii intermedia,* Oct. 6, 1963 (CNC). *Ontario:* Newstedt, March 1942, ex *P. porcella* (CNC); Galt, March 16, 1941, ex *P. rimosa* (CNC); Hornpayne, ex *Celerio gallii,* June 19, 1954 (F.I.S. 1954, CNC).

Winthemia citheroniae Sabrosky
(Figs. 29, 40)

Winthemia citheroniae Sabrosky, 1948: 65 (Type locality, Gainesville, Fla. from pupae of *Citheronia regalis*), (USNM no. 58501); Patton, 1957: 70 (biology); 1958: 84 (reared from *Citheronia regalis*).

Diagnosis. This species is closely related to *W. cecropia* but is differentiated from that species principally by the presence of densely matted patches of hairs on the underside of abdominal sgments III and IV and by dense, fine hairs on parafacialia.

Male. Front at vertex 0.24 of the head width; facial length 0.77 of the frontal length; parafrontalia and ocellar triangle pale gray pollinose, densely clothed with long and fine hairs; frontals about eighteen with four or five below base of antennae; upper bristles slender; inner verticals parallel, reclinate, rather strong; outer ones robust, strongly divergent; ocellars slender and strongly proclinate; frontal vitta reddish to brown; parafacialia pale yellow to white pollinose, appearing yellowish at certain angles of light, densely covered with short pale hairs; antennae red; third segment twice the length of second; arista red in the basal two-thirds; cheeks black, gray pollinose, one-seventh of eye height, densely clothed with fine hairs (fig. 29); palpi yellow with black hairs on ventral and lateral surfaces.

Thorax black in ground color, except for the brownish postalar callus and the reddish yellow apical half to three-fourths of scutellum; mesonotum covered with thin ashy gray pollen; first and second intraalar postsuturals usually very weak.

Legs black, mid tibia with one large anterodorsal bristle near middle; hind tibia with anterodorsal row of dense, flattened bristles of uniform size.

Abdomen black in ground color, reddish on sides, apex of anal segment reddish yellow; last three segments with pale gray pollen; segment I and II without median marginals; segment III with a row of strong marginals; segment IV covered with long, irregularly spaced bristles on the distal two-third; venter of segments III and IV with strong patches of matted hairs; inner forceps brownish to yellow, outer forceps yellow (fig. 40).

Total length: 10 to 14 mm.

Female. Front at vertex 0.30 to 0.32 of the head width; facial length as long as frontal length; parafrontalia pale gray yellow pollino-

se; the pollen fading toward the apex, densely covered with thin black hairs; two pairs of orbitals and verticals present; ocellars slender, widley divergent; antennae reddish; third segment about three times the length of second; parafacialia gray pollinose, densely covered with small pale hairs along the inner margins; cheeks gray pollinose, thickly covered with small pale hairs; palpi yellow, distinctly swollen at tips. Mid tibia similar to *datanae;* hind tibia with an even row of anterodorsal bristles, with a long bristle below middle, short and closely placed. Abdomen with or without one pair of median marginals on segment II.

Total length: 12 to 15 mm.

Recorded distribution. USA (Florida, Illinois, Maryland).

New distribution records. USA. *Florida:* Gainesville, Alachua Co., Dec. 2, 1946 (I. J. Cantrall, AU). *Illinois:* Mounds, Aug. 26, 1947, ex pupae of *C. regalis* (L. G. Brown, CNC). CANADA. *Ontario:* Tillsonburg, Sept. 19, ex *Actias luna* (F. I. S. 1947, CNC).

Winthemia datanae (Townsend)
(Figs. 15, 42, 66)

Exorista datanae Townsend, 1892: 288 (Type series apparently lost; type locality, New York).
Winthemia datanae; Reinhard, 1931: 29; March, 1938: 138 (biol.).

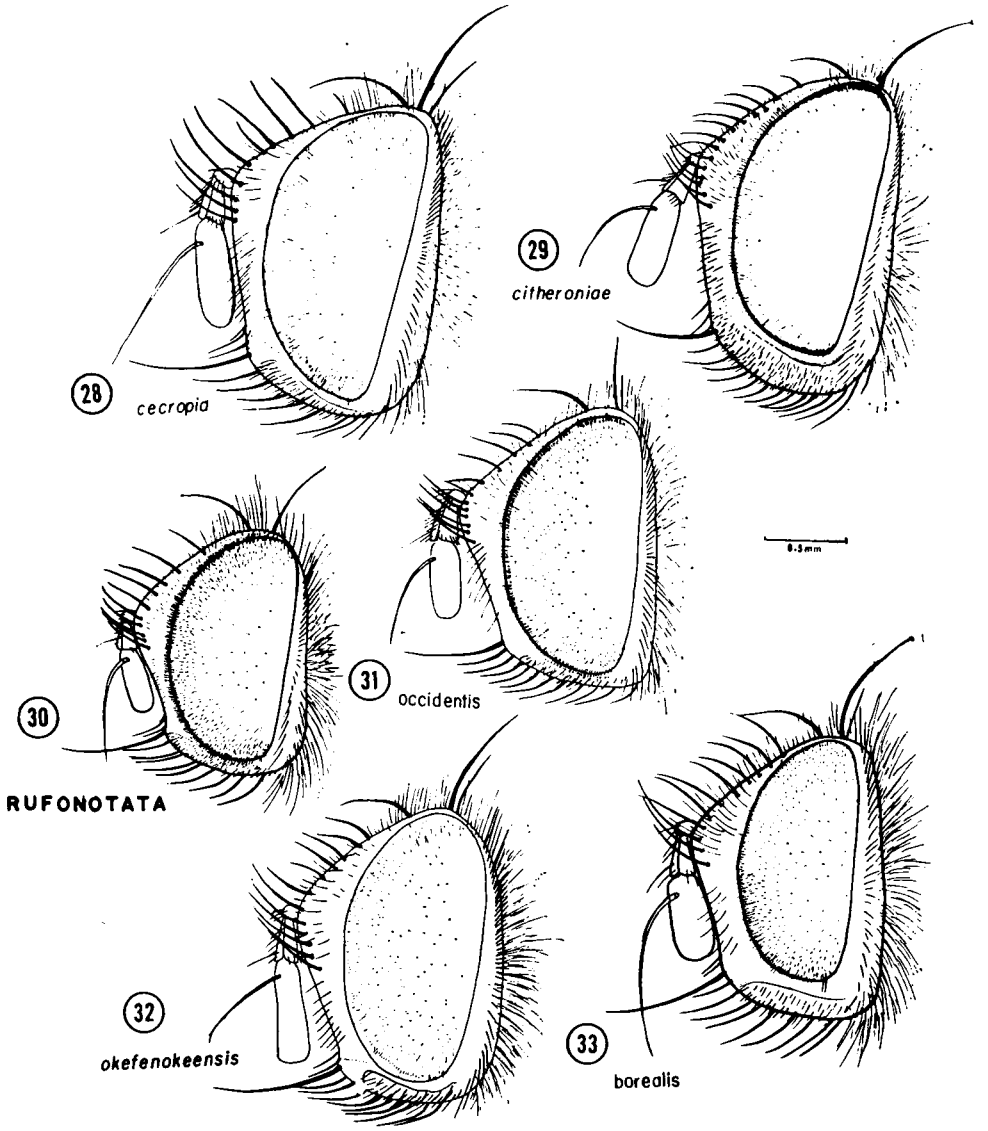
Diagnosis. This species is closely related to *W. citheroniae* but is differentiated from that species principally by the absence of a dense patch of matted hairs ventrally on tergites III and IV. The parafacialia is thickly pilose but the hairs are not so dense and fine.

Male. Front at vertex 0.21 of head width; facial length 0.77 of the frontal length; parafrontalia and ocellar triangle pale yellow to golden pollinose the pollen becoming thinner towards the vertex revealing the black, shinning integument; front covered with dense thin hairs outside of the frontals; frontals about ten bristles, short and strong, with three to five bristles below base of antennae; upper bristles short and slender; inner verticals parallel, reclinate; outer one small, slender, indistinctly differentiated from the occiptal bristles; ocellars strong and short; frontal vitta brown; parafacialia silvery to pale yellow pollinose, covered with thin and dense black hairs; antennae black, third segment reddish on mesal surface; arista reddish on basal half, slightly thickened on basal third; cheeks black, gray-white pollinose about one- seventh the eye height (fig. 15); palpi yellow, becoming brownish at base, with stiff black hairs on ventral and lateral surfaces.

Thorax black in ground color, except for the brownish to reddish postalar callus and the reddish orange apical half of scutellum; mesonotum covered with thin yellowish gray pollen; first intra-alar postsutural absent or very small.

Legs black, mid tibia with an anterodorsal bristle near middle and usually one or two smaller bristles just above; hind tibia with an anterodorsal row of dense, flattened bristles of uniform size.

Abdomen black in ground color, the sides and apex reddish yellow; last three segments with dense ashy gray pollen; segment I and II without median marginals, segment III with a row of strong marginals; segment IV covered with long bristle-like hairs on distal two-thirds and several



28-33, Head of *Winthemia* spp., males, lateral view.

irregular bristles near apex; hairs of intermediate segments fine, short and depressed; venter without differentiated patches of hairs; inner forceps black, outer forceps orange to reddish (figs. 42 and 66).

Total length: 8 to 12 mm.

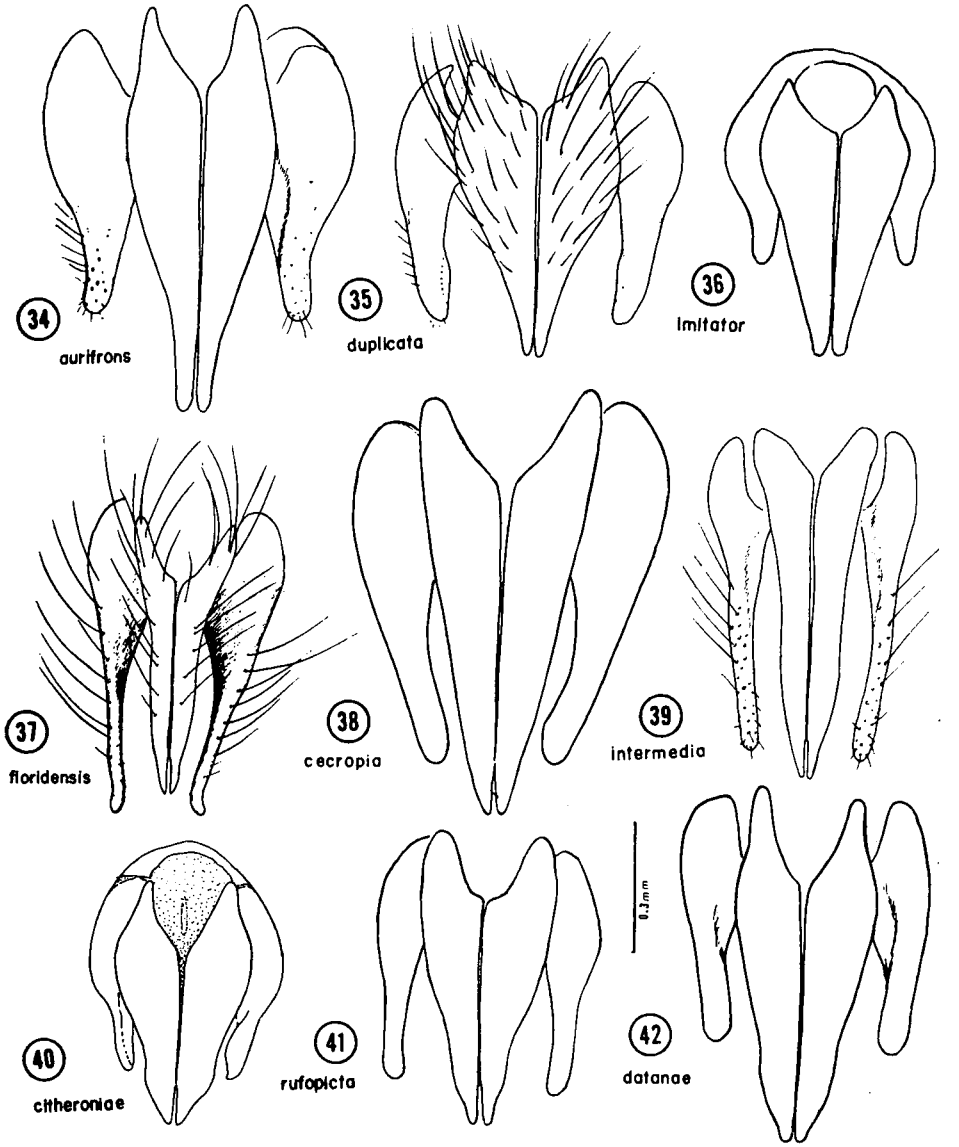
Female. Front at vertex 0.29 to 0.30 of the head width; facial length 0.84 of the frontal length; parafrontalia yellow to pale pollinose, moderately covered with long fine hairs outside the frontals; two pairs of orbitals and verticals present; ocellars strongly divergent; antennae brown; third segment broad, about 2.5 the length of second; parafacialia gray, moderately covered with short, thin hairs on middle; cheeks gray, sparsely clothed with long hairs; palpi yellow, infuscated at base, slightly swollen toward the tips. Abdomen black in ground color, tip of segment IV orange yellow; segment II with a strong pair of median marginals.

Total length: 8 to 15 mm.

Recorded distribution. USA (Florida, Illinois, New Mexico, New York and Oregon). CANADA (British Columbia to Ontario).

New distribution records. USA. *Arizona:* 18 mi. n. of Douglas, 4500', July 30, 1946 (H. A. Scullen, OSU); *California:* Mill Potrero, Kern Co., July 6, 1959 (R. D. Gehring, UCB); Pinecrest, Tuolumbe Co., Aug. 19, 1948 (P. H. Arnaud, PAC); *Colorado:* Jefferson Co., July 3, 1947 (M. T. James, WSU); *Connecticut:* no date or locality (Williston, KU); *Florida:* Orlando, March 1944 (R. & C. Bohart, UCD); *Virginia:* Falls Church, (N. Banks, MCZ); Mt. Vernon, Sept. 19, 1926 (N. K. Bigelow, CNC); *Indiana:* Plymouth, July 28, 1917 (M. R. Smith, USNM); *Iowa:* Sioux City, July 27, 1922 (UM); Ames, Aug. 16, 1952 (W. L. Downes, PAC); *Kansas:* Douglas Co., May 24, 1959 (Ent Class, UCR); *Kentucky.* Crailhoé, June 28, 1947 (C. Cook, PAC); *Massachusetts:* Melrose Highlands, July 26, 1942 (A. Brooks, CNC); W. Springfield, June 18, 1915 (H. E. Smith, USNM); *Michigan:* Chebogan Co., June 28, 1939 (E. E. Kenaga, CNC); *Maryland:* Beltsville, July 4, 1916 (R. W. Walton, USNM); Cabin John, Aug. 1916 (R. M. Fouls, USNM); Plummers Is., Sept. 1, 1907 (W. L. McAtee, USNM); *Maine:* Orono, Aug. 17, 1958 (USNM); *Minnesota:* Houston Co., Aug. 31, 1936 (H. R. Dodge, UM); Itasca Pk., July 13, 1937 (H. R. Dodge, UM); *New Mexico:* Koehler, Aug. 14 (W. R. Walton, USNM); *New Jersey:* Bear Swamp, nr. Ramsay, Sept. 3, 1917 (J. Bequaert, MCZ); Fort Lee (J. Bequaert, MCZ); Riverton, Aug. 3 (C. W. Johnson, MCZ); Lebanon, Fort Bringthon Co., Aug. 19, 1958 (Evans & Beneway, CNC); Lucaston, Sept. 9, 1905 (C. W. Johnson, MCZ); Clementon, Sept. 11, 1909 (USNM); Riverton, July 3 (C. W. Johnson, MCZ); *North Carolina:* Highlands, June 21, 1957 (W. R. Mason, CNC); Aberdeen, June 28, 1930 (T. B. Mitchell, NCSU); *New York:* Beaver Creek, McLean Res., Aug. 30, 1924 (CUC); Centereach, L. I., Sept 1, 1934 (Blanton & Borders, CU); Baiting Hollow, L. I., Aug. 18, 1922 (H. C. Hucket, CU); Ithaca, Aug. 17, 1905 (H. E. Smith, MCZ); Ringwood, Dryden, July 27, 1958 (D. F. Nenneway, KU); Albany, Oct. 7, 1905 (CU); Shelving Rock, Lake George, Sept. 2, 1920 (M. D. Leo-

nard, CU); Wading River, L. I., Aug. 26, 1923 (H. C. Huckett, CU); Oswego, Sept. 3, 1921 (L. S. West, CU); *Ohio:* Summit Co., July 16, 1936 (L. J. Lipovsky, KU); Newark, Sept. 8 (J. S. Hine, OSU); Amherst, July 18, 1934 (H. J. Reinhard, PAC); *Oregon:* Grants Pass, July 12 (R. H. Beamer, KU); *Pennsylvania:* Roxborough, June 28, 1928 (USNM); *South Dakota:* Brookings, (J. M. Aldrich, UI); Falls Church, June 18



34-42, Male genitalia of *Winthemia* spp., posterior view. (Note: The revesting hairs on inner and outer forceps have been omitted from most drawings, expect in those cases in which they may be of diagnostic value.)

(N. Banks, MCZ); *Washington:* Ocean Park, Aug. 25, 1957 (M. T. James, WSU); *Wisconsin:* Ashland, june 29, 1960 (Kelton & Whitney, CNC); Madison, July 11, 1928 (L. Fluke, PAC). CANADA. *Alberta:* Jumping Pd. Cr., 20 mi. W. Calgary, Aug. 8, 1962 (K. C. Herrman, CNC); *British Columbia:* Robson, Aug. 9, 1949 (H. R. Foxlee, ISC); Bannock Point, Sept. 16, 1958 (ex *Schizura concinna,* UCD); Trinity Valley, July 15, 1939 (K. Graham, CNC); Port Haven, Sept. 21, 1900 (ex *Deilephila lineata,* CNC); *Quebec:* Rougemount, Aug. 12, 1925 (G. H. Hammond, CNC); Mont Joll, July 28, 1954 (J. R. McGillis, CNC); Joliette, June 15 (J. Ouellet, PAC); Laniel, June 12, 1944 (A. R. Brooks, CNC); Corey Hill, Aug. 17, 1924 (G. S. Walley, CNC); Meach Lake, July 9, 1941 (G. A. Hobbs, CNC); Abbotsford, Aug. 29, 1935 (G. E. Shewell, CNC); Hemmingford, Sept. 3, 1926 (G. H. Hammond, CNC); Rigaud, July 2, 1934 (J. Oullet, CNC); *Manitoba:* Aweme, Aug. 25, 1923 (CNC); 2 mi. E. Douglas, Aug. 27, 1958 (J. G. Chicott, AU); *Ontario:* Lowbush, ex Sphingidae, F. I. S. 1939 (CNC); Hornpayne, April 19, 1954, ex *Celerio gallii,* (F. I. S., CNC); Blind R., Oct. 29, 1941, ex *Anisota rubicunda* (F. I. S., 1941, CNC); *Ottawa:* July 26, 1942 (A. Brooks, CNC); Niagara Falls, Oct. 22, 1916 (R. C. Shannon, FMNH); Espanola, (F. I. S., 1941, CNC); Mt. Pelee, July 4, 1937 (E. P. Ide, CNC); Ottawa, March 24, 1941, ex *Pholus* sp., (F. I. S., 1941, CNC); Jordan, July 11, 1919 (V. A. Ross, CNC); *Saskatchewan:* Rock Glen, Aug. 2, 1955 (C. D. Miller, CNC); Holdfast, July 8, 1925 (K. M. King, CNC).

Winthemia deilephilae (Osten Sacken)
(Figs. 24, 50, 62)

Tachina deilephilae Osten Sacken, 1887: 164 [Type locality unknown, presumably Missouri, no locality and date, reared from *Deilephila lineata,* C. V. Riley col. (MCZ)].
Winthemia quadripustulata; (part) Coquillett, 1897: 125.
Winthemia deilephilae; Reinhard, 1931: 33; Patton, 1958: 85 (Fla. recs.).

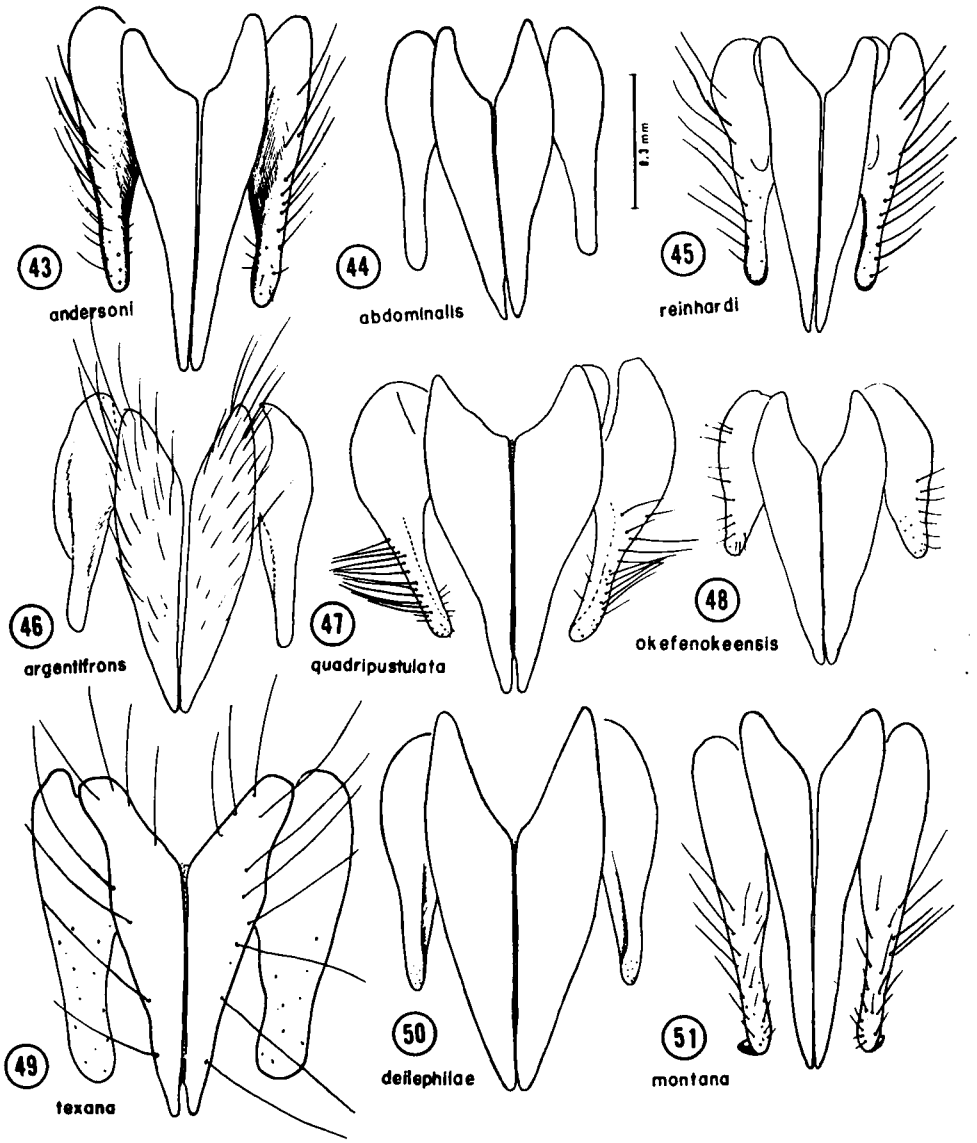
Diagnosis. Median sized species; abdomen yellow with a dorsal stripe on middle; prosternum with one or more bristles at sides; ventral patches of matted hairs on segment III and IV.

Male. Front at vertex 0.25 of the head width (average of five specimens); facial length 0.77 of the frontal length; parafrontalia darkened, silvery gray pollinose, with few scattered hairs, more abundant toward vertex; frontals about ten, directed inward; inner verticals well developed, proclinate, slightly divergent; antennae black, third segment about three times the length of second, reddish at the base, arista thickened in the basal two-thirds; facialia silvery gray pollinose, with few scattered hairs near the frontal sutures; cheeks about one-ninth the eye height thickly covered with long black hairs (fig. 24); palpi yellow, brownish at the base.

Thorax black, white pollinose; scutellum reddish, with the margin black; mesonotum black, dusted with whitish pollen, with four conspicuous black stripes not interrupted at the suture; propleura ciliate with at least one long bristle on each side.

Legs black; mid tibia with two or three long bristles near middle; hind tibia thinly ciliated.

Abdomen broadly yellow, with a median dorsal black vitta which extends from the first segment to the base of the fourth; segment IV entirely yellow; segments I and II without median marginals; segment III with a marginal row of about ten; segment IV with two rows of



43-51, Male genitalia of *Winthemia* spp., posterior view.

scattered bristles on posterior margin and also erect bristles in front; genitalia as in figs. 50 and 62.

Total length: 10 to 11 mm.

Female. Front at vertex 0.35 of head width; facial length 0.63 of the frontal length; parafrontalia gray pollinose with sparse hairs; parafacialia gray, moderately pilose, antennae red, third segment one and one-half longer than second; palpi swollen at tips; thorax thickly gray pollinose; dorsal stripes distinct; prosternum usually with a long bristle at sides; calypteres white, opaque. Mid tibia with a long anterodorsal bristle near middle and one smaller one just above it; hind tibia evenly ciliate, rarely with a long bristle near middle; claws and pulvilli short. Abdomen broadly reddish, without a pair of median marginals on second segment.

Total length: 8 to 11 mm.

Recorded distribution. USA (Oregon to Michigan, S. to California, Florida).

New distribution records. *Arizona:* Patagonia, Sept. 10 (T. R. Haig, UCD); Continental, Apr. 24 (C. D. Butler, KU); Wilcox, Cochise Co., Aug. 14, 1958 (P. A. Opler, UCB); Sunnyside Canyon, Huachaca Mts., July 9, 1940 (KU); Portal, Chiricauhua Mts., Aug. 2, 1958 (J. M. Marston, UCD); 20 mi. N. Flagstaff, July 3, 1952 (C. Liang, KU). *Arkansas:* 5 mi. N. Hope, Hempstead Co., July 8, 1955 (T. F. Leigh, UA). *California:* Lake Almenor, Plumas Co., July 8, 1949 (P. D. Hurd, UCB); Samuel Spr., Napa Co., May 1955 (UCD). *Colorado:* Mt. Vernon, Cn. nr. Golden, 7200', July 31, 1961 (G. H. Mann, KU); 9 mi. S. Wray, Sept. 2, 1951 (P. P. Cook, UCB); Boulder, June 8, 1952 (R. H. Beamer, KU). *Florida:* Larkins, Febr. (MCZ); Gulf Hammock, March 23, 1952 (J. R. Vockroth, CNC). *Idaho:* 5 mi. N. Bliss, Gooding Co., July 12, 1955 (J. E. Gillaspy, UI). *Indiana:* Elkhart, (C. W. Johnson, MCZ). *Iowa:* Shennandoah, July 25, 1963 (D. R. Riley, ISC); Ames, May 9, 1940 (Maclure, MCZ). *Kansas:* Douglas Co., 900' (KU); Garden City, Jan. 13, 1913 (F. B. Milliken, USNM), (bred from *Phlegethontius*); Riley Co., Oct. 4 (J. B. Morton, KSU); 5 mi. S. Lawrence, June 10, 1950 (C. D. Michener & J. R. White, UK); Harper Co., 1417', 1916 (R. H. Beamer, KU); Douglas Co., Nov. 7, 1940 (R. H. Beamer, KU). *Nevada:* Winnemucca, Aug. 9, 1958 (T. R. Haig, UCD). *New Mexico:* 18 mi. N. Rodeo, Hidalgo Co., July 25, 1958 (R. M. Bohart, UCD); Vaughn, July 20, 1952 (R. H. & L. D. Beamer, KU). *Oregon:* Dixie, July 8, 1931 (J. Nottingham, KU). *Ohio:* Ashland, Sept. 8, 1955 (Hardwood, CNC); Amherst, July 1933 (H. J. Reinhard, CNC); sugar grove, May 8, 1926 (D. G. Hall, USNM). *Tennessee:* Clarkville, June 7, 1921 (J. V. Gilmore, USNM). *Texas:* College Station, Febr. 19, 1959 (H. J. Reinhard, KSU); nr. Pt. of Rocks, 10 mi. W. Ft. Davis, May 30, 1959 (F. McAlpine, CNC); Sonora, May 4, 1954 (L. D. Beamer, KU). *Washington:* Pullman, June 20, 1954 (J. A. Quist, WSU). *Wisconsin:* Riparia, June 6, 1950, (R. Sparrier, WSU). MEXICO. Cuernavaca, 12 mi. N. Morelos, Aug. 14, 1954 (J. G. Chillcott, KU); 9 mi. W. Fres-

nillo, Zacatecas, Aug. 10, 1954 (E. G. Linsley, UCB); 5 mi. N. W. Jalastillag, Jalisco, July 19, 1954 (J. G. Chillcott, KU).

Winthemia duplicata Reinhard

(Figs. 23, 35, 51)

Winthemia duplicata Reinhard, 1931: 17 (Type locality, Hell Canyon, New Mexico, Manzano Natl. Forest) (USNM no. 43340).

Diagnosis. This species is separated from the other known species by the characters given in the key. This species is closely related to *W. rufonotata* (Bigot).

Male. Front at vertex 0.23 of the head width (average of 6 specimens) rather prominent below; facial length 0.81 of the frontal length; median stripe wine red; parafrontalia with pale grayish yellow pollen becoming golden upward, densely haired outside the frontals; inner verticals moderately developed, outer ones hairlike; frontals ten to fourteen in number, extending to apex of second antennal segment, directed inward, reduced in size above and stopping before ocellar triangle; antennae black, third segment usually reddish near base on inner sides, about twice as long as second; arista blackish, longer than antennae, thickened almost to middle; parafacialia gray pollinose. the sides with moderatley dense hairs, at the narrowest point wider than the width of third antennal segment; vibrissae situated above the front border of mouth; palpi yellow; cheeks red, gray pollinose, thickly clothed with long black hairs, in profile about one-sixth of the eye height.

Thorax black, subshining, gray pollinose, marked with five narrow opaque black stripes, poorly defined after suture; scutellum red, covered with uniform thin gray pollen; calypteres opaque, white.

Legs slender, black; tibiae brownish red; mid tibia with one stout anterodorsal bristle beyond middle; hind tibia thickly ciliated.

Abdomen broadly red on sides, abdominal segment I and II with brownish pollen on middle; segments II with a pair of median marginals, sometimes absent; segment III with a marginal row of about ten; segment IV with a marginal row and covered with irregularly placed bristly hairs in front; venter without any defined patches of matted hairs; genitalia with the outer forceps yellow; inner forceps with a notch at the curved apex, conspicuously keeled behind on the basal two-thirds (figs. 35 and 57).

Total length: 10 to 11 mm.

Recorded distribution. USA (New Mexico).

New distribution records. USA. *Colorado:* Dawnson, May 30, 1931 (J. Nottingham, KU); *New Mexico:* Hell Canyon, Manzano Natl. Park, Sept. 12, 1916, on foliage (C. H. T. Townsend, USNM).

Winthemia floridensis, sp. n.
(Figs. 18, 37, 65, 84)

Diagnosis. This species differs from the other nearctic species principally by the very weak ocellars, gray pollinose parafacialia and the shape of male genitalia.

Male. Front 0.22 of the head width at vertex. widening rather slowly to base of antennae; facial length 0,41 of the frontal length; parafrontalia gray pollinose, pale yellow at vertex, covered with few long black hairs; median stripe reddish, weakly narrowed upward; inner verticals of moderate length; outer ones vestigial; ocellar vestigial scarcely differentiated from the ocellar triangle pile; frontals strongly divergent beneath; antennae extending to base of insertion of arista, the uppermost bristles not much reduced in size, reclinate; sides of face gray pollinose, bearing a few incospicuous hairs along the inner margins; antennae black elongate; third segment almost reaching the oral margin; 2.3 times the length of second; arista slender as long as the antennae, slightly thickened in the basal half; vibrissae on oral margin, the ridge with few bristles above, palpi yellow; cheeks gray pollinose, clothed with fine black hairs, in profile about one-sixth the eye height (fig. 18).

Thorax black, gray pollinose, marked with four opaque black stripes; scutellum red, covered with uniform thin gray pollen; calypteres opaque, yellow.

Legs reddish, mid tibia with a stout anterodorsal bristle near middle; hind tibia with elongate and well spaced bristles, not flattened (fig. 84).

Abdomen broadly red on sides, with a broad median dorsal black stripe beginning at middle of segment I and extending to the apex of segment IV; last three segments with pale yellow to gray pollen confined to the basal half; basal segments without median marginals; segment III with a marginal row and irregularly placed bristles in front; venter of segment III rather thickly pilose, the hairs forming dense patches with sharp limited margins; genitalia as in figs. 37 and 56.

Female. Unknown.

Holotype male. Tampa, Florida, July 20, 1934 (CNC).

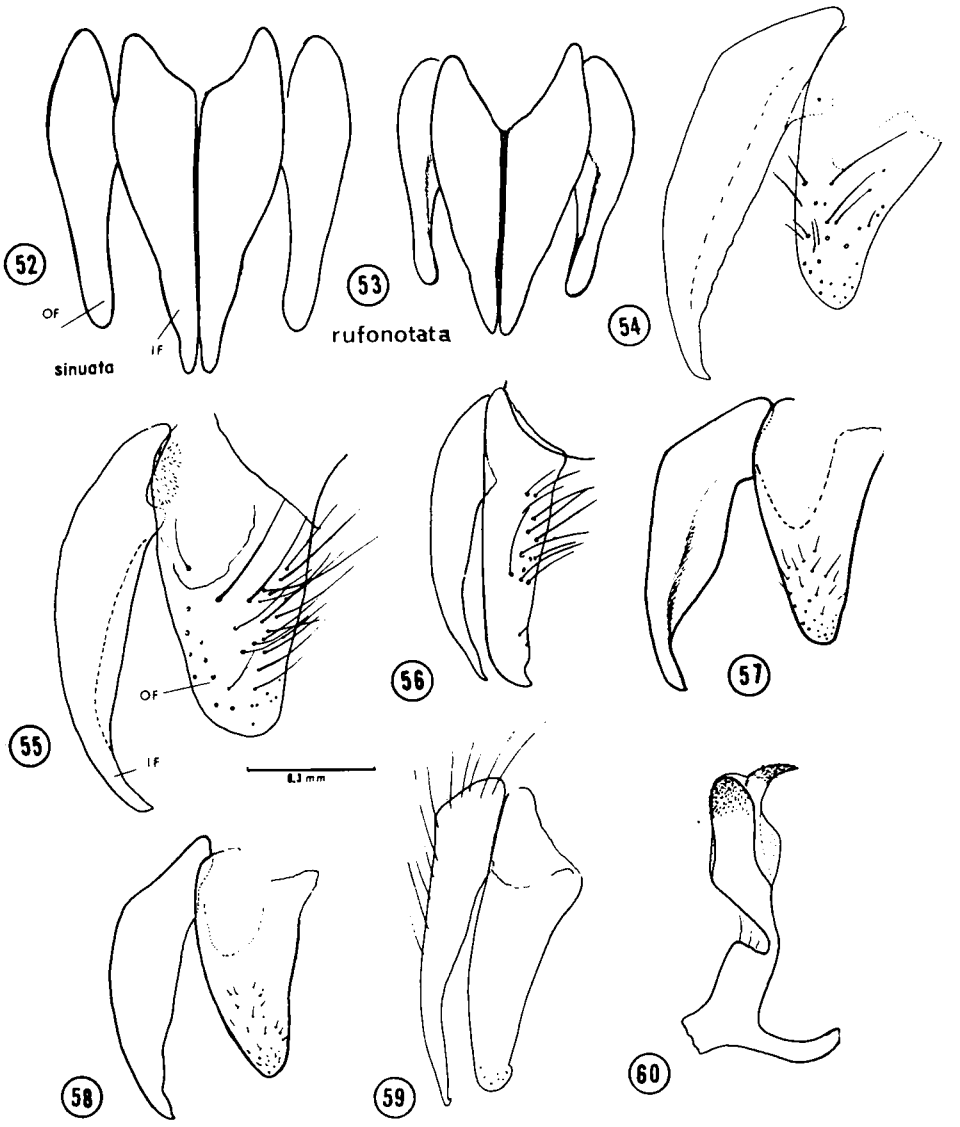
Winthemia imitator Reinhard
(Figs. 25, 36, 56, 80)

Winthemia imitator Reinhard, 1931: 39 (Type locality, Brownville, Texas) (Illinois St. Nat. Hist. Surv. Mus.).

Diagnosis. This species is closely related to *intermedia*, differing from that species principally in the shape of the genitalia (figs. 36 and 65).

Male. Front at vertex 0.22 of the head width; facial length 0.90 of the frontal length; parafrontalia silvery pollinose, clothed with few and fine black hairs, tinged with yellow toward vertex; ocellars slender and

strongly proclinate; frontals about fifteen in number with about five bristles below base of antennae; inner verticals long and parallel; outer verticals slender, scarcely differentiated from the occipital bristles; ocellars slender and strongly proclinate; frontal vitta brown; parafacialia gray, clothed with few inconspicuos hairs near middle, the sides narrow downward; antennae black, elongate; third segment twice the length of



Male genitalia of *Winthemia:* 52, *sinuata;* 53, *rufonata;* 54, *aurifrons,* sp. n.; 55, *cecropia;* 56, *floridensis,* sp. n.; 57, *duplicata;* 58, *rufonotata;* 59, *intermedia;* 60, *quadripustulata,* aedeagus. (OF, outer forceps; IF, inner forceps).

second; arista brown, as long as the vibrissae, slightly thickened on the proximal third; cheeks red, dusted with gray pollen and covered with dense black hairs, about one-sixth of eye height in profile (fig. 25); palpi brown.

Thorax black, gray pollinose; mesonotum with four distinct wide black stripes anterior to the suture and five posterior to the suture; first intra-alar postsutural very small; scutellum brown, dusted with gray whitish pollen, calypteres opaque, orange.

Legs brown, mid tibia with one stout anterodorsal bristle near middle, hind tibia evenly ciliated (fig. 80); claws and pulvilli elongate.

Abdomen black, reddish on sides and apex of fourth segment; last three segments largely covered with changeable grayish white pollen; segment I without median marginals; segment II with or without one pair; segment III with a row of about nine; segment IV entirely covered with erect bristle hairs and an irregular row of weak bristles near apex; hairs of intermediate segments depressed; venter with defined patches of dense hairs on segment III and IV; genital segments yellow; inner forceps black; genitalia as in figs. 36 and 65.

Length: 8 mm.

Female. Unknown.

Recorded distribution. USA (Texas).

New distribution record. MEXICO. *Guerrero:* Pautla, Oct. 1950 (W. G. Downs, CNC).

Winthemia intermedia Reinhard
(Figs. 22, 39, 59, 85)

Winthemia intermedia Reinhard, 1931: 41, pl. 1 fig. 4. (Type locality, College Station, Texas) (USNM no. 43348).

Diagnosis. This species is characterized by the very slender inner forceps which are feebly keeled near base; outer forceps are nearly as long as the inner ones; the abdomen has defined patches of dense hairs on third and fourth segments.

Male. Front at vertex 0.21 of the head width; facial length 0.72 of the frontal length; parafrontalia dark, dusted with whitish gray pollen and clothed with fine long hairs, more abundant toward apex; frontal vitta dark brown; frontals ten to eleven, directed inward and extending below to the end of second antennal segment, uppermost bristle weak, placed considerably before the triangle; antennae black, third segment about twice the length of second; arista shorther than antennae; parafacialia silvery pollinose, beset with few long black hairs along the inner margins; palpi yellow, with numerous black hairs below; cheeks gray pollinose covered with fine hairs, about one-seventh the eye heigth; occiput densely pilose (fig. 22).

Thorax black, gray pollinose; mesonotum with four wide and very distinct black stripes before and five behind suture, the median stripe very narrow; scutellum red, dusted with whitish-gray pollen: calypteres opaque, white.

Legs brown, long and slender; mid tibia, with one long anterodorsal bristle below middle; hind tibia evenly ciliate, with one long bristle near middle of the row. (Fig. 85); front claws and pulvilli as long as the combined lengths of the last tarsal segments.

Abdomen black, anal segment and sides of intermediate segments red; last three segments dusted with grayish white pollen; first segment without median marginals; second with or without one pair; third with a row of about twelve: fourth bearing erect hairs in front and an irregular row near apex; venter of abdomen with well defined patches of dense hairs on third and fourth segments; smaller on latter; genital segments yellow; inner and outer forceps as in figs. 39 and 59.

Total length: 8 to 11 mm.

Female. Front at vertex 0.26 — 0.29 of the head width; facial lenght 0.87 of the frontal length; parafrontalia gray pollinose, with scattered hairs outside the frontals; ocellar triangle testaceous pollinose; two pairs of verticals and orbitals present; antennae black to dark brown; third segment twice the length of second; parafacialia gray pollinose, with scanty hairs along the inner margins; palpi yellow, swollen towards the tips. Mid tibia with a long stout anterodorsal bristle near middle. Abdomen black in ground color, thickly dusted with grayish pollen; segment II with a strong pair of median marginals; abdominal hairs depressed.

Total length: 8 to 11 mm.

Recorded distribution. USA (Texas, Utah to Massachusetts, south to Texas and Florida, ? Brazil.

New distribution records. USA. *Michigan:* Agr. Coll., July 15, 1922 (L. G. Geniger, CNC); *Ohio;* Amherst, July - Aug. 1958 (H. J. Reinhard, CNC); no specific locality, Aug. 20 (H. J. Reinhard, CNC); *Texas:* College Station, April 12, 1929 (H. J. Reinhard, CNC); *Wisconsin:* Milwaukee, May 22, 1967, ex *H. cecropia* (CNC).

Winthemia intonsa Reinhard

Winthemia intonsa Reinhard, 1931: 28 (Type locality, Kaslo, British Columbia) (USNM no. 43343).

Diagnosis. *W. intonsa* can be distinguished from all other species of *Winthemia* by the presence of two laterals scutellars. The male is not yet known. Reinhard's description of this species follows:

Female. Front at vertex 0.30 the head width (one specimen) rather prominent below, the sides thickly covered with dull pale yellow pollen

and bearing scattered fine short hairs; mediam stripes reddish, not much narrowed before triangle; verticals two pairs; ocellars and orbitals present; frontals descending to apex of second antennal joint, the uppermost two or three bristles in each row stout but not very long, reclinate; antennae reddish, third joint one and one-half times the length of second; arista long, slender, with a short penultimate joint; sides of face dull pale yellow, thickly clothed with rather coarse black hairs, not much narrowed downward; vibrissae situated on the lower edge of face; cheeks covered with dense grayish pollen, about one-eighth; palpi yellow; occiput thickly pale yellow.

Thorax black, gray pollinose, with four dark dorsal stripes and a median one apparent behind the suture in some views; scutellum reddish on apical half, gray pollinose, bearing only two lateral bristles besides a smaller decussate apical and discal pair; calypteres opaque, white.

Abdomen black in ground color; the intermediate segments entirely covered with dense gray pollen; fourth segment wholly red, with reflecting changeable spots on the margin above; first segment without median marginals; second with one stout pair; third with a marginal row of about 12; fourth with irregularly placed discals and marginal row; hairs on dorsum rather long and coarse but depressed.

Legs black; mid tibia with one long bristle on front side near middle; hind tibia with a row including two longer bristles on outer posterior edge; tarsi ordinary; claws and pulvilli shorter than last tarsal joint.

Wings hyaline; fourth vein curved inward beyond bend and reaching costa considerably before tip of wing; first posterior cell open; third vein with one hair at base; no costal spine.

Length: 9 mm.

Male. Unknown.

Described from a single specimen collected at Kaslo, British Columbia by R. P. Currie.

This species is known only from the holotype in the USNM, which I have been able to examine. The normal number of lateral scutellars in *Winthemia* is three but sometimes the median pair is small or even absent. Since this character is subject to variation, and since *intonsa* was described from a single female it is possible that this species could be a synonym of other previously described species occurring in northwestern North America. Townsend (1936) believed that this species is a western representatives of his *W. platysamiae* (= *cecropia* Riley). I have not found anything fitting the original description.

Winthemia manducae Sabrosky & DeLoach

Winthemia manducae Sabrosky & DeLoach, 1970: 173 (Type locality, near Clayton, Johnston County, North Carolina), (USNM no. 70951).

Diagnosis. The following diagnose and description was taken from the original description. Parafrontals golden, in strong contrast to the silvery parafacials, which are sparsely and inconspicuously haired; venter of abdominal terga IV and V moderately densely beset with long hairs, but not with well-defined patches.

Parafrontalia golden, sharply contrasting with the silvery parafacials and face; frontal stripe maroon to blackish; antennae chiefly reddish, more so in females than in males, third segments more or less blackish dorsally and distally, second segments infuscated especially on outer surface and particularly in males; palpi yellow. Thorax densely gray tomentose, slightly yellowish gray on mesonotum, with five narrow black stripes, the median less distinct than the others; scutellum, chiefly reddish gray, dusky towards base. Abdomen black in ground color toward base and on median third to half, reddish on sides and apex, more or less yellowish-gray tomentose, intermediate segments (III, IV) shining on distal fourth to third. Legs black, femora heavily gray tomentose, tibiae dusky yellow. Hairs and bristles black, except for white hairs on base of head.

Male. Width of front at vertex 0.200 (0.174 - 0.214/10) times the head width and half or a little less the width of an eye, widening slightly anteriorly; parafacial sparsely and inconspicuosly haired, with at most two irregular rows of fine hairs, more commonly one row of a few scatterd hairs, often appearing bare at low magnifications, and occasionally actually entire bare (average, 6 hairs per parafacial, range 0-16, with 75% having from 2-8 hairs); vibrissae clearly above level of anterior margin of mouth; antennae smaller than in female, third segment equal to or barely wider than the width of a parafacial below.

Ventral aspect of abdominal terga IV and V without sharply defined hair patches, though centrally with hairs longer and denser than usual, and obviously different than the evenly distributed hairs of *datanae, sinuata* and similar species; inner forceps in profile distally narrowed and strongly curved (as in fig. 6 of Reinhard, 1931).

Legs: Mid tibia anterodorsally usually with 1 long and strong median bristle (95 of 100 specimens; in 5 with slightly developed bristly hair proximad of it); hind tibia anterodorsally commonly (67 of 100) evenly and closely ciliate, sometimes (33) with a longer bristle midway on at least one tibia.

Length: 8,5 - 11.5 mm.

Female. Width of front at vertex 0.286 (0.278-0.299/10) times the head width, widening anteriorly; parafacial very sparsely haired, less so than in males of the species (and much less than in female *datanae*), with average 3.69 hairs per parafacial (range 0-10, with nearly 75% having from 1-5 hairs); antenna longer and larger than in male, third segment 1.6-2 times than width of a parafacial below. Mesonotum, scutellum, and abdomen more heavily tomentose than in male, and also more than in female *datanae,* the general appearance yellowish gray; strong median marginals bristles on abdominal tergum III (apparent II), and

rarely (8 of 100) a pair or one of a pair (3) of weaker but evident median marginals on tergum II. Legs: Mid tibia anterodorsally with 1 long and strong median bristle, and usually with normal hairs (77 of 100 specimens), occasionally (23) with a short but bristle like hair proximad of the median bristle; hind tibia anterodorsally not as evenly closely ciliate as in male, and with one strong outstanding bristle beyond middle of row of cilia.

Length: 8.0 - 10.5 mm.

Recorded distribution. USA (North Carolina).

Winthemia montana Reinhard

(Figs. 14, 51, 71, 77)

Winthemia montana Reinhard, 1931: 36 (Type locality, Indian Creek Canyon, Chiricahua Mts., 6,100', Arizona) (USNM no. 43345).

Diagnosis. This species is characterised by the possession of two rows of frontals on the male; mesonotum with four distinct black stripes on its entire length.

Male. Front at vertex 0.24 of head width; facial length 0.86 of frontal length; parafrontalia black, pale pollinose; frontals in two distinct rows, the inner one with about eighteen bristles, extending below the level of arista and stopping before triangle, the outer row with about seven to eight bristles extending upwards from base of second antennal segment, occupying about one-third of frontal length; parafrontalia covered with dense hairs, more abundant near the vertex; inner verticals robust but shorter than the outer verticals; parafacialia yellow, white pollinose, covered with long, but few, hairs; antennae black, second segment about one-third the length of third; arista elongate, longer than the antennae; cheeks densely covered with thin hairs, about one-seventh the eye height (fig. 14); palpi yellow covered with sparse hairs ventrally.

Thorax black, pale yellow pollinose; scutellum yellow with the basal margin black; mesonotum with four conspicuous black vittae extending its entire lengths, not interrupted near suture.

Legs black; pale yellow pollinose; mid tibia with one stout anterodorsal bristle in middle; hind tibia thickly ciliate (fig. 77); claws and pulvilli elongate.

Abdomen reddish, yellow laterally; segment I entirelly dark; segments II and III darkened on dorsum with a thin median black vitta interrupted near the suture; segments I and II with median marginals; segment III with a robust row of marginals and ventral hair patches; segment IV covered with long and strong hairs becoming stronger toward the apex; last three segments gray pollinose. Genitalia as in figs. 51 and 71.

Total length: 10 to 14 mm.

Recorded distribution. USA (Arizona, New York). MEXICO.

New distribution records. USA. *Arizona:* Millers Cyn., 4 mi. W. Knicksville, Cochise Co., Oct. 18, 1956 (J. W. MacSwain, CNC). MEXICO. *Oaxaca:* 12 mi. S. Chivela, Aug. 18, 1959 (L. A. Stange, and A. S. Menke, CNC); *Puebla:* Atalixco, Sept. 6, 1947 (F. A. Cowan, CNC).

Winthemia occidentis Reinhard
(Figs. 31, 89)

Winthemia occidentis Reinhard, 1931: 22 (Type locality, Wigwan Inn, Burrad Inlet, British Columbia, Canada) (AMNH); Boyes & Wilkes, 1953: 125 (caryotype).

Diagnosis. This species is closely related to *W. sinuata,* from which it differs by polished black mesonotum, lightly dusted with thin gray pollen; abdominal segments II and III thinly dusted with bluish white pollen. The female is indistinguishable from *W. sinuata.*

Male. Front at vertex 0.18-0,25 of head width; slightly narrowed before triangle, then widening rapidly towards base of antennae; parafrontalia covered with golde pollen, more or less blackish and subshinig before vertex; frontal vitta brown; verticals two pairs, the outer one weak; ocellars of ordinary size; frontals about twelve, directed inward and extending to apex of second antennal segment; the uppermost bristle hairlike and placed before apex of triangle; parafacialia gray pollinose sparsely clothed with rather coarse black hairs near middle; antennae black, third segment about 0.66 the length of second; arista black, slightly thickened on basal two-fifths; cheeks blackish and thinly gray pollinose, densely covered with fine black hairs, in profile about one-eighth the eye height (fig. 31); palpi slender black, sometimes orange at tips.

Thorax black, slightly dusted with gray pollen; mesonotum shining black; dorsal stripes indistinct; scutellum reddish except in the basal fifth, faintly pruinose; calypteres tawny.

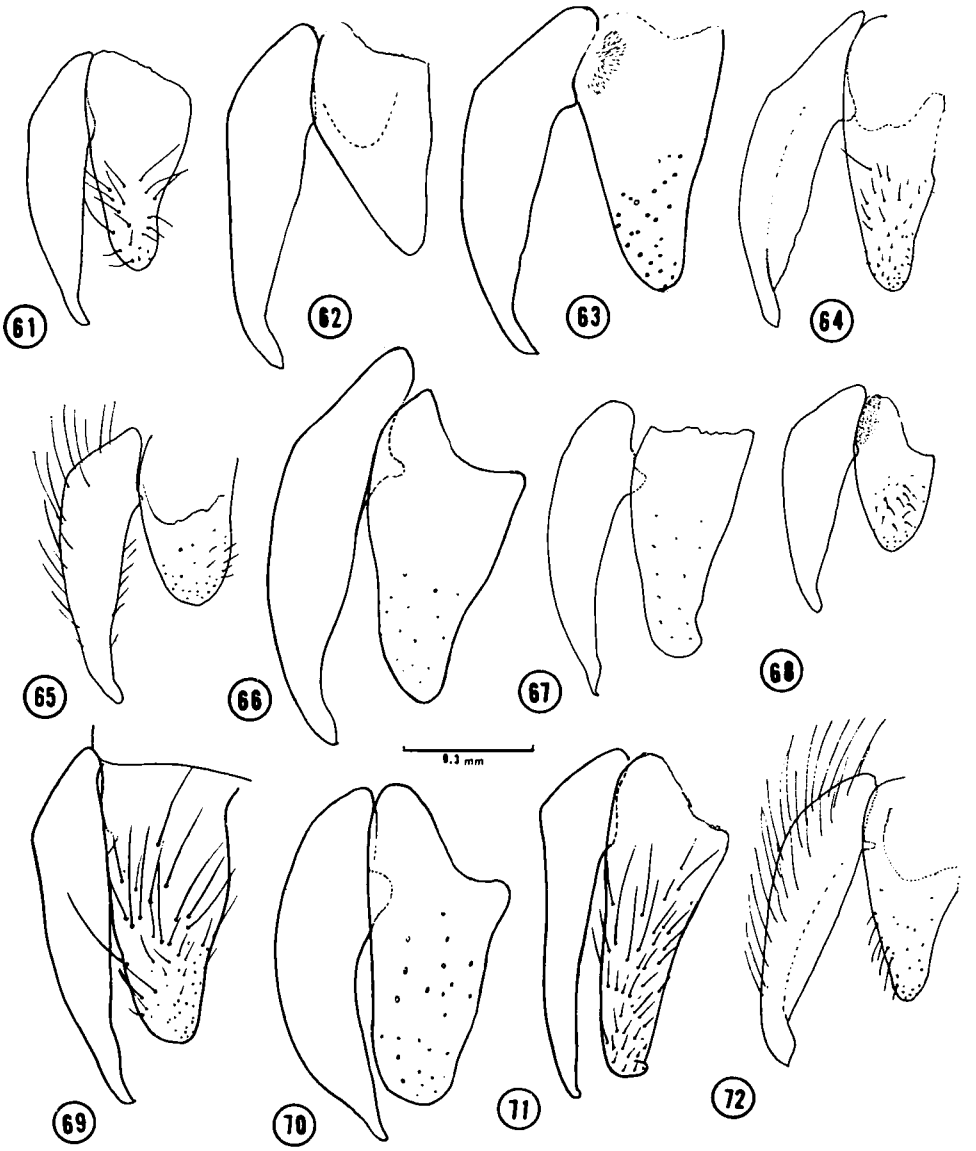
Legs black; mid tibia with one stout anterodorsal bristle near middle; hind tibia evenly ciliate (fig. 89); claws and pulvilli elongate.

Abdomen black in ground color, the sides and narrow apex distinctly reddish, last three segments densely gray pollinose; segment IV polished on posterior half; segment I without median marginals; segment II with or without one pair; segment III with a marginal row of about ten; segment IV with several irregular rows on apical half; venter without any defined patches of matted hairs. Genitalia indistinguishable from *W. sinuata.*

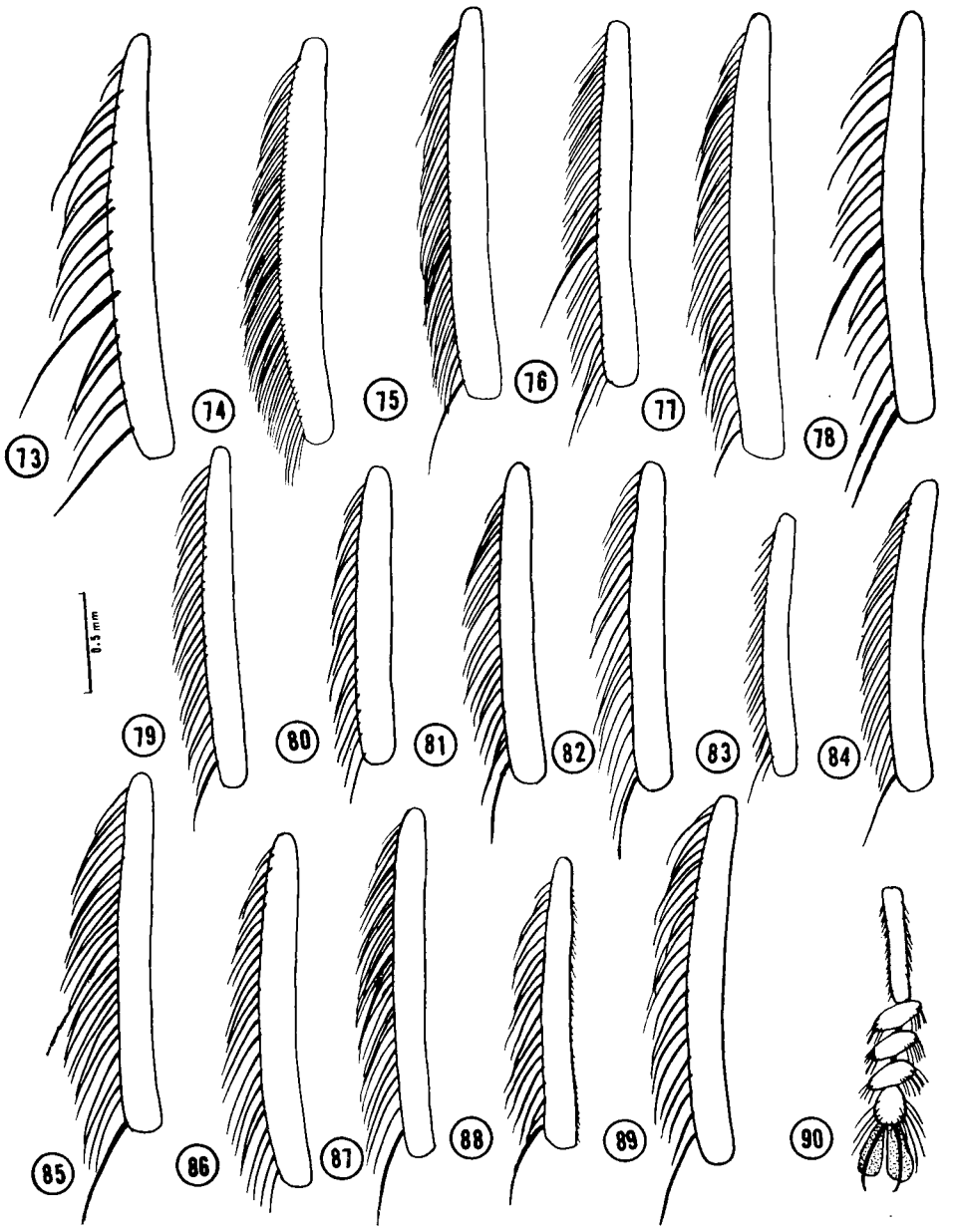
Total length: 8 to 9 mm.

Female. Front at vertex 0.31 of the head width; facial length 0.72 of the frontal length; parafrontalia pale gray pollinose, the pollen becoming thinner toward the vertex, sparsely covered with thin long black hairs outside the frontals; two pairs of orbitals and verticals present; ocellars strongly divergent; parafacialia gray pollinose, moderately co-

vered with long pale hairs on middle; antennae infuscated; third segment a little swollen, nearly twice the length of second; cheeks gray pollinose, covered with long and scattered hairs; palpi yellow, slightly swollen toward apex; mid tibia with a strong anterodorsal bristle on middle and 2 or more smaller bristles above; hind tibia with a widely spaced anterodorsal row, with a long bristle near middle; abdomen with an erect pair of median marginals on second segment.



Male genitalia of *Winthemia*, lateral view: 61, *abdominalis;* 62, *deilephilae;* 63, *sinuata;* 64, *rufopicta;* 65, *imitator;* 66, *datanae;* 67, *reinhardi,* sp. n.; 68, *okefenokeensis;* 69, *andersoni,* sp. n.; 70, *texana;* 71, *montana;* 72, *argentifrons,* sp. n.



Hind tibia of male *Winthemia,* showing the patterns of the antero-dorsal row of bristles: 73, *andersoni,* sp. n.; 74, *rufopicta;* 75, *cecropia;* 76, *quadripustulata;* 77, *montana;* 78, *borealis;* 79, *abdominalis;* 80, *imitator;* 81, *reinhardi,* sp. n.; 82, *texana;* 83, *argentifrons,* sp. n.; 84, *floridensis,* sp. n.; 85, *intermedia;* 86, *sinuata;* 87, *rufonotata;* 88, *okefenokeensis;* 89, *occidentis;* 90, *okefenokeensis,* front tarsus.

Total length: 8 to 9 mm.

Recorded distribution. USA (Arizona, Michigan, Montana, New Mexico, Washington). CANADA. (British Columbia, Manitoba, Newfoundland, Ontario). MEXICO.

New distribution records. USA. *Iowa:* Council Bluffs, June 15, 1912 (R. L. Webster, ISC); Alleman, Polk Co., Aug. 27, 1952 (J. L. Laffoon, ISC). *Massachusetts:* Woburn, Aug. 20, 1949 (R. H. van Zwaluwenburg, USNM). *Michigan:* Manister Co., July 18, 1948 (R. R. Dreisbach, CNC). *Minnesota:* Princeton, July 16-19, 1921 (E. Hoffman, UM). *New Hampshire:* Mt. Washington, Aug. 14, 1958 (J. R. Vochroth, CNC). *New Jersey:* Ridgewood, June 10, 1913 (M. D. Leonard, CU). *New York:* Babylon, L. I., June 6, 1935 (Blanton & Borders, CAS). *Ohio:* Amherst, July 1933 (H. J. Reinhard, CNC). *Utah:* Provo, Squaw Peaktrail, Aug. 8, 1968 (Host: Geometridae) (M. W. Minnoch, USNM). *Washington:* Copalis, July 25, 1932 (A. T. Peters, KU); Mt. Baker, July 23, 1931 (J. Nottingham, KU). *Wisconsin:* Madison, May 15, 1929 (OSU). CANADA. *Alberta:* Elk Is. Park, Sept. 8, 1947 (CNC); Edmonton, July 11, 1923 (E. H. Strickland, CNC); Red Rock Cy. (ex *Proserpinus flavofasciata*), Oct. 4, 1949 (CNC). *British Columbia:* Vancouver, April 6, 1932 (G. R. Hopping, CNC), (host: *Nepytia phantasmaria* Str.); Wigwam Inn, Burrad inlet, June 10, 1930 (G. R. Hoppings, CNC), (emerg. in lab. ex western hemlock looper) (paratype); Victoria, May 21, 1949 (J. H. McLeod, CNC), (Host; *Lambdina somniaria*); Uplands, Vancouver Is., April 21, 1949 (host: *Ellopia somniaria*); Seymor cr., Vancouver, July 16, 1931 (G. R. Hopping, CNC); Robson, July 22, 1949 (H. R. Foxlee, CNC); Hope, Jan. 8, 1931 (J. Nottingham, CNC); Cascade, March 22, 1954 (CNC), (ex *Xylomyges* sp.); Lakelse Lake bog, S. of Terrace, July 2, 1960 (B. Heming, CNC); Fairmont, July 28, 1926 (A. A. Renn, CNC); Upland, Vancouver Is., June 21, 1949 (ex oak looper, *Ellopia somniaria,* CNC). *Manitoba:* Clear Lake, Aug. 23, 1956, ex Geometridae, (no coll. data, CNC); Teulon, July 22, 1923 (A. J. Hunter, CNC); Ninnete, June 21, 1958 (J. F. McAlpine, CNC). *New Brunswick:* New Castle, June 18 (F. M. McKenzie, CNC). *Ontario:* Mer Bleue, Ottawa, Aug. 19, 1963 (J. R. Vockroth, CNC); nr. Burgess Twp., Lanark Co., Aug. 25, 1966 (D. M. Wood, CNC); March Twp., Carleton Co., June 6, 1965 (D. M. Wood, CNC). *Quebec:* L. Brule, Aug. 16, 1946 (O. Peck, CNC).

Winthemia okefenokeensis Smith
(Figs. 32, 48, 68)

Winthemia okefenokeensis Smith, 1916: 95 (Type locality, Billy's Island, Okefenokee Swamp, Ga., (USNM no. 20054); Curran, 1928: 108 (occ. in Porto Rico); Reinhard, 1931: 52; Patton, 1958: 85 (Fla. recs.).

Okea okefenokeensis; Townsend, 1916b: 74.

Diagnosis. This species is differentiated from all other *Winthemia* species by having the intermediate segments of the front tarsi of male conspicuosly flattened and obliquely expanded (fig. 90).

Male. Front 0.21 of the head width at vertex; facial length 0.98 of the frontal length; frontals about fourteen in number extending a little above the level of insertion of arista and stopping before the ocellar triangle; ocellar triangle dusted with pale pollen, thickly pilose; ocellars strong; parafacialia concolorous with front, with few scattered hairs more abundant below; antennae black, elongate; segment II about 0.5 the length of segment III; cheeks black, silvery pollinose, about one-seventh the eye height (fig. 32); palpi infuscated, covered with long cilia below.

Thorax black, grayish pollinose; scutellum black or brown at the apex; mesonotum with four distinct parallel stripes on its entire length.

Legs black, mid tibia with a strong anterodorsal bristle near middle; hind tibia with a row of robust bristles (fig. 88).

Abdomen polished, yellow with a dorsal median stripe extending from segment I and ending at the base of segment IV: segment II and II with median marginals; segment IV with a robust row of about eight to ten marginals; segment IV entirely yellow with long erect bristles on middle and two irregular rows of marginals at the basal one-third; segments II and III with a thin ring of yellow pollen on posterior margins; venter of segments III and IV with conspicuous patches of matted hairs. Genitalia as in figs. 48 and 68.

Total length: 7 to 8 mm.

Female. Differs from male by the following characters:

Front at vertex 0.26 to 0.30 of the head width; facial length 0.77 of the frontal length; parafrontalia gray pollinose, with small, scattered hairs outside the frontals; two pairs of orbitals and verticals present; ocellars moderately developed not much divergent; parafacialia gray pollinose, covered with fine, indistinct hairs along the inner margins; antennae black; third segment elongate, twice the length of second; mid tibia with one large anterodorsal bristle and with a longer bristle near middle. Abdomen dark red, dusted with grayish pollen, more abundant on the proximal one-fifth of segment II and III.

Total length: 8 mm.

Recorded distribution. USA (Florida, Georgia), Cuba, Porto Rico (Curran, 1928).

New distribution records. USA. *Alabama:* Mobile, (H. E. Smith, MCZ). *Florida:* Hilliard, Aug. 19, 1930 (J. Nottingham, KU); Plant City, Aug. 15, 1930 (R. H. Beamer, KU); Brandford, July 16, 1934 (R. H. Beamer, KU); Ft. Mead, Aug. 13, 1930 (R. H. Beamer, CNC); Levy Co., March 24, 1949 (CNC); Miami, Nov. 13, 1908 (C. H. T. Townsend, USNM); White Sprs., Oct. 16 (C. H. T. Townsend, USNM), Larkins, Oct. (MCZ). *Georgia:* Thomasville, June 30, 1948 (R. H. Beamer, KU); Billy's Is., Okefenokee Swamp, June 1912 (CU); Spring Creek, Decatur Co., July 16-29, 1912 (CU). CUBA. Holgun, Dec. 23, 1904 (H. S. Parish, OSU); Bonito, Sept. 13, 1964 (OSU); Paso Real, April 23, 1923 (J. S. Hine, OSU).

Winthemia polita Reinhard

Winthemia polita Reinhard, 1931: 21 (Type, labelled "1950, August 15, TD 356', supposed to be from Melrose Highlands, Massachusetts) (USNM no. 43341).

Diagnosis. Small sized species; abdomen black polished, the basal fifth of second and third segment dusted with silvery white pollen; closely related to *vesiculata* which differs by the shinning black abdomen.

Female. Front at vertex 0.25 of the head width in the single specimen; parafrontalia dusted with pale white pollen fading out upward, becoming shninning black before vertex; front sparsely haired; median stripe reddish-brown, wider than one parafrontalia before the triangle; verticals well developed; ocellars of ordinary size; the usual two pairs of orbitals present; frontals about eight, the lowermost reaching the middle of second antennal segment; upper two reclinate; parafacialia silvery pollinose, with few pale hairs on middle; vibrissae on oral margin; antennae black; third segment broader than one parafacialia, and twice the length of second segment; arista brown, longer than antennae, thickened on basal fourth; cheeks in profile very narrow about one-twelfth the eye height, dusted with thin gray pollen; palpi yellow, infuscated toward base.

Thorax shinning black, thinly dusted with pale white pollen, more abundant on humeri and pleura; mesonotum with four inconspicuous narrow stripes, indistinct behind suture; scutellum black, thinly dusted with white pollen; calypteres with the posterior lobes pale yellow, light testaceous toward the inner borders; anterior lobes entirelly white.

Legs entirely black, reddish on joints; mid tibia with a stout anterodorsal bristle near middle; hind tibia with a row of unevenly spaced anterodorsal bristles, with one longer bristle near middle; tarsal segments ordinary; claws and pulvilli short. Wings subhyaline, tawny near base and along costal margins.

Abdomen black; abdominal segment I without median marginals; segment II with one pair; segment III with a marginal row of about eight; segment IV with one discal and marginal rows of erect bristle-like hairs; hairs on segment II and III depressed.

Total length: 8 mm.

Male. Unknown.

Recorded distribution. USA (Massachusetts).

New distribution record. USA. Massachusetts: Melrose Highlands, Aug. 6, 1911 (H. E. Smith, MCZ).

According to Reinhard the type specimen is labelled "1950, August 15, TD 356", no locality but supposed to be from Massachusetts. Dr. Sabrosky (*in litt.*) kindly informed that 1950 means "Gipsy Moth Parasite Laboratory note no. 1950" which was written on August 16, 1908,

and says that the fly was "collected by Clemons near Lab. yesterday", meaning at Melrose Highlands, Mass. This information was taken from the Townsend's card file in the USNM.

Winthemia quadripustulata (Fabricius)
(Figs. 21, 47, 60, 76)

Musca quadripustulata Fabricius, 1794: 324 (Type locality, Germany, type lost).
Winthemia illinoensis Robertson, 1901: 286 (Type locality, Carlinville, Illinois).

Diagnosis. This species is differentiated from the other *Winthemia* species by the characters given in the keys. The following description fits all the three forms which are discussed at the end.

Male. Front at vertex 0.15 to 0.20 of the head width; facial length 0.84 of the frontal length; front prominent below, widening rapidly beyond middle to base of antennae; frontal vitta wine red to black, not much narrowed upward; parafrontalia densely gray pollinose (forms A and B) to yellow pollinose (form C), thickly clothed with black hairs outside of frontals; inner verticals moderately developed; outer verticals weak or hair-like; ocellars large, proclinate but not much divergent; frontals about twelve in number, extending below middle of second segment, the uppermost reduced in size well before the triangle; parafacialia gray pollinose, moderately to thickly pilose; antennae black, third segment usually reddish near base, about one and half times as long as second; arista black, longer than antennae, thickened on basal fourth and very slender beyond; palpi yellow, infuscated at bases; cheeks gray pollinose, covered with fine hair, in profile about one-seventh the eye height (fig. 21).

Thorax black, thinly gray pollinose; mesonotum subshining showing five poorly defined stripes when viewed from behind; scutellum reddish except on narrow basal margin, covered with uniform thin gray pollen; calypteres opaque, white.

Legs black; mid tibia usually with one stout anterodorsal bristle near middle and one or two smaller bristles just above (form C) or with only one large anterodorsal bristle (form A, B, fig. 76); hind tibia evenly ciliate (form C); with or without one longer bristle in the row; claws and pulvilli elongate.

Abdomen black, broadly red on sides (form C) to entirely black (form A, B); last three segments with grayish pollen, the pollen is dense near base becoming thinner behind but extending almost to the posterior margin of each; segment IV with the pollen confined to the basal half; hairs, except on the anal segment, depressed; segment I with or without median marginals; segment II with or without a pair (form A and B), or with two or more (form C); segment III with a marginal row of about ten bristles; segment IV with two marginal rows and erect bristle-like hairs in front; venter of abdomen with no defined patches of dense

hairs; genitalia with the inner forceps tapering uniformly from base outward to a moderately incised apex; outer forceps shorter than inner ones, the tips broadly subtruncated (fig. 47).

Total length: 7 to 11 mm.

Female. Front at vertex 0.26 of the head width; facial length 0.68 of the frontal length; parafrontalia cinereous pollinose, the pollen becoming thinner and blackish toward vertex; parafacialia gray, thickly pilose; antennae black; third segment a little swollen, twice the length of second. Thorax gray pollinose; mesonotum thinly gray pollinose, dorsal stripes distinct; calypteres white, opaque; mid tibia with a long anterodorsal bristle near middle. Abdomen black at sides, whitish pollinose, with a pair of median marginals on segment I and II.

Total length: 7 to 12 mm.

The identity of the complex called *W. quadripustulata* in America north of Mexico in comparison with the European complex is still an unsolved problem. It is evident that species and subspecies concepts are not used identically in different groups by different authors; in the past, European and American dipterists have been inclined to work independently. The taxonomic work necessary to clarify the position of the *quadripustulata* complex should be carried out by a specialist fully acquainted with the Holarctic fauna and working with abundant material. Unfortunatelly, as it was not possible to obtain extensive Palearctic material to study the conclusion reached in the following analysis concerns only the Nearctic population of the *quadripustulata* complex.

Winthemia quadripustulata belongs to one of the familiar tachinid complexes consisting of extremely variable groups of individuals.

Townsend (1936), who did not agree with most investigators of muscoid flies, maintained that *W. quadripustulata* of the American authors was in fact *Omotoma rufonotata* of Bigot. He further stated that the Europen authors had erroneously synonymized *Tachina variegata* Meigen (considered the type species of *Winthemia*) under *Musca quadripustulata* Fabricius. Reinhard (1931) was criticized by Townsend *(loc. cit.)* for confusing *T. variegata* Meigen with *M. quadripustulata* Fabricius. Townsend maintained that both were generically distinct. Mesnil (1949) placed these two species in different subgenera.

In order to describe and discuss these variations, three forms, northwestern, northeastern, and middle western, referred to as forms A, B, and C, respectively, have been recognized. The variability is such over most of the range that no definite line can be drawn between the three groups, and therefore it is not always possible to assign certain specimens to any one particular group. The following discussion of forms concerns only males. Morphological evidence indicates that these three populations may be at least good subspecies, but until further biological and ecological data are obtained, there is little justification for recognizing more than one species. However, I have kept separate the information concerning the three groups in the following discussion and records, in the event that further genetic study substantiates the view

that there may be subspecies or sibiling species involved. In discussing regional variations among different forms, the specimens were compared with a "standard" which is a specimen of each form chosen from an area where the form is usually distinct, where there are few, if any intergrades, and where the majority of these specimens look alike. In the following discussion the term "standard" refers only to these specimens.

The standards are: form A — Pullman, Washington, Malaise trap, Aug. 12, 1965 (Roger D. Akre, WSU); form B — Queens Park, Aylmer, Quebec, Canada (CNC); form C — Douglas Co., 900', Kansas (R. H. Beamer, CNC).

The area where the forms are usually distinct, where there are few, if any intermediates is show in fig. 91. The dots show the localities where the standards were chosen and the lines indicate the approximate range of distribution of *W. quadripustulata.* In the area between the three basic populations, there is great amount of variation and it seemed impractical to describe intergrades among the forms.

FORM A

Parafrontalia gray pollinose, the pollen becoming brown towards the apex; palpi yellow, infuscated towards bases; mid tibia with a stout anterodorsal bristle near middle of the row and one smaller bristle just above it; hind tibia with an uneven row of anterodorsal bristles, the bristles being slender and widely spaced, with a long bristle near middle of the row. Abdomen black, indistinctly reddish on sides; second segment with one or two pairs of median marginals.

Distribution. USA (California, Idaho, Washington). CANADA (Alberta, British Columbia, Manitoba, Quebec, Saskatchewan).

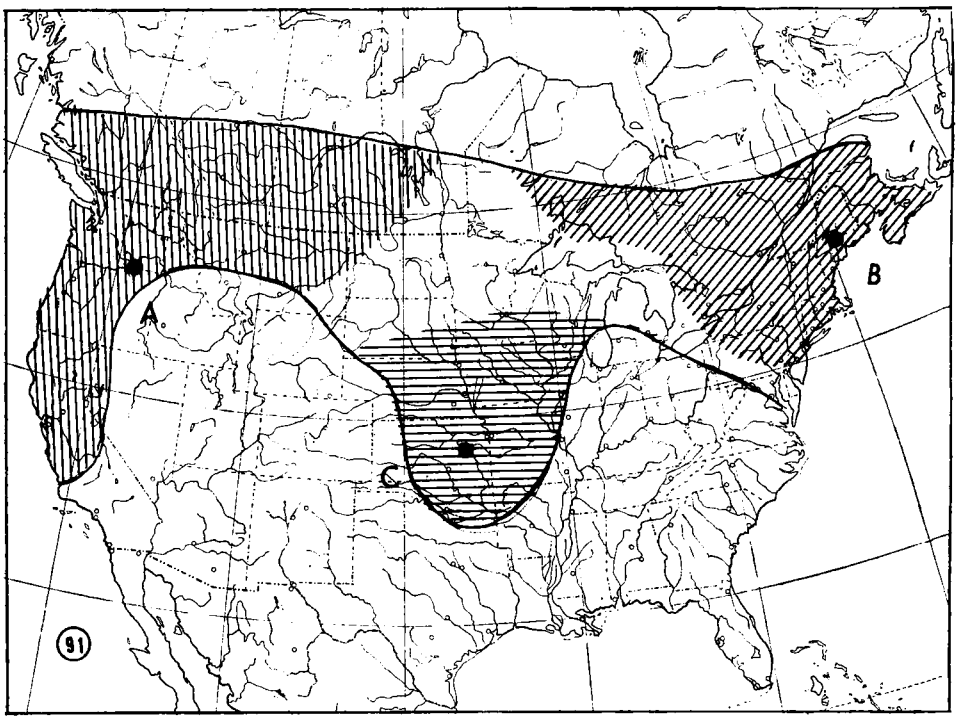
Recorded distribution. USA. *California:* Mt. Shasta, Siskiou Co., Aug. 5, 1963 (P. H. Arnaud, Jr. PAC). *Idaho:* 3 mi. S. W. Webb, Nez Perce Co., June 8, 1962, (IU). *Washington:* Pullman, Malaise trap, Aug. 10, 1965 (Roger D. Akre, WSU); Seatle (J. M. Aldrich, USNM); Fort Lewis, Pierce Co., July 30, 1914 (P. H. Arnaud Jr., PAC). CANADA. *Alberta:* Waterton, July 3, 1923 (E. H. Strickland, CNC); Jumping Pd. Cr. 20 mi. W. Calgary, July 3 (W. R. Mason, CNC); Banff, June 12, 1922 (C. B. Garrett, CNC); Edmonton, Aug. 1923 (E. H. Strickland, CNC). *British Columbia:* Agassiz, July 26, 1920 (CNC); Kitwanga, July 1, 1960 (G. E. Shewell, CNC); Wellington, S. Vancouver Id., June 15, 1953 (R. Guppy, PAC); Wellington, S. Vancouver Id., June 15, 1953 (R. Guppy, PAC); Summit Lake, mi. 392, Alaska Hwy., Aug. 19-21, 1959, 4200' (R. E. Leach, CNC); Robson, Oct. 2, 1949 (H. R. Foxlee, CNC); Miracle Beach, nr. Oyster River, June 13, 1955 (J. R. McGillis. CNC); Terrace, 200', July, 1966 (B. Henning, CNC); Spring Creek Terrace, June 11, 1960 (C. H. Mann, CNC); Lilloet, July 25, 1818 (A. W. A. Phair, CNC). *Manitoba:* Ninette, June 12, 1958 (J. F. McAlpine, CNC); Gillan, July 10, 1950 (H. R. Foxlee, CNC). *Saskatchewan:* Nipawin, June 4, 1948 (J. R. Vockroth, CNC); Prince Albert, May 29, 1948 (J. R. Vockroth, CNC).

FORM B

Parafrontalia pale yellow pollinose, the pollen becoming brownish toward apex, in some forms the pollen is entirely ashy gray; palpi yellow infuscated toward base; mid tibia with one large long anterodorsal bristle near middle; hind tibia ciliated, the bristles are long, slender, closely placed and usually without a long bristle near middle of row. Border of calypteres tawny on inner margin; abdomen distinctly reddish on sides with one or more pairs of median marginals.

Distribution. USA (Michigan, New Jersey). CANADA (Quebec, Ontario, New Brunswick, Nova Scotia).

Recorded distribution. USA. *Michigan:* Ann Arbor, 1959 (PAC). *New Jersey:* Baddeck, July 21, 1936 (T. N. Freeman, CNC). CANADA. *Ontario:* Chatham, May 21, 1925 (G. S. Walley, CNC); Kearney, July 27, 1911 (M. C. van Duzee, CNC); Mer Bleu, 5 mi. E. Ottawa, July 27, 1966 (D. D. Munroe, CNC); Mormora, July 18, 1914 (G. H. Hammond, CNC); Blackburn, June 6, 1955 (J. F. McAlpine, CNC); Brockville, June 9, 1963 (J. F. Vockroth, CNC); Strathroy, July 2, 1925 (H. F. Hudson, CNC). *New Brunswick:* Chamcook, July 2, 1965 (G. E. Shewell, CNC). *Nova Scotia:* White Pt., Queens Co., 1935 (J. McDonnough, CNC).



Distribution of *Winthemia quadripustulata* complex in America north of Mexico: A, northwestern form; B, northeastern form; C, middle western form. (The dots indicate the locality where the "standard" was collected.)

FORM C

Parafrontalia gray pollinose, the pollen fading toward apex; palpi yellow, not much infuscated on bases; abdomen broadly reddish on sides, thickly dusted with ashly gray pollen; calypteres white, opaque; mid tibia with one stout anterodorsal bristle near middle, sometimes one small bristle is present just above; hind tibia thickly ciliated, the bristles are slender, uneven and closely placed, usually there is a long bristle near middle of row; second abdominal segment usually with 2, exceptionally with 3 pairs of median marginals.

Distribution. USA (Arkansas, Indiana, Iowa, Kansas).

Recorded distribution. USA. *Arkansas:* Washington Co., April 20, 1921 (USNM). *Indiana:* Lafayette, May 16, 1967 (J. M. Aldrich, USNM). *Iowa:* Ames, May 8, 1957 (Howbackle, ISC); Ledges St. Park, May 16, 1947 (J. L. Laffoon, ISP); Davis Co., July 1948 (W. D. Klimstra, ISC). *Kansas:* Douglas Co., May 23 (R. H. Beamer, KU); Lawrence, (J. M. Aldrich, USNM); Riley Co., May 5, 1964 (L. R. Ertle, KSU).

Winthemia reinhardi, sp. n.
(Figs. 16, 45, 67, 81)

Diagnosis. A medium sized species with black polished thorax; calypteres tawny, infuscated in the inner margins; abdomen gray pollinose on segments II and III. Differs from the other species principally by the shape of male genitalia.

Male. Front 0.20 of the head width at vertex; facial length 0.72 of the frontal length; parafrontalia narrowed, pale gray pollinose downward clothed with short black hairs; median stripes brownish to black, narrowed behind; inner verticals rather short; outer ones vestigial; frontals, ten to eleven, directed inward and extending below middle of second antennal segment; uppermost bristles weak, placed just below the triangle, the latter densely pilose; ocellars strong and short; face and cheeks pale yellow pollinose on red ground color; parafacialia narrow sparsely clothed with short black cilia; antennae black, third segment about 0.52 as long as second; arista about the length of antennae, slightly thickened near base; palpi pale yellow, black-haired at tips; cheeks densely clothed with long hairs (fig. 16), about one-sixth of eye height.

Thorax black, subshining, lightly dusted with gray pollen; mesonotum with the dorsal stripes indistinct; scutellum reddish except on narrow base, covered with thin gray pollen; calypteres opaque, infuscated on inner margins.

Legs black; mid tibia with one anterodorsal bristle near middle; hind tibia densely and evenly ciliated (fig. 81); claws and pulvilli distinctly elongated. Wings hyaline, lightly infuscated, tinged with brown near base; venation as usual.

Abdomen black, reddish on sides, covered with thick gray pollen; the pollen on last three segments interrupted by a narrow but distinct black median stripe; segment I and II without median marginals; segment III with a marginal row of about seven; segment IV shining black, dusted with thin gray pollen, covered with smaller bristles which are irregularly placed; hairs on intermediate segments depressed; venter without defined patches of thick or matted hairs. Genitalia as in figs. 45 and 67.

Total length: 9 mm.

Female. Unknown.

This species is named for Dr. H. J. Reinhard whose basic studies on this genus have contributed much to the understanding and clarification of this group.

Holotype male. Baiting Hollow, New York, L. I., Aug. 8, 1923, (H. C. Huckett, CU).

Winthemia rufonotata (Bigot)
(Figs. 30, 53, 87)

Chaetolyga rufonotata Bigot, 1889: 257 (Type locality, Rocky Mts.).

Diagnosis. Closely related to *W. duplicata* but the thoracic stripes are more distinct; dorsal stripes between the anterodorsal and intra-alar presutural are wider and more distinct.

Male. Front 0.24 of the head width, prominent below; facial length 0.80 of the frontal length; parafrontalia blackish above, densely pale grayish yellow pollinose downward, thickly clothed with short hairs outside frontals; median stripe wine red exceeding the parafrontal width throughout entire length; inner verticals moderately developed; outer ones weak, hairlike; frontals about twelve in number, directed inward and extending almost to apex of second antennal segment, the uppermost bristles smaller, situated before the triangle; ocellars well developed; antennae black, apex of second segment and base of third tinged with red; second segment 0.71 the length of third; arista black, longer than antennae, thickened on basal two-fifths; parafacialia gray pollinose, clothed with long hairs; vibrissae slightly above the front edges of mouth; palpi yellow infuscated basally, slender, bearing numerous black hairs; cheeks gray pollinose, covered with fine hairs, in profile about one-thirteenth the eye height (fig. 30).

Thorax black in ground color, white pollinose; mesonotum showing five well defined black stripes when viewed from behind; median stripe very narrow, extending without interruption the entire length of mesonotum; scutellum red except on narrow margin, covered with uniform gray pollen. Calypteres white, opaque.

Legs black; mid tibia with only one stout anterodorsal bristle near middle; hind tibia ciliate (fig. 87); claws and pulvilli elongate.

Abdomen broadly red on sides, with a wide black median stripe with undulating margins produced laterally on the margins of segment II and III and expanding on segment I to include all but the posterior half at sides; last three segments with grayish pollen; segment IV with the pollen confined to the basal half; hairs, except on segment IV, depressed; two basal segments without median marginals; segment III with a marginal row of about ten; segment IV with a marginal row of irregularly placed bristles and covered with erect bristle-like hairs in front; venter of abdomen without defined patches of matted hairs; genitalia with the outer forceps yellow; inner forceps brownish yellow (figs. 53 and 58).

Total length: 7 to 10 mm.

Lectotype designation: Bigot described *Chetolyga rufonotata* from two syntypes, all males from "Rocky Mountains". Coquillett (1897: 125) erroneously regarded this species as synonymous with *quadripustulata.* Sabrosky (1955: 1090) placed it as synonymous with *rufopicta* chiefly from Aldrich compared specimen with the type in British Museum (Bigot's coll.).

Recently Dr. D. M. Wood (Ottawa) called to my attention that the two syntypes of *rufonotata* are not conspecific. Dr. Crosskey (London) after the examination of Bigot's syntypes of *rufopicta* and *rufonotata* sent the following information:

"I have looked at Bigot's type-material of *rufopicta* and *rufonotata* and certainly agree with Dr. Wood that all the specimens are not all conspecific. However, there is a sligth complication, because I think that the two syntypes of *rufonotata* are probably not correctly associated.

1. *rufopicta.* There are two male syntypes, which I am sure are both the same species. The frons is extremely narrow, the gena extremely narrow, and there is no strong intercalary seta on the *ad* fringe of the tibia. The pollinosity of the face and parafacialia is grayish white or silvery (not at all yellow), and the head is *not* "subtriangular" in side view. The frons width in one specimen is 0.14 of the head-width (in units, total head-width 118, frons at vertex 17); in the other specimen the frons width is 0.15 of head-width (in units, total head-width 111, frons at vertex 17).

2. *rufonotata.* There are two male syntypes, in my view belonging to different species. The better specimen is definitely not the same as *rufopicta,* but the second (rather poor syntype) might just possibly be the same as *rufopicta.* From the condition of the specimens I think it would be best if you selected the better specimen as lectotype of *rufonotata* — in this case then there will be no doubt that *rufonotata* will be a completely different species from *rufopicta.* If we call the better specimen "A" and the poor specimen "B", then here is information on the two:

"A": frons 0.19 of the head width (in units, total head-width 114, frons at vertex 22). Gena rather wide, parafacials as wide

as antenna, head in side view with rather conspicuously "subtriangular" shape, pollinosity of face and parafacials brassy-yellow. (I am unsure about strong seta on *aa* surface of hind tibia, because all fringe is rubbed off on the one remaining hind tibia — but I cannot see a larger pore indicating a definite bristle).

"B": frons about 0.17 of head-width (in units, total head-width 99, frons at vertex 17). Gena narrow, facial profile generally like *rufopicta,* no intercalary seta in hind tibial fringe".

In view of this information supplied by Dr. Crosskey it would be best to treat "A" as LECTOTYPE of *rufonotata,* which would then be definitely distinct from *rufopicta.*

New distribution records. USA. *Arizona:* Huachaca Mts., 5000', April 10, 1967 (D. M. Wood, CNC); Ramsay Canyon, Huachaca Mts., April 10, 1967 (D. M. Wood, CNC); Sunnyside Canyon, Huachaca Mts., July 9, 1940 (R. H. Beamer, KU); Cave Creek, Cochise Co., Chiricauhua Mts., Aug. 27, 1965 (E. I. Schlinger, UCD); *Colorado:* Dawnson, June 30, 1931 (J. Nottingham, KU).

Winthemia rufopicta (Bigot)
(Figs. 17, 41, 64, 74)

Chetolyga rufopicta Bigot, 1889: 259 (Type locality, Rocky Mts.) (Type examined by Dr. Crosskey).
Exorista ciliata Townsend, 1891: 363 (Type locality: Illinois).
Winthemia rufopicta; Reinhard, 1931: 31.

Diagnosis. A medium-sized species overall length is 5 to 11 mm. The males are distinguished from those of all the other species by the greatly narrowed front and by having the hind tibia thickly and evenly ciliate, rarely with a longer bristle in the row. Both sexes have the cheeks almost linear in profile. This is the commonest species of the genus in North America.

Male. Front at vertex 0.13-0.18 of head width; facial length 0.73 of the frontal length; parafrontals densely grayish white pollinose, pollen fading out upwards becoming blackish towards the vertex; front sparsely clothed with rather short black hairs which become longer below and denser before vertex; parafacialia gray pollinose, sparsely clothed with fine black hairs on its entire length; frontal vitta brownish black; two pairs of verticals, the outer ones about the size of postocellars; ocellars well developed, directed forward, slightly divergent; frontals ten to twelve directed inward, extending to middle of antennal segment and stopping before triangle above, the uppermost two bristles smaller than the preceding ones; antennae black; base of third segment red inside; more than twice as long as second segment; arista reddish, slightly thickened on basal two-fifths; penultimate segment short; vibrissae approximated, on level with oral margin; palpi yellow, beset with numerous black hairs;

cheeks gray pollinose densely clothed with slender black hairs, almost linear in profile, beard white. (Fig. 5).

Thorax black, gray pollinose; mesonotum with thin pollen and marked with five black vittae; scutellum red, dusted with pollen; post-scutellum thinly pollinose; calypteres opaque, white, the margin tinged with yellow.

Legs slender; mid tibia black, with one stout anterodorsal bristle near middle; hind tibia thickly ciliate (fig. 74). Wings hyaline, venation as usual; third vein dorsally with one or two hairs at base; costal spine absent.

Abdomen widely red on sides, with a broad black median stripe which extends from the first segment to the base of anal segment; the latter, except for the basal black base, wholly reddish yellow; segments II and III gray pollinose on sides and pale yellow pollinose on middle and distal margin with a narrow velvet black median vitta; segment I dusted with gray pollen on the basal half, interrupted by a black reflection spot; first two segments without median marginals; segment III with a marginal row of about ten bristles; segment IV covered with erect hairs with an irregular apical row; hairs on intermediate segment depressed; venter without any defined patches of dense hairs; inner and outer forceps as in figs. 41 and 63.

Total length: 8 to 12 mm.

Female. Front at vertex 0.24-0.27 of the head width; facial length 0.68 of the frontal length; parafrontalia gray pollinose, moderately pilose outside the frontals; two, pairs of verticals and orbitals present; third antennal segment twice the length of second segment; thorax thickly gray pollinose, the dorsal stripe conspicuous; mid tibia with one stout anterodorsal bristle near middle; hind tibia less densely ciliated than in males, with or without a large bristle near middle.

Total length: 8 to 12 mm.

Recorded distribution. Manitoba to Vermont and Massachusetts, south to California and Florida, British Columbia.

New distribution records. USA. *Alabama:* Decatur, July 6, 1939 (J. D. Beamer, KU). *Arkansas:* Washington Co., May 1, 1965 (H. R. Dodge, UA); Arkansas Co., June 10, 1931 (UA); Lee Co., June 1931, ex *P. saucia* (UA); Polk Co., Aug. 8, 1928 (A. M. Jones, KU); Fayeteville, April 30, 1965 (H. R. Dodge, UA); Pearidge, April 23, 1965 (H. R. Dodge, UA); Ashley Co., July 5, 1955 (H. A. Turney, UA); Mississippi Co., Aug. 9, 1966 (UA); Prairie Co., May 1955 (L. D. Warren, UA); Coway Co., Aug. 17, 1963 (UA). *Arizona:* Phoenix, june 2, 1942 (E. S. Ross, CAS). *California:* 5 mi. N. E. Bartle, Siskiyou Co., June 20, 1954 (J. C. Downey, UCD); San Francisco, Presidio, Sept. 29, 1963 (P. E. Arnaud, PAC); Bardine Creek, Monterey Co., July 6, 1931 (McClay, UCD); Tanbark Flat, Los Angeles Co., Aug. 13, 1950 (K. G. Whitesell, UCD). *Colorado:* Boulder, July 12 (T. D. Cockerell, USNM). *Florida:* Suwannee Spr., Aug. 2-3, 1939 (R. H. Beamer, KU); Tampa, July 20, 1934 (J. D. Beamer, KU). *Georgia:* Spring Creek, Decatur Co., July

16-29, 1912 (CU); Billy's Id., Okefenokee Swamp, June 1912 (CU); De Witt, Mitchell Co., July 23, 1912 (M. D. Leonard, CU). *Illinois:* Caterville, Williamson Co., Sept. 10, 1956 (UCD); Carbondale, Jackson Co., Oct. 5, 1951 (C. T. Wearer, UCE); W. Frankfurt, Franklin Co., July 5, 1963 (R. M. Bohart, UCD); Urbana, Aug. 12, 1950 (G. P. Waldbauer, CNC); Champaign Co., (W. A. Snow, KU); Beecher, Aug. 4, 1926 (PAC); Chicago, July 1, 1935 (H. Dybas, FMNH). *Indiana:* Waterloo, July 14, 1924 (ISU); Tremont, June 24, 1936 (B. Krogh, ISU); Nevada, July 30, 1924 (ISU); Valparaiso, June 30, 1904 (D. Coob, CNC); Bervely Sprs., Porter Co., July 2, 1939 (H. Dybas, CU). *Iowa:* Dickinson, Aug. 6, 1952 (J. C. Schaffner, ISU); North Liberty, Spt. 15, 1942 (D. T. Jones, ISU); Frazier, Aug. 26, 1946 (J. V. McGuire, ISU); Pike's Peak St. Pk., Clayton Co., July 4, 1949 (J. Laffoon, PAC); Hancook Co., July 19, 1962 (J. S. Schaffner, PAC); Ames, March 18, 1952 (W. L. Downes, PAC); Hartford, July 22, 1924 (ISU); Johnson Co., Sept. 25, 1956 (UCB); Hardin Co., Aug. 1927, ex armyworm (ISU); 5 mi. S. E. Boone, Boone Co., July 1, 1960 (J. C. Schaffner, ISU); Oak Grove St. Park, Sioux Co., Aug. 18, 1953 (J. L. Laffoon, ISU); Shenandoah, July 13, 1952 (J. C. Browning, ISU); Clarion, June 7, 1924 (ISU); Gitche, Manitou St. Park, Lyon Co., Aug. 20, 1953 (J. L. Laffoon, ISU). *Idaho:* Clarion, July 26, 1924 (ISU); Waterloo, July 16, 1924 (ISU); Genesee, July 25, 1965 (B. A. Freeman, IU). *Kansas:* Douglas Co., July 7, 1920 (W. E. Hoffman, KU); Manhattan, June 16, 1958 (N. Marston, KSU); Pottawatomie Co., July 6, 1958 (KSU); Onaga, June 30, 1923 (KSU); Chanute, Aug. 29, 1939 (R. H. Beamer, KU); Leavenworth Co., June 1924 (E. P. Breakway, KU); Cowley Co., 1114', 1916 (R. H. Beamer, KU); Lawrence, Sept. 17, 1933 (H. W. Sandersen, CU); Dunes, 5 mi. N. Hutchinson, July 17, 1953 (H. E. Evans, CU); Riley Co., May 7, 1964 (L. R. Eptle, KSU). *Maryland:* Baltimore, July 22, 1950 (F. S. Snyder, PAC); 4 mi. S. W. Williamsburg, Sept. 8, 1952 (W. Downes, PAC); Cecil Co., July 11, 1948 (D. Shappiro, PAC); Cabin John, June 8 (G. E. Guinter, USNM). *Massachusetts:* Taunton, Aug. 9 (G. W. Pepper, MCZ); Melrose Highlands, Aug. 1917 (Gipsy Moth Lab., USNM). *Michigan:* Munroe, May 29, 1948 (G. Steykal, PAC); Cheboygan Co., June 18, 1935 (M. F. Miles, KU). *Minnesota:* Camp Carlos, Aug. 4, 1941 (McDonald, UM). *North Carolina:* Newland, Aug. 15, 1938 (bred, NCDA); Highlands, 3800', June 7, 1957 (J. V. Vockroth, CNC). *New Jersey:* Fort Dix, Wrightstown, July 24-30, 1962 (N. L. Light, PAC). *Oregon:* Greene Co., June 2, 1955 (Knull, OSU); Lucas Co., July 11 (R. C. Osburn, OSU); Put-in-Bay, Aug. 14 (R. C. Osburn, OSU); Fairfield Co., Aug. 15 (Knull, OSU); Wooster, June 10, (O. A. Peterson, OSU). *Pennsylvania:* Gettsburg, June 18, 1935 (L. L. Pechuman, CU); Philadelphia, July 14, (CU); Castle Rock, May 15, 1906 (USNM). *Louisiana:* Opelousas, March 1897 (FMNH); Rosslyn, May 2, 1907 (F. Knab, USNM); Batton Rouge, Aug. 3, 1916, ex *P. eridania* (USNM). *Missouri:* Kirkwood, Sept. 11, 1952 (W. Townes, PAC); Warrenton, Warren Co., July 8, 1962 (R. M. Bohart, UCD); Columbia, June 29, 1890 (KU); St. Louis, April 7, 1952 (W. Downes, UM). *Missouri:* Charleston, Oct. 15, 1913 (Vernon King, USNM). *Nevada:* Charleston Mts., Lees Cn., May 29, 1950 (H. E. Colt, UCD). *New York:* New York City, Aug. 10, 1961 (P. H. Arnaud, PAC); Hoversville, June 20, 1913

(M. D. Leonard, CU); Connecticut Hill, Trumbull Corner, 2095', June 1, 1936 (H. C. Hallock, CU); Ontario Beach, N. Fairhaven, July 5, 1922 (L. S. West, CU); Cedarville, June 19, 1921 (CU); Wading River, L. I., Aug. 8, 1923 (H. C. Huckett, CU); Irving, July 4, 1929 (M. C. van Duzee, CAS); Central Park, N. Y. City, Aug. 18, 1962 (P. Arnaud, Jr., PAC); Waterton, summer 1952 (A. Muka, reared from pupae of armyworm, CU); Ithaca, Aug. 15, 1949 (CU); Bedee Lake, Ithaca, June 22, 1930 (CU); Rochester jc., July 4, 1914 (M. D. Leonard, CU); Babylon, L. I., July 22, 1939 (F. S. Blanton, CU); Albany, July 23, 1896 (CU); Normans Hill, Alba Co., Aug. 25, 1923 (CU); Inwood, Hill Park, N. Y. City, June 9, 1962 (P. H. Arnaud, PAC); McLean, Tompk Co., July 21, 1921 (L. S. West, CU). *North Carolina:* Williard, May 11, 1936 (F. S. Blanton, CU); Raleigh, July 28, 1926 (C. S. Brimley, NCDA). *Ohio:* Amherst, July-Aug. 1958 (H. J. Reinhard, PAC); Cincinnati, June 9-16, 1905 (J. S. Hine, OSU); Summit Co., Feb. 6, 1937 (L. P. Lipovsky, KU); Miami Co., June 25, 1926 (D. G. Hall, USNM). *Oklahoma:* Davis, April 30, 1926 (W. J. Brown, CNC); Lakeside, Ottawa Co., June 3, 1920 (D. G. Hall, USNM). *Tennessee:* Clarksville, ex *P. saucia,* July 1, 1939 (R. H. Beamer, KU); Nashville, ex *C. unipuncta,* (W. H. Larrimer, USNM). *Texas:* Austin, April 4, 1949 (F. A. Cowan, PAC); College Station, June 21, 1928 (H. J. Reinhard, CU); Dierk's Ford, July 4, 1947 (S. Camras, PAC); Camp Bullis, June 24, 1942 (E. S. Ross, CAS); Huntsville, June 18, 1953 (F. A. Cowan, PAC). *Utah:* Farmington, Aug. 1946 (D. S. Bohart, UCD); Newton, Aug. 11, 1954 (W. R. Walker, UCD); Formingtown, June 1946 (G. S. Bohart, CAS). *Virginia:* Stony Creek, Giler Co., 2000', May 26, 1962 (J. G. Chillcott, CNC); Dixie Ldg., July 8 (KU); Falls Church, Sept. 6 (N. Banks, MCZ); Great Falls, Fairfax Co., Sept. 23 (P. H. Arnaud, Jr., PAC). *Washington, D. C.:* Rock Creek Park, Oct. 13, 1956 (P. H. Arnaud, Jr., PAC); Washington, D. C. (W. R. Walton, USNM). *Washington:* Pullman, Aug. 7, 1965 (Roger D. Akre, WSU). *Wisconsin:* Dane Co., Sept. 14, 1950, (no coll. data, PAC); Madison, May 10, 1949 (student class, PAC); Waupaca, Sept. 16, 1920 (L. G. Genter, USNM). CANADA. *Alberta:* Banff, June 18, 1922 (C. B. D. Garrett, CNC); Lancaster Park, Aug. 28, 1963 (J. R. Vockroth, CNC). *British Columbia:* Likely, July 9, 1938 (J. K. Jacob, UK); Trinity Valley, July 25, 1937 (K. Graham, CNC); Mission City, July 27, 1953 (C. J. Spencer, CNC). *Quebec:* Gatineau, Lucksville, ex *Grapholitha bethunei,* July 9, 1953 (no coll. data, CNC); Norway Bya, July 29, 1938 (G. E. Shewell, CNC); Abbotaford, May 29, 1933 (C. R. Bourgault, CNC); Montreal, Sept. 4 (O. J. Ouellet, PAC); mi. 13, Route 58, La Verendrye, Aug. 18, 1965 (D. M. Wood, CNC). *Manitoba:* Treebank, Aug. 17, 1958 (J. G. Chillcott, CNC). *Ontario:* Jordan, June 6, 1915 (W. A. Ross, CNC); Pt. Pelee, May 28, 1925 (G. S. Walley, CNC); Ottawa, Aug. 1957 (J. C. Guppy, CNC); Niagara Glen, June 8, 1926 (G. S. Walley, CNC); Toronto, Aug. 11, 1914 (W. A. Ross, CNC); Jordan, June 13, 1925 (P. W. Hall, CNC); Chatthan, July 4, 1928 (A. B. Baird, CNC); Vineland S. Station, Aug. 6, 1931 (W. L. Putman, CNC). *New Brunswick:* St. Andrews, July 3, 1957 (G. E. Shewell, CNC). *Ontario:* Ottawa, May 5, 1946 (A. Brooks, CNC); Thornhill, Sept. 5, 1964 (J. R. Vockroth, CNC); Elfrida, July 21, 1955 (L. A. Kelton, CNC); Simcoe, June 26, 1939 (G.

E. Shewell, CNC); Pr. Edw. Co., March 19, ex armyworm (Brinley, CNC); Jordan, Aug. 11, 1914 (W. A. Ross, CNC); Rondeau Park, Sept. 7, 1954 (G. S. Walley).

Winthemia sabroskyi, sp. n.

Diagnosis. This species can be distinguished from all other *Winthemia* by the golden pollinose parafrontalia, dorsum of thorax and abdomen. The males are unknown.

Female. Front 0.32 of the head width, rather prominent below, the sides thickly covered with golden yellow pollen and bearing scattered fine hairs; facial length 0.57 of the frontal length; median stripes brownish, not much narrowed before triangle; ocellars and orbitals present; frontals eight to ten, lowermost bristle below middle of second antennal segment; uppermost bristle reclinate; sides of face silvery pollinose, with sparse hairs along inner margin; antennae black, third segment twice the length of second, arista red brown, longer than antennae, thickened on basal third and slender beyond cheeks, in profile one-eigth the eye height, thickly gray pollinose; palpi yellow; back of head tinged with golden pollen above.

Thorax black in ground color, thickly dusted with golden pollen; mesonotum with four distinct narrow dark stripes, interrupted at suture; scutellum yellow, densely dusted with golden pollen; calypteres white, opaque.

Legs black; mid tibia with a large anterodorsal bristle beyond middle; hind tibia with a row of uneven anterodorsal bristles; tarsal segment ordinary; claws and pulvilli small.

Abdomen slender, broadly reddish, last three segments wholly golden pollinose; abdominal segment I without median marginals; segment II with one large stout pair; segment III with a marginal row of about eight; segment IV with two discals and a marginal row on distal half; hairs on segment II and III depressed.

Total length: 8 to 9 mm.

Male. Unknown.

This species is named in honor of Dr. Curtis W. Sabrosky of the Systematic Entomology Laboratory, USDA, who suggested this study to me and generously has given me help on this and another project now in progress.

Holotype female. Blood Mts., Georgia, July 30, 1947 (P. W. Fattig, USNM). Paratype 1 female, Southampton, New York, L. I., Aug. 12, 1956 (L. Wilcox, USNM).

Winthemia sinuata Reinhard

(Figs. 20, 52, 63, 86)

Winthemia sinuata Reinhard, 1931: 25 (Type locality, Plummers Island, Md.). (USNM no. 43342).

Diagnosis. Small species, overall length 7 to 9 mm. This species is close to *occidentis* but distinguished from that species by the moderately broad front at vertex, yellow to golden pollinose; parafacialia wholly whitish to pale yellow, clothed with few shart hairs.

Male. Front at vertex 0.22 to 0.27 of the head width, widening rapidly beyond middle to bases of antennae; facial length 0.82 of the frontal length; parafrontalia covered with golden pollen becoming blackish and subshining at the vertex, with moderate hairs outside the frontals; median stripe dark brown; verticals with the inner pair not well developed; ocellars of ordinary size directed forward, slightly divergent; frontals about ten to twelve starting from the apex of second antennal segment and stopping before ocellar triangle, uppermost bristle small, decussate, placed well before the ocellar triangle; parafacialia gray pollinose, the sides concolorous below and golden from the lowermost frontals upward, sparsely clothed with rather coarse black hairs except along the eye margins; antennae black, third segment tinged with red near base on inner side, more than twice the length of second, arista thickned on proximal third; cheeks darkened, thinly gray pollinose, covered with fine black and in profile about one-eighth of the eye height (fig. 20); palpi yellow, darkened on base.

Thorax black, thinly dusted with gray pollen; humeri and notopleura gray pollinose; mesonotum subshining above, with five shining black stripes; scutellum reddish beyond basal third, faintly pruinose; calypteres opaque, yellow at the margin.

Legs black; mid tibia with one anterodorsal bristle near middle; hind tibia evenly ciliated (fig. 86); claws and pulvilli elongate.

Abdomen black in groud color, thinly dusted with gray pollen; intermediate segments with a black median spot; segment III shining on apical third, the pollen on basal margins interrupted by a black changeable stripe; basal segment without median marginals; segment II usually without median marginals; segment III with a marginal row of about ten; segment depressed; venter without defined patches of dense hairs; genital segment reddish yellow, reduced and retractile, inner and outer forceps as in fig. 63.

Total length: 6 to 10 mm.

Female. Front at vertex 0.27 to 0.29 of head width; facial length 0.74 of the frontal length; parafrontalia gray to pale gray, yellow pollinose, the pollen becoming thinner toward the apex, covered with fine short hairs outside the frontals; orbitals and verticals present; ocellars strongly divergent; antennae dark red; third segment enlarged, about twice the length of second; parafacialia gray pollinose, with few scattered hairs on middle; cheeks gray pollinose, moderately covered with thin pale hairs; palpi yellow, swollen towards the tips. Mid tibia with a long anterodorsal bristle near middle; hind tibia with a well spaced row of uneven anterodorsal bristles, with a long bristle near middle. Abdomen with a pair of erect median marginals.

Total length: 6 to 10 mm.

Recorded distribution. USA (N. Dakota to Maine, south to Georgia).

New distribution records. *Alabama:* Marion Jct., June 16, 1930 (R. H. Beamer, KU). *Arkansas:* Washington Co., Sept. 2, 1939 (UA); Mississippi Co., Oct. 2, 1952 (UA); Osceola, Aug. 1957 (KU); Crawford Co., June 7, 1967 (KU); Conway Co., June 27, 1960 (Malaise trap, KU). *Florida:* Ft. Mead, Aug. 13, 1930 (J. Nottingham, KU). *Illinois:* Bluffs, Scott Co., Aug. 29, 1907 (A. T. McClay, UCD); Beecher, July 4, 1936 (B. Krogh, FMNH). *Iowa:* Ames, May 16, 1952 (W. Downes, PAC); Alleman, Polk Co., Aug. 27, 1952 (J. L. Laffoon, ISU); Gitche Maniton State Park, Lyon Co., Aug. 20, 1933 (J. L. Laffoon, ISU); Nevada, Sept. 17, 1966 (R. R. Pinke, ISU); Stony Lake, sec. 29, Excelsior Twp., Dickson Co., July 21, 1965 (ISU); Lodges State Park, Boone Co., July 27, 1956 (J. L. Laffoon, ISU); 3 mi. S. E. Boone, July 4, 1953 (J. L. Laffoon, ISU); Sioux City, June 27, 1953 (J. L. Laffoon, ISU); Des Moines, Sept. 16, 1946 (J. V. McGuire, ISU). *Kansas:* Douglas Co., Sept. 30, 1933 (Hobart M. Smith, CU); Manhattan, May 11, 1959 (N. Marston, KSU); Riley Co., Oct. 2, 1963 (N. Marston, KSU); Leavenworth Co., June 25, 1924 (R. H. Beamer, KU); Crawford Co., 993 ft, 1915 (R. H. Beamer, KU); Lawrence, Douglas Co., Sept. 21, 1951 (H. A. Rupert, KU). *Maryland:* Chevy Chase, Aug. 14 (C. H. T. Townsend, USNM); Beltville, July 4, 1916 (W. L. McAtee, USNM); Hancock, Aug. 1930 (UCB); Cabin John, June 1929 (F. R. Cole, UCB). *Massachusetts:* Wellesley, Spt. 7, 1904 (A. P. Morse, MCZ); Lexington, June 27 (MCZ); Melrose Highlands, June 18, 1907 (H. E. Smith, USNM); New Bedford (MCZ). *Michigan:* Prosque Is. Co., July 26, 1947 (N. Dreisbach, PAC); E. Lansing, June 26, 1949 (Cole, UCD); Livingston Co., July 11, 1947 (R. R. Dreisbach, PAC). *Minnesota:* Norman Co., July 24, 1923 (A. A. Nichol, UM); Ramsay Co., June 8, 1940 (Jellinson, UM). *New Jersey:* Palisades, May 20, 1921 (J. Bequaert, MCZ). *New York:* Trenton Falls, June 5-8, 1921 (Leonard & Forbes, CU); Oswego, Aug. 28, 1921 (L. S. West, CU); McLean, Tompkin Co., Sept. 13, 1921 (L. S. West, CU); Hamburg, June 6, 1909 (M. C. van Duzee, CAS); East Aurora, July 17, 1910 (M. C. van Duzee, CAS); Lake Charlotee, July 26, 1920 (CU); Slaterville, Aug. 19, 1921 (L. S. West, CU); Fall Creek, Ithaca, June 20, 1926 (CU); West Hills, L. I., June 1, 1935 (Blanton & Bordes, CU). *North Carolina:* Highlands, 3850', May 31, 1957 (J. R. Vockroth, CNC); Highlands, Macon Co., 3850', July 7, 1927 (CNC); Raleigh, June 18, 1921 (C. S. Brimley, NCDA). *North Dakota:* Fargo, June 13, 1918 (J. M. Aldrich, USNM). *Ohio:* Summit Co., July 2, 1936 (L. J. Lipovsky, KU); Toledo, June 15, 1926 (D. G. Hall, USNM); Amherst, July 1933 (H. J. Reinhard, CU); Columbus, Apr. 8, 1926 (H. W. Allee, USNM); 4 mi. W. Bowling Green Wood Co., Aug. 28, 1956 (J. L. Laffoon, ISU). *Pennsylvania:* Swarthmore, Aug. 25, 1907 (UCB); Delaware Co., July 7, 1913 (C. W. Johnson, MCZ). *Virginia:* Chain Bridge, May 28 (N. Banks, MCZ); Brush Mt. 2800', Blacksburg, May 27, 1962 (J. G. Chillcott, CNC); New Church, June 15, (L. D. Anderson, UCR). *Wisconsin:* Madison, Aug. 28, 1919 (L. G. Gentner, USNM); Polk Co., July (J. M. Aldrich, USNM); Casco, June 25, 1930 (R. Buschnell, PAC). CANADA. *British Columbia:* Lac du Bois, Kamloops, July 21, 1946 (G. J. Spencer, CNC); Vancouver, Jan. 1930

(G. J. Spencer, CNC). *Manitoba:* Aweme, July 7, 1927 (N. Criddle, CNC); Ninette, June 1-2, 1958 (J. E. McAlpine, CNC); 5 mi. S. W. Shilo, June 16, 1958 (C. D. Miller, CNC). *Nova Scotia:* White Pt. Beach, Queens Co., Aug. 22, 1936 (J. McDonnough, CNC); Baddeck, June 29, 1936 (J. McDonnough, CNC). *Ontario:* Norway Pt., Lake of Bays, July 30, 1919 (J. F. McDonnough, CNC); March Twp., Carleton Co., June 16, 1965 (D. M. Wood, CNC); Kircadine, June 13-14, 1961 (Kelton & Brumpton, CNC); Ottawa, June 16, 1965 (J. F. McAlpine, CNC); Marmora, Aug. 19, 1952 (J. R. Vockroth, CNC); Blackburn, July 6, 1955 (J. F. McAlpine, CNC). *Quebec:* Montreal, June 11, 1949 (C. W. Johnson, MCZ). *Saskatchewan:* Saskatoon, July 22, 1949 (A. R. Brooks, CNC).

Winthemia texana Reinhard

(Figs. 27, 49, 70, 82)

Winthemia texana Reinhard, 1931: 19 (Type locality, Menard, Texas) (USNM no. 43580).

Diagnosis. Medium-sized species, overal length 8 to 9 mm. This species is closely related to *quadripustulata,* differing mainly in the shape of outer forceps.

Male. Front at vertex 0.20 of the head width; facial length 0.63 of the frontal length; parafrontalia dark tinged with yellow, bearing sparse short hairs; frontal vitta dark brown; frontals ten to twelve directed inward and extending below almost to distal end of second antennal segment; uppermost bristle weak, placed considerably before triangle; antennae black, the third segment 3.5 times longer than the second; arista shorther than antennae; parafacialia cinereous pollinose, beset with long black hairs; palpi yellow, infuscated at the base, slender with numerous black hairs below; cheeks gray pollinose covered with fine hairs about one-seventh the eye heigth; occiput densely pale pilose (fig. 27).

Thorax black, dusted with gray pollen; subshining, marked with five inconspicuous black vittae when observed from behind; scutellum red, lightly dusted with gray pollen; calypteres opaque, white.

Legs black; mid tibia with a long and stout anterodorsal bristle near middle and one or two smaller ones just above; hind tibia evenly ciliate, the bristles slender and elongate (fig. 82).

Abdomen widely reddish, with a median broad black dorsal stripe; last three segments largely covered with changeable grayish pollen; segment II with or without a pair of median marginals; segment III with a row of about nine; segment IV entirely covered with erect bristle-like hairs and an irregular row of weak bristles near apex; hairs of intermediate segments depressed; venter without defined patches of dense hairs; genital segments brown; inner and outer forceps as in figs. 49 and 70.

Total length: 8 to 10 mm.

Recorded distribution. USA (Texas).

New distribution records. *Arizona:* S. W. Res. Station, 5 mi. W. Portal, Cochise Co., July 1, 1965 (M. E. Irwin, UCR); Sunnyside Canyon, Huachaca Mts., July 9, 1940 (R. H. Beamer, CNC); 4 mi. N. Paradise, Cochise Co., Aug. 5, 1967 (Fred G. Andrews, UCR). *Colorado:* Eldora, July 12, 1969 (KU); Pingee Park, Aug. 6, 1949 (R. H. Beamer, CNC). *New Mexico:* Lake Burford, June 2, 1918 (A. Wetmore, USNM); Sandia Mts., July 17, 1952 (R. H. & L. D. Beamer, CNC). *Texas:* Menard, May 5, 1930 (H. E. Parish, CNC); Kerville, April 2, 1959 (W. R. E. Mason, CNC); Fredericksburg, April 18, 1969 (J. E. McAlpine, CNC); Austin, April 10, 1931 (CNC). MEXICO. *Hidalgo:* 7 mi., Jalaca, July 27, 1954, 5000' (UK Exp., KU).

Winthemia vesiculata (Townsend)

Trisisyropa vesiculata Townsend, 1916a: 28 (Type locality, Sebago Lake, Me.) (USNM no. 19600).
Winthemia vesiculata; Reinhard, 1931: 20.

Diagnosis. Small species, abdomen slender; parafrontalia densely yellow pollinose; apex of scutellum and abdomen reddish; second and third abdominal segments with whitish pollen on basal third to half, the hind margins shining black.

Female. Front at vertex 0.30 of the head width; facial length 0.32 of the frontal length; parafrontalia densely yellow pollinose, with few long bristles; frontals about eight to nine, the upper two reclinate; parafacialia silvery pollinose with a few hairs at middle, none along border of eye; antennae black; third segment broader than one parafacialia and about twice the length of second segment; palpi yellow infuscated at bases; ocellars strong and widely proclinate; orbitals two pairs, proclinate; cheeks in profile one-eight eye height.

Thorax narrower than usual; mesonotum shining black, thinly dusted with pale gray pollen; thoracic stripes indistinct; scutellum sprinkled with grayish or white pollen; calypteres white, inner margins tinged with yellow.

Legs black, hind tibia with a row of uneven anterodorsal bristles; mid tibia with one large and two small anterodorsal bristles near middle; claws and pulvilli short.

Abdomen slender, shining black, with the apex reddish; intermediate segments polished on distal half; venter black; segment I without median marginals; segment II with a large pair; segment III with a marginal row of about ten; segment IV with an irregular discal and marginal row.

Total length: 9 mm.

Male. Unknown.

Recorded distribution. USA (Maine).

New distribution records. USA. *New Hampshire:* Franconia, July 27, 1915 (C. H. T. Townsend, USNM). *Massachusetts:* Melrose Highlands, July 3, 1911 (MCZ); CANADA. *Quebec:* Obigoon Post, ex Sphingidae (F. S. I., CNC).

UNRECOGNIZED SPECIES OF *WINTHEMIA*

The following species were not recognizable from the original descriptions. All types except those of Walker and Bigot are apparently lost according to Reinhard (1931).

Exorista leucaniae Kirkpatrick, 1861, type locality, Ohio, reared from *Pseudaletia unipuncta* (Lep. Noctuidae) and *Exorista ostensackenii* Kirkpatrick, 1861, type locality, Ohio (the types of both species are considered lost).

Despite the loss of types the identity of *E. leucaniae* and *E. ostensackenii* appears to me to be virtually certain since reference is made to *P. unipuncta* (as *Leucania*), the common and widespread host of *W. rufopicta.* The available evidence from host association and from geographical considerations suggests strongly that Kirkpatrick had before him the common species, *W. rufopicta,* whose distribution is centered in the eastern United States. However, since it is impossible to check this evidence, I prefer to consider both species as unrecognized.

Senometopia militaris Walsh, 1861, type locality, Illinois, reared from "armyworm". The type is apparently lost and the original description is too inadequate to allow recognition of this species. According to Townsend, (1936), there are in the USNM collection specimens determined many years ago as *militaris* Walsh by both Riley and Pergande, who were both quite familiar with Walsh's species. These are *W. rufopicta.*

Exorista infesta Williston *in* Forbes, 1865, type locality, Illinois reared from *Laphygma frugiperda;* unrecognized for the same reason as above.

REVIEW OF THE LITERATURE OF HOSTS OF NEARCTIC SPECIES OF *WINTHEMIA*

The literature of agricultural and forest entomology in the United States and Canada contains many records of the hosts of *Winthemia* species occurring in the Neartic region. The present survey will show that these records were often based on misidentification of the tachinid parasites. The attempt of the present review is to bring up to date the available records in the literature with an indication of their validity. That the hosts themselves were correctely identified is assumed since many of the hosts are well-known and widespread lepidopterous pests.

The majority of the species are known as parasitoid of (almost) glabrous lepidopterous larvae but some of the reported rearings of species in the genus are from coleopterous larvae (Parker, 1916). Allen

(1925) reported that *W. quadripustulata* (a misidentification for *W. rufopicta*) parasitized 19 species of lepidopterous larvae in eight families, but species of Noctuidae were the favored host.

Schaffner & Griswold (1934) listed 26 species of lepidopterous larvae in seven families as hosts for *W. datanae* which they divided into four other varieties apparently on the basis of host preferences, although they presented no other reasons for their subdivision.

The records in the literature are presented below and have been classified into five categories according to the following criteria:

(a) Correct. Parasite material on which the record was made has been studied and found to be correct; or the parasite was identified by an authority on tachinids; or the record was confirmed from a correctly assigned host association in a collection.

(b) Probably valid. Parasite material on which the record was based not personally examined but the parasite identification almost certainly correct.

(c) Very suspect. Parasite material on which the record was based not seen but the parasite almost certainly misidentified (judging mainly from the present knowledge of geografical distribution and from data of correctly assigned host associations).

(d) Erroneous. Parasite material on which the record was based examined by the author and found misidentification, or the parasite was not seen but is recorded out of the geographical are of distribution.

(e) Not verified. No material or information was available to check the validity of the record.

HOST RECORDS OF NEARCTIC *WINTHEMIA*

Winthemia borealis
Scoliopteryx libathrix (L.), (Noctuidae); Canada, Ontario, Raizenne, 1952 (e).

Winthemia cecropia
Hyalophora cecropia (L.), (Saturnidae); USA, Gainesville, Fla., Kensington, Md., Sabrosky, 1948 (e).
Eacles imperialis, (Saturnidae); USA, Florida, Patton, 1957 (a).

Winthemia datanae
Acronicta impleta Walk., (Noctuidae); NE USA, Schaffner & Griswold, 1934 (e).
Anisota senatoria (Smith), (Citheronidae); USA, South Windsor, Hitchcock, 1961 (b).
Ceratomia catalpae (Bdv.), (Sphingidae); NE USA, Schaffner & Griswold, 1934 (e).
Datana sp. (Notodontidae); USA, New York, Townsend, 1892 (e).
Datana angusi G. & R., (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Datana integerrima G. & R., (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Datana ministra Dru., (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Datana ministra Dru., (Notodontidae); USA, Maine, Proctor, 1946 (b).
Datana ministra Dru., (Notodontidae); USA, North Carolina, Blanton, 1952 (b).

Datana ministra Dru., (Notodontidae); USA, Florida, Patton, 1958 (a).
Datana sp., (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Hyalophora walkeri advena Pack, (Saturnidae); NE USA, Schaffner & Griswold, 1934 (e).
Isia isabella, (Arctiidae); NE USA, Schaffner & Griswold, 1934 (e).
Pheosia rimosa, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Pheosia rimosa, (Notodontidae); Canada, Ontario, Raizenne, 1952 (b).
Pseudaletia unipuncta, (Noctuidae); Canada, Boyes & Wilkes, 1953 (d).

Winthemia datanae (var. A of Schaffner & Griswold)
Catocala sp., (Noctuidae); NE USA, Schaffner & Griswold, 1934 (e).
Ianassa lignicolor, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Schizura concinna, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Schizura badia, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Schizura leptinoides, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Schizura unicornis, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).

Winthemia datanae (var. B of Schaffner & Griswold)
Anisota senatoria, (Citheronidae); NE USA, Schaffner & Griswold, 1934 (e).
Anisota rubicunda, (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).
Cressonia juglandis, (Sphingidae); NE USA, Schaffner & Griswold, 1934 (e).
Hyloicus drupiferarum, (Sphingidae); NE USA, Schaffner & Griswold, 1934 (e).
Hyloicus gordius, (Sphingidae); NE USA, Schaffner & Griswold, 1934 (e).
Paonias excaecata, (Sphingidae); NE USA, Schffner & Griswold, 1934 (e).

Winthemia datanae (var. C of Schaffner & Griswold)
Diacrisia virginica (Fab.), (Arctiidae); NE USA, Schaffner & Griswold, 1934 (e).
Estigmene acrea, (Arctiidae); NE USA, Schaffner & Griswold, 1934 (e).
Euchaetias egle (Dru.), (Arctiidae); NE USA, Schaffner & Griswold, 1934 (e).
Hemerocampa leucostigma, (Liparidae); NE USA, Schaffner & Griswold, 1934 (e).
Unidentified Arctiidae; NE USA, Schaffner & Griswold, 1934 (e).

Winthemia deilephilae
Celerio lineata (Fab.), (Sphingidae); USA, Missouri, Osten-Sacken, 1887 (e).

Winthemia intermedia
Autographa precations (Gn.), (Noctuidae); USA, Georgia, Fattig, 1949 (e).

Winthemia occidentis
Lambdina fiscellaria somniaria, (Geometridae); Canada, British Columbia, Boyes & Wilkes, 1953 (a).
Lambdina fiscellaria lugubrosa, (Geometridae); Canada, British Columbia, Reinhard, 1931 (a).

Winthemia quadripustulata

There are innumerable host records in the entomological literature under this name. In almost all the cases this species was misidentified as *W. rufopicta, datanae, sinuata* and others. Since this species has been extremely liable to misidentification and because of the impracticality of verifying these records, no reference will be given.

Winthemia rufopicta
Manestra configurata Wlk., (Noctuidae); Canada, British Columbia, Hanford, 1962 (e).
Peridroma saucia (Hubn.), (Noctuidae); USA, Indiana, Montgomery, 1933 (e).
Peridroma ornithogalli Guenee, (Noctuidae); USA, Oklahoma, Botrell, 1969 (a).
Pseudaletia unipuncta How., (Noctuidae); Canada, Ontario, Guppy, 1967.
Pseudaletia unipuncta How., (Noctuidae); Canada, New Brunswick; Pond, 1960 (a).
Pseudaletia unipuncta How., (Noctuidae); USA, Louisiana; Burrel, 1967 (a).
"tent caterpillar", (Lasiocampidae); Canada, Quebec; Le Roux, 1961 (c).

Winthemia sinuata
Calpe canadensis Beth. (Noctuidae); NE USA, Schaffner & Griswold, 1934 (e).
Cingilia catenaria (Dru.), (Geometridae); NE USA, Schaffner & Griswold, 1934 (e).

Erannis tiliaria (Har.), (Geometridae); NE USA, Schaffner & Griswold, 1934 (e).
Hamadryas antiopa, (Nymphalidae); NE USA, Schaffner & Griswold, 1934 (e).
Plathypena scabra (Fab.), (Noctuidae), NE USA, Schaffner & Griswold, 1934 (e).
Plathypena scabra (Fab.), (Noctuidae); USA, Delaware, Whiteside, et al., 1967 (a).

Winthemia sp.
Catocala antinympha (Hbn.), (Noctuidae); NE USA, Schaffner & Griswold, 1934 (e).
Catocala minuta Edw., (Noctuidae); NE USA, Schaffner & Griswold, 1934 (e).
Hemileuca maia (Dru.), (Saturnidae); NE USA, Schaffner & Griswold, 1934 (e).
Hyalophora cecropia (L.), (Saturnidae); NE USA, Schaffner & Griswold, 1934 (e).
Lambdina fiscellaria Gn., (Geometridae); NE USA, Schaffner & Griswold, 1934 (e).
Symmerista albifrons (Smith), (Notodontidae); NE USA, Schaffner & Griswold, 1934 (e).

SYNOPSIS OF THE NEARCTIC SPECIES OF *WINTHEMIA* AND THEIR KNOWN HOST

The following list is based only upon reared material examined and identified during the present revision. Many of the hosts are well-known and widespread lepidopterous pests and the correctness of the host identification is assumed in the absence of any possibility of checking them. All Nearctic species of *Winthemia* are listed, but no host are yet known for some species. The known hosts are all in the Lepidoptera, and the nomenclature is that which is valid; the localities of reared specimens are given.

Winthemia abdominalis
(unknown)

Winthemia andersoni, sp. n.
(unknown)

Winthemia argentifrons, sp. n.
(unknown)

Winthemia aurifrons, sp. n.
Smerinthus cerysyi Kby., (Sphingidae); California.
Paonias myops A. & S., (Sphingidae); Canada, British Columbia.

Winthemia borealis
Unidentified Noctuidae; Canada, Ottawa.

Winthemia cecropia
Pheosia rimosa, (Notodontidae); Canada, Ontario.
Hyalophora cecropia, (Saturnidae); Canada, Ontario; USA, Wisconsin, Iowa.
Celerio gallii intermedia, (Saturnidae); Canada, Alberta.

Winthemia citheroniae
Citheronia regalis, (Citheronidae); USA, Illinois.
Semiothisa granitata Gn., (Geometridae); Canada, British Columbia.
Nepytia phantasmaria Str., (Geometridae); Canada, British Columbia.
Unidentified Geometridae; Canada, Manitoba; USA, Utah.
Xylomyges sp., (Noctuidae); Canada, British Columbia.
Actias luna L., (Saturnidae); Canada, Ontario.
Proserpinus flavofasciatus Wlk., (Sphingidae); Canada, British Columbia, Alberta.

Winthemia okefenokeensis
(unknown)

Winthemia polita
(unknown)

Winthemia quadripustulata
northern complex
(unknown)
northeastern complex
Dargida procincta, (Noctuidae); California.
Prodenia praecifica, (Noctuidae); California.
middle western complex
(unknown)

Winthemia reinhardi, sp. n.
(unknown)

Winthemia rufopicta
Pseudaletia unipuncta (Haw.), (Noctuidae) "armyworm"; Iowa, Virginia, District of Columbia, Maryland, Tennessee, Wisconsin, New York, Utah. Canada, Ontario.
Peridroma saucia (Hon.), (Noctuidae), "variegated cutworm"; Kansas, Arkansas.
Prodenia ornithogalli Guenné, (Noctuidae); Kansas.

Winthemia datanae
Diacrisia virginica, (Arctiidae).
Datana ministra, (Citheronidae); Canada, Ontario.
Anisota rubicunda, (Citheronidae); Canada, Ontario.
Schizura concinna, (Notodontidae); Canada, Ontario.
Pheosia rimosa, (Notodontidae); Canada, Ontario.
Celerio lineata, (Saturnidae); Canada, British Columbia.
Pholux sp., (Sphingidae); Canada, Ontario.
Sphinx drupiferarum, (Sphingidae); Canada, Ontario.

Winthemia deilephilae
Phlegethontius sp., (Sphingidae); Kansas.

Winthemia duplicata
(unknown)

Winthemia floridensis
(unknown)

Winthemia imitator
(unknown)

Winthemia intermedia
(unknown)

Winthemia intonsa
(unknown)

Winthemia montana
(unknown)

Winthemia occidentis
Lambdina fiscellaria lugubrosa (Hulst.), (Geometridae). Western hemlock looper; Canada, British Columbia.
Lambdina fiscellaria somniaria (Hlst.), (Geometridae); British Columbia, Utah.
Lambdina praecifica Grote, (Noctuidae); Idaho.
Prodenia eridania (Crammer), (Noctuidae); Louisiana.

Winthemia sabroskyi, sp. n.
(unknown)

Winthemia sinuata
Plathypena scabra (Fab.), (Noctuidae), "Green clover worm"; Arkansas.

Winthemia texana
(unknown)

Winthemia vesiculata
(unknown)

Winthemia rufonotata
(unknown)

DISCUSSION ON THE HOST-PARASITE HABITS THE NEARCTIC SPECIES OF *WINTHEMIA*

An analysis of the host-parasite list of *Winthemia* species presented here obviates the need to initiate fundamental studies on the life-history and annual development of this group, an area of research sadly neglected. Such research will provide information on the breeding habits of these entities in nature and allow taxonomists to define these biological units with certainty. In addition, these studies will provide the ethologists with information vital to research on pest management by means of integrated control programs using these biological agents.

If the data provided in the list for each species of parasitoid is correlated with the coded description of the larval habits created by the insect hosts strongly support Townes' (1962) statement.

"Probably the most important single factor determining host selection after those factors that limit the parasite to a very broad phyletic line of hosts, are the ecological factors. There are first the general ecological that limit parasites to host within its geographical range, ecological habitat, and seasonal distribution. These are rather obvious, but it is commonly overlooked that the ovipositing female of each species of parasite searches for hosts of certain characteristics in a restricted ecological niche, and that a parasite may attack a variety of hosts which happen to meet its peculiar ecological requirements: the occurrence of a narrow host range does not necessarily mean that the parasite selects only members of a certain narrow phyletic group. In many cases, possibly the majority, it means only that a single phyletic group occupies the ecological niches exploited by the parasite".

This quotation might be interpreted as a warning to many parasitologists who attempt to classify host by means of parasitological data, an archaic technique supported by Mackauer (1965). This procedure is the cause of much of the confusion existing in the classification of parasitoids in general.

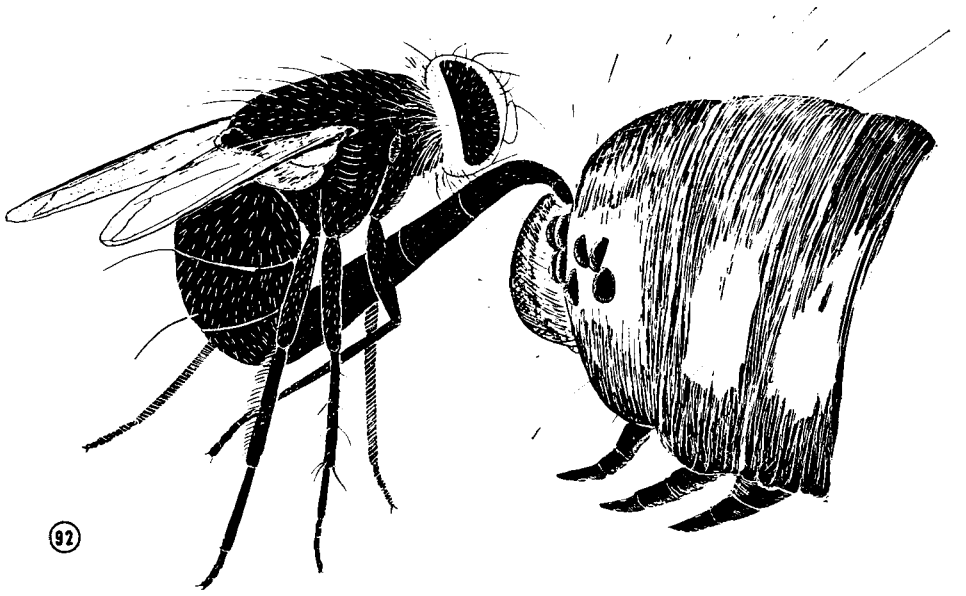
In the Tachinidae detailed information on habitat selection is lacking but there are some data which support the view that among this family some parasitoids rather than being host specific are more niche specific. Emden (1949) discussed the anomalous behavior in regard to host-selection of *Paratheresia claripalpis*. This species placed in the tribe Theresiini (Dexiinae) belongs to a group of Tachinidae which are regularly parasitic in larvae of Coleoptera as far as their hosts are known. *Paratheresia claripalpis* is recorded as parasite of *Diatraea saccharalis* (Lepidoptera, Pyralidae) and other borers in sugar cane, corn and wild grasses in tropical South America. According to Myers (1935: 228-231),

P. claripalpis was found parasitizing *Diatraea* in wild grass, several of which frequently harbour curculionid larvae in the same stalk as the *Diatraea.* This would lead the conclusion that the original host of this species has not been a lepidopterous but a coleopterous larva and has secundarialy adapted itself to the sugarcane habitat shared with *Diatraea.*

Another well-known example is found in *Compsilura concinnata* a palearctic species introduced into the United States with an estimated list of 200 hosts among several families of Lepidoptera also including few saw-flies (Hymenoptera, Tenthredinoidea).

A suggestion that host selection in these cases is atributable to a parasitophylletic relation would be unaceptable because the insect host inhabiting these niches frequently belongs in the case given here to different families or even to different insect orders. It is interesting to note that the insect hosts of different orders, with which these parasitoids are associated create very similar niches.

Picard & Robaud (1914) were the first to stress the fact that habitat selection might be even more important for the survival of the parasite than the host itself. Franklin & Holdway (1966) working with the tachinid *Lydella grisescens,* a cornborer parasite found that the most important step in host selection was the attraction to a particular corn hybrid. Allen (1925) reported that *Heliothis zea,* the corn earworm is heavily parasitized by *Winthemia quadripustulata* when feeding on foliage but not when it feeds within corn ears, bean pods or tomato fruits. Botrell, et al. (1968) made extensive rearings of *Heliothis* sp. in Oklaho-



Sketch illustrating a female of *Winthemia* sp., ovipositing on a hornworm (adapted from a photograph taken in July, 1968).

ma during 1965/66 from cotton, peanut, sweet corn and small grains and obtained several parasites. Although *W. rufopicta* was reported to be common throughout the season, this species was reared only from *Heliothis zea* and *H. virescens* feeding on alfalfa.

In conclusion I believe that the parasitoids treated here are niche-specific and any trends in their habits toward host-specificity are attributable to the fact that only single species of insects occupy the niches exploited by the parasitoids. I further hypothesize that it will eventually be proved that the insect parasitoids belonging to the order Diptera are more rarely host-specific and more commonly niche-specific.

ORIGIN AND DISTRIBUTION

The interpretation of the present distribution pattern of North America *Winthemia* in relation to the past geological events is an extremely complicated subject. Because of the absence of fossil records the interpretation mostly depends on indirect evidence, often incomplete such as phylogeny based mainly on morphological data, isolating mechanism and pattern of distribution of host species.

Darlington (1957) has presented a comprehensive study of various invasions of the North American continent by vertebrates. Similarly the North America *Winthemia,* as well as many other tachinids, represent many individual lineages that have spread from the temperate regions of Eurasia into this continent, from the Neotropical region or have evolved within the confines of North America. Many of these dispersals are impossible to date.

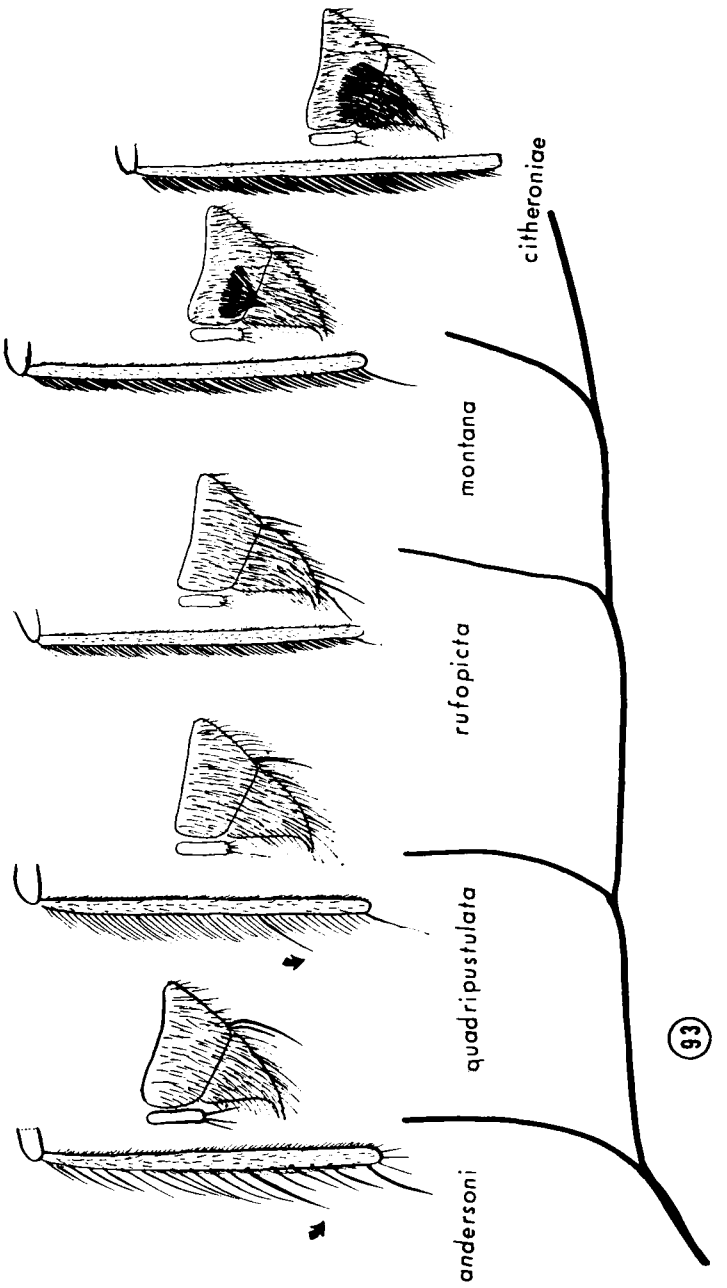
The group may have originally developed in the Northern Hemisphere; however, since other Winthemiini genera and species (e.g., *Nemorilla, Omotoma* and *W. quadripustulata*) are Holarctic in distribution, data from plant fossils support the view that the *Winthemia* ancestor probably spread between Europe and North America at the Miocene period. By the end of this period most of the major formations (i.e., coniferous and deciduous forest, prairies, grasslands, desert, etc.) and their associated fauna were present. The climate was apparently warmer than it is now, and this likely allowed many species, especially subtropical forms, to live farther north.

The genus is a dominant group in the New World and includes some of the commomnest species in the North American fauna.

The species of *Winthemia* occurring in the United States and Canada may be placed in four groups on the basis of distributional patterns:

1) *Northeastern group*. These species are fairly widely distributed throughout the eastern part of the continent and usually extend over northern United States and southern Canada. Included species: *abdominalis, cecropia, rufopicta, sinuata, vesiculata, quadripustulata* (eastern and middle west form), *sabroskyi* and *citheronia.*

2) *Northwestern group*. These species occur in northwestern United States and southwestern Canada; *andersoni* sp. n. extending south



Morphocline illustrating the probable evolutionary sequence of hind tibia ciliation vs. abdominal hairs on venter of tergites III and IV (for explanation see the text).

along the Pacific coast. Included species: *borealis, occidentis, quadripustulata* (northwestern form) and *intonsa.*

3) *Western group*. These species occur in northern Mexico and southwestern United States. Included species: *montana, duplicata, texana, intermedia* and *rufonotata.*

4) *Caribbean group*. Members of this group occur in the Gulf Coast and the Southern Coastal plains but are most common in Florida, Georgia and the Greater Antilles. Included species: *floridensis, okefenokeensis.*

It is probable that the species in the first two groups include most of the older elements in the North American fauna, while those in the last two groups represent more recent southern derivatives. The distributional pattern of the tachinids as well as other parasitic species is in part directly related to that of their hosts and in part dependent on a number of environmental conditions; therefore, in order to understand biogeographically the distributional pattern of this group a knowledge of the host food-chain patterns occurring in such ecosystems would be of basic importance. In certain cases the natural distribution of the host species has been already influenced by man since early times. Agricultural practices and the large scale modification of the environment have affected to a great extent the distribution of many insect species, thus making difficult the interpretation of the complex host-parasite interactions within larger ecosystems. Certain lepidopterous caterpillars recorded as *Winthemia* hosts e.g. armyworms, clover greenworm, etc., which are serious agricultural pests have had their populations considerably increased by the cultivation of extensive acreage of their food plants, affecting directly the abundance and distribution of the parasites.

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