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## INTRODUCTION

The recently increased importance of sunflowers (*Helianthus annuus* Linnaeus) as a crop has brought with it an increased interest in the sunflower maggot, a long-recognized common name for *Strauzia longipennis* (Wiedemann). The larva of this species bores downward in the stem and feeds upon the pith of sunflowers. Until recently the genus *Strauzia* was considered to include only the type-species *S. longipennis*, with 7 varieties (Foote, 1965). It is now known that some of these varieties should be classed as distinct species, differing morphologically and biologically.

All species of *Strauzia* whose biology is known to any extent bore in the stems of various plants of the family Asteraceae (Compositae) during the larval stage and feed only on the pith. This mode of feeding apparently does not harm the plant, although it has been stated (Brink, 1922) that a reduction in seed production is caused thereby, and that the stems are weakened sufficiently for high winds, frequent in the Middle States where the greater amount of sunflowers is grown. This comes at the crucial time when the seed heads are ripening, causing considerable loss by destroying plants which, if uninfected, may have survived (Caesar, 1924; Westdal and Barrett, 1960; Schulze, personal communication). Other deleterious effects, such as increased attack by other organisms, have also been attributed to the work of the sunflower maggot.

The genus *Strauzia* is restricted to North America. The species are very similar in general appearance, as may be inferred from the fact that they at one time were all treated as varieties of one species. This was summarized in 1894 by Snow, who stated, "The material at hand, though not large, is sufficient to show the inadvisability of erecting any of the members of this group to the importance of species, though specimens may be selected which present a vivid contrast. It is even almost impossible to characterize distinct varieties. The most constant character for such differentiation lies apparently in the relative size of the frontal bristles in the males. In regard to the characters of the wing pattern there are not only gradations between seemingly distinct varieties, but even the two wings of an individual show considerable differences. Characters derived from the picture of the thorax are also very unstable." Much more material has been accumulated since Snow's time, and the use of the terminalia of both sexes has become commonplace, but his statement is still true to a great extent. More will be said on this matter under *S. longipennis*.

The species of *Strauzia* are also very similar, in general appearance as well as in detailed morphology, to species of the genera *Euleia* and *Myoleja*. The American leaf miner of parsnip and related plants, *Euleia fratria* (Loew), and its close European relative, the celery leaf miner *E. heraclei* (Linnaeus) are so similar in wing pattern to females of *Strauzia longipennis* or to either sex of *S. perfecta* that they may easily be taken for one another. In fact, the seminal receptacles of *Euleia fratria* were described by Sturtevant (1925-1926) as those of *S. longipennis* (see Steyskal, 1972). Characters to separate *Strauzia* from its closest relatives will be given under the generic heading.

The species now known as *Gymnocarena diffusa* (Snow) and originally proposed in the genus *Oedicarena* was for a time placed in *Strauzia*. It somewhat resembles *Strauzia longipennis* and has been found to develop in the seed heads of sunflowers.

### Genus *Strauzia* Robineau-Desvoidy

*Strauzia* Robineau-Desvoidy, 1830: 718. Type-species, *inermis* R.-D., by designation of Coquillett, 1910: 609 (= *longipennis* [Wiedemann]); Agassiz and Loew, 1846: 37 (*Strauzia*, derived from "Strauss-Durckheim"); Agassiz, 1846: 354 (*Strauzia*, with note on use of *Straussia* in botany); Osten Sacken, 1858: 77 (*Strauzia*, as syn. of *Ortalis*); Loew, 1873: 243 ("*Straussia* may be preserved," after giving description of varieties of *longipennis* in *Trypeta*); Osten Sacken, 1878: 189 (*Straussia*, as subgenus of *Trypeta*); Snow, 1894: 159 (*Straussia*); Aldrich, 1905: 602 (*Straussia*); Cresson, 1907: 100 (*Straussia*); Phillips, 1923: 125 (*Straussia*, with key to varieties); Neave, 1940: 325 (*Strauzia* valid, with *Straussia* Agassiz, 1846 emendation thereof); Foote, 1965: 676 (*Strauzia*, with list of varieties).

Why Robineau-Desvoidy spelled *Strauzia* with a *z* may never be certainly known, but he stated that he dedicated the name to his great contemporary Hercule Eugène Straus-Durckheim ("Je le dédie à M. Straus, anatomiste"). Agassiz noted in the index to his nomenclator that *Straussia* had been used in botany by De Candolle. The botanical name, however, was stated by De Candolle (1830) to have been named for one "Laur. Strauss," who in 1666 published what was thought to be the first reference to coffee as a drink. Loew apparently considered *Straussia* to be a proper emendation of *Strauzia* (" . . . *Strauzia*, which may be preserved, after being modified into the more correct form of *Strauzia*"), and most entomological authors followed his usage until Foote (1965), except that Cresson already in 1907 stated definitely that *Strauzia* has priority. There is no justification under modern rules for emendation of *Strauzia*, and even if there were it could only be to *Strausia*.

### GENERIC CHARACTERIZATION

Because no satisfactory subfamily classification has been proposed for North American Tephritidae, no effort is made here to place *Strauzia* in a subfamily. However, many would place it in the Trypetinae because of well-extended basal cubital (anal) cell, non-inflated scutellum, and acute, black postocular setae, as well as its obvious relationships with *Euleia* and *Myoleja*.

The following combination of characters will distinguish *Strauzia* among all North American Tephritidae: Humeral setae present; basal cubital cell closed by strongly bent vein, cell elongated at lower apex; dorsocentral setae anterior to halfway point between supra-alar and acrostichal setae and closer to supra-alars then to transverse furrow of thorax (Fig. 8); scutellum not inflated, posterior upper fronto-orbital setae absent (Fig. 20), rarely present as a setule; oral margin anterior to genal seta without well developed setae; presutural thoracic setae present; antennae extending but little below middle of face; head higher than long, rounded in profile below; proboscis not geniculate; wing pattern (Fig. 1-7) pronounced, consisting of bands of yellow or brown color; postocular setae few, thin, acute, and black.

### HOST RELATIONSHIPS AND BEHAVIOR

All species of *Strauzia* known to any extent biologically are feeders in the larval stages on the pith of the stems of plants of the family Asteraceae (Compositae). The known hosts are listed under each species in the sequel, and include plants of the genera *Ageratina*, *Ambrosia*, *Helianthus*, *Rudbeckia*, *Smallanthus*, and *Verbesina*. Several species of *Helianthus* are involved, but species preferences and possible species specificity are not yet clear. Unfortunately, the host data cited by Wasbauer (1972) are largely suspect because of the poor previous state of *Strauzia* taxonomy.

The adult flies, at least of *S. perfecta* and *S. longipennis*, are late-day crepuscular. When the sun is close to the horizon, females may be seen on their host plant. I do not know how late they remain active nor whether they are also active in early morning. They oviposit between the upper internodes of the plant by standing crosswise on the stem and inserting their ovipositors into the pith. Larvae bore downward, feeding on the pith, until they reach the crown of the plant in early autumn. Pupation takes place in the crown or adjacent thereto in the soil, perhaps according to the species of fly. All known species are univoltine, emerging early the following spring.

Epigamic behavior has not been

described, but the enlarged frontal setae of some species are likely used in territory-defending skirmishes between males. The elongated and specially patterned wings of some males may be of use either in intimidating males or inducing females to copulate or both.

## DISTRIBUTION

The genus is restricted to North America. One or more species should be found in every contiguous State of the United States and in the southern part of all Provinces of Canada. Very few records are available from California (Foote and Blanc, 1963), and none so far from Oregon and Washington.

## TAXONOMY

Although more than 1500 specimens were examined in this study, the taxonomic problems remain little more resolved than when Snow (1894) made the statement quoted in the introduction. However, we now know that, as in most cases of pronounced sexual dimorphism, such characters are variable and that specimens may occur wherein the dimorphic characters are virtually undeveloped and males look like females. The instability of thoracic markings has been confirmed, but it is now known that some parts of the thoracic pattern are much more stable than others. The extent of black marking on the scutellum and metathorax is much more stable than the longitudinal striping on the mesoscutum. Of the pleural markings, a roundish spot above the hindcoxa is most stable. The wing pattern, except for male dimorphism, is not subject to much variation.

The male postabdomen, as in many other Tephritidae (Stone, 1942; Steyskal, 1977, 1979a; Foote, 1981). is much more difficult to work with than the female postabdomen and also much less characteristic at the species level. The male organs of *Strauzia* species are similar throughout the genus and subject to considerable variation; they have not been used in this study.

The female postabdomen, although of quite uniform structure throughout the genus, has proven more useful than that of the male. Microscope slide preparations have been made, which, because of the flatness of the parts, are very comparable. The spermathecae, also useful in *Strauzia*, show up well on slides.

As in the key, one species after another has been recognized as of specific rank on the basis of relatively slight morphological characters, the only ones that appear to be stable. *Strauzia perfecta* is distinct from all other species, but there seems to be no way to make satisfactory groupings of the others on external or genitalic structures. The final residue, here designated as *S. longipennis* (Wiedemann) may still be a species complex, but it is certainly one of taxa less distinct than the others here recognized. When satisfactory criteria can be distinguished, it will then be proper to make examinations of the types of the species at present left in the synonymy of *S. longipennis*. The taxon that Loew considered typical of *longipennis* has not been encountered in specimens other than those Loew had. Except for *S. longipennis*, those here recognized seem to be host specific.

Although a considerable amount of rearing has been done, much more must yet be done, as well as mating experiments and hybridizing. Along with such biological work chromatographic and other chemical techniques may provide better conclusions.

## MORPHOLOGICAL TERMINOLOGY

The terminology of general body parts is traditional, that of wing venation is as in my recent papers (Steyskal, 1979b, 1984), and that of female terminalia as in my papers (Steyskal, 1977, 1979a, 1979b, 1984) and Foote (1981).

The chief point of difference between my terminology for the wing venation and that of McAlpine (McAlpine et al., 1981) lies in the designation of the erstwhile "anal" cell. Because I cannot consider *CuP* a true vein but merely the claval furrow, I have called the cell "basal cubital cell." I have also used the designation of the hindmost vein of compound veins for the sake of simplicity (*R3, R5*, etc.). I furthermore still find the common European designations for the crossveins of higher Diptera useful: *ta, tb, tp*).

My opinions on the female postabdomen differ more fundamentally from those of McAlpine (1981, p. 38), who states that "often in the Diptera all the elements of the terminalia, including the cerci, are called the ovipositor (oviposition tube, ovicauda) . . ." I believe that this is too broad an extension of the term. The 3 sections -- "oviscape, eversible ovipositor sheath, and 8th segment with

cerci" (McAlpine, 1981, fig. 2.109, 110) -- have not generally been termed ovipositor as a whole, at least in the Tephritidae, but they are sufficiently modified to be termed terminalia, or, as by Hennig, postabdomen. In my key to the genus *Anastrepha* (Steyskal, 1977), I termed the first section 'ovipositor sheath,' the second section 'ovipositubus,' and the terminal section 'ovipositor.'

The 7th abdominal segment has the 8th and following segments retracted into it when the ovipositor is not in use, often with none externally evident. It is therefore quite properly termed a sheath. Munro (1947) called it 'oviscape' and remarked that "it has been called the ovipositor, the base of the ovipositor, and the ovipositor sheath." I believe that it is entirely proper to revert to the pre-Munrovian term 'ovipositor sheath.' The terms 'oviscape' and oviscapt' are both inapt. The former is from Latin *ovi-* 'egg' and *scapus* 'stem, stalk, trunk, cylinder, column' (originally Greek). The latter term is from the same Latin *ovi-* with Greek *skaptos* 'dug.' Neither has any reference to the laying of eggs. It is difficult to form 3-part Latin compounds, but 'ovipositivagina' is possible and a word of Greek derivation would be 'ootococoleus'; neither of these hardly seems commendable.

The long tube that makes possible the telescoping of all the other parts into the sheath was termed 'ovipositubus' by me in order to have a single-word term; the term 'inversion membrane' (Munro, 1947) is quite as apt and probably the first term to be applied to this part. I believe that all parts of it, bearing either minute spicules or rasping teeth of various sizes, represent the intersegmental membrane between the 7th and 8th segments. It is certainly not a sheath in the ordinary meaning of the word. The retrorse spicules and teeth are apparently secondary sclerotization well divided into small portions to maintain great flexibility of the tube. Similar structure is seen in the membrane serving for inversion in other families. In the Tanypezidae both the 7th and the following segments retract into the 6th segment by 2 separate sections of such membrane. This incidentally casts some doubt on the inclusion of the Tanypezidae in the superfamily Tephritoidea, as was somewhat tentatively proposed by McAlpine (1977).

The ovipositor *per se*, the last of the 3 divisions of the female postabdomen (or terminalia), was divided by McAlpine (1977) into 'stalk' and 'aculeus' and by Munro (1947) was termed 'aculeus' as a whole. It is certainly of somewhat complex origin and composition inasmuch as everything from the 8th segment to the telson is included in it. Although the 2 flaps on the ventral side are likely the 8th sternum, there is no assurance that the 8th tergum is directly above them. Even in the Tipulidae the 8th sternum projects well posterad of the 8th tergum. Epiproct, hypoproct, and 9th and 10th segments in some form or other are all parts of the ovipositor. In most Tephritidae, the apical part of the ovipositor (beyond the oviduct) retains traces of compound origin. In the Tanypezidae, the 2 sclerites immediately basad of the cerci are obviously present. Above the paired 'flaps' there are structures under which the egg must pass; I have proposed the term 'oviprovector' for one such structure in the Otitidae (Steyskal, 1979b). The finer structure of the ovipositor in the Tephritoidea and related groups needs much study. Although the vast majority of female Diptera with the tephritoid type of ovipositor have well-developed mouthparts and apparently feed, at least a little, the fate of the caudal end of the alimentary canal (anal orifice, rectum, rectal papillae, etc.) seems to be unknown.

I am referring to divisions of the antenna and tarsus as segments, a good English word referring to similar parts of nearly anything. I do not believe that having a special name (scape, pedicel, flagellum) for each of the 3 segments of the simple antenna of the Muscoidea, regardless of their morphological significance, contributes anything to the general understanding of keys and descriptions.

A configuration in the ovipositor per se, probably homologous to the oviprovector, is here used for the first time and termed the signum. It consists of fine, arcuate, usually interrupted cuticular ridges and grooves. It is sometimes difficult to see and always requires high magnification.

Key to Species of *Strauzia* Robineau-Desvoidy

1 (2). Scutellum, metanotum, and pleural sclerites wholly yellowish, without dark markings; wing (Fig. 3) with hyaline band between crossveins extending anteriorly to costa and posteriorly at least a little beyond *Cu*; postocellar setae nearly or quite as far apart as distance from one of them to nearest inner vertical seta (Fig. 20).

♀: Ovipositor sheath (Fig. 9) with broad black apical ring; ovipositor (Fig. 9, 10) with preapical lateral projections; major rasper teeth small, approximately rectangular, with slightly blunt tip; spermathecae teardrop-shaped, preterminal vesicle more than half diameter of terminal vesicle, latter with appressed teeth oblique or even mostly longitudinal; signum absent, present only in New Mexico specimen.

♂: Frontal setae usually enlarged, blunt-tipped; wing usually longer than in ♀, but with same pattern.

Host: *Ambrosia trifida* L. ..... *S. perfecta* Loew

2 (1). Scutellum with lateral corners black; metanotum usually with at least lower black strip, often largely black; pleura unmarked or with black mark above hindcoxae and sometimes also with other dark marking; wing with hyaline band between crossveins not extending posterad of vein *Cu*, sometimes not reaching costa anteriorly and somtimes in ♂ variously modified; postocellar setae much closer together (Fig. 21) than distance from one of them to nearest inner vertical seta.

♀: Ovipositor sheath with narrow black apical ring, sometimes also with dark basal marking; ovipositor (except in *S. verbesinae*, Fig. 13) with arcuate transition from sides to tip or (*S. stoltzfusi*, Fig. 14) with slight angulation, oviprovector not develop; major rasper teeth larger, often with extended point or lobe; spermathecae more or less globular, appressed teeth of terminal vesicle latitudinal; signum of ovipositor present.

♂: Frontal setae various; wing various, often with greatly modified pattern.

3 (4). Last tarsal segment blackish, at least in large part; median hyaline band of wing (Fig. 6) extending from costa nearly to vein *Cu*, ending roundly a little before vein; scutum with short blackish stripe mesad of edge of supra-alar declivity and sometimes with interrupted sublateral stripe; mesopleuron, pteropleuron, sternopleuron, and sometimes hypopleuron above hindcoxa with dark marks; lateral margins of abdominal terga usually darkened.

♀: Ovipositor sheath (Fig. 18) yellowish or with some basal darkening; ovipositor (Fig. 11) with tips of ventral flaps divergent, rounded; major rasper teeth bilaterally concave to narrow tip; spermathecae with globular terminal vesicle and discoidal preterminal vesicle, about 3/4 of diameter of terminal vesicle.

♂: Frontal setae usually enlarged and blunt-tipped; wing somewhat elongated but with pattern as in ♀.

Host: *Rudbeckia laciniata* L. ..... *S. intermedia* Loew

4 (3). Last tarsal segment concolorous with other segments, at most slightly darkened at tip; median hyaline band of wing reaching vein *Cu*; pleural markings various.

♀: Ovipositor sheath (Fig. 19) largely blackish or yellow with narrow blackish apical band; tips of ventral flaps various; major rasper teeth various; sparmathecae with more or less globular terminal vesicle, sometimes basally truncate, and with preterminal vesicle usually half or less of diameter of terminal vesicle and at least one-third as long as its own diameter.

♂: Frontal setae and wings various.

5 (6). Wings (Fig. 4, 5) with median hyaline band not extending to costa but turned apicad at vein *R5* or ending; cell *Sc* (pterostigma) and hyaline spot in apical part of cell *br* long (pterostigna 3x as long as basal width and hyaline spot attaining level of tip of vein *R1*); mesoscutum with well developed pair of sublateral dark stripes interrupted at transverse furrow; large part of mesopleuron with coarse black setae; black spot present on pleuron above hindcoxa.
♀: Ovipositor sheath (Fig. 17) narrowly blackish at tip; ovipositor (Fig. 12a, b) with lateral margins distinctly concave before tip, preapical "shoulders" broadly arcuate and wider then stem; major rasper teeth with distinct, short, apical mucro; spermathecae nearly globular, terminal vesicle with small basal truncation, preterminal vesicle yellow, about 2/3 diameter of terminal vesicle.
♂: Similar to ♀, frontal setae sometimes slightly enlarged.
Host: *Helianthus grosseserratus* M. Martens .... *S. arculata* Loew

6 (5). Wing with median hyaline band extending more or less directly to costa; if somewhat constricted, then other characters differing.

7 (8). ♀: Ovipositor (Fig. 13) with lateral preapical angulations continuing directly to side margins of ovipositor but with small concavity where joining tapered apex; ventral flaps coarctate apically; signum well developed; major rasper teeth bilaterally concave and with narrow points; spermathecae with subglobular terminal vesicle and small colorless preterminal vesicle; ovipositor sheath yellowish with slight apical darkening; thorax with dark markings only above neck and wings, at lateral corners of scutellum, and in lower and lateral corners of metanotum.
♂: Similar to ♀ in thoracic markings and wing characters; upper frontal setae enlarged, usually blunt-tipped.
Host: *Verbesina occidentalis* (L.) Walter .....
..... *S. verbesinae*, n. sp.

8 (7). ♀: Ovipositor with lateral preapical arcuation or blunt, very obtuse angulation; otherwise differing.

9 (10). Mesoscutum with blackish markings as follows: nearly complete submesal, interrupted sublateral, and short lateral (above supra-alar declivity) stripes; well developed blackish areas also on mesopleuron, pteropleuron, sternopleuron, and hypopleuron above hindcoxa; last tarsal segment not darkened.
♀: Ovipositor sheath largely blackish; ovipositor (Fig. 14) with very obtuse, blunt lateral preapical angulations; ventral flaps separately rounded apically; major rasper teeth small, bluntly angulate; signum present; spermathecae with small terminal vesicle (collapsed in type specimen), preterminal vesicle long-ovate, relatively large.
♂: Only available specimen with frontal setae not enlarged, wing pattern as in ♀.
Host unknown ..... *S. stoltzfusi*, n. sp.

10 (9). Mesonotum variously marked, but lacking long submesal stripes, lateral stripes lacking; mesopleuron, pteropleuron, and sternopleuron at most with small or faint dark markings.
♀: Ovipositor sheath (Fig. 19 largely yellowish; ovipositor with lateral preapical arcuation; rasper teeth frequently with narrow points; spermathecae with large globular terminal vesicle and small preterminal vesicle (Figs. 15, 16 a-g).
♂: Frontal setae often enlarged and blunt-tipped; wing often elongated and with modified pattern (differing from that of ♀).

11 (12). Distinct spot present on pleuron above hindcoxa.
♀: Ovipositor (Fig. 15) with unusually blunt tip, serrations very fine and not extending full length of tip; major rasper teeth small. rounded; spermathecae with terminal vesicle strongly flattened at base.
♂: Frontal setae not enlarged; wing aa in ♀.
Host: *Helianthus giganteus* L. ..... *S. gigantei*, n. sp.

12 (11). Dark spot above hindcoxae usually lacking or faint.
♀: Ovipositor (Fig. 16a-g) with more sharply pointed tip; major rasper teeth usually distinctly pointed, often bilaterally concave; spermathecae usually with virtually globular terminal vesicle.
♂: wing in specimens with well developed sexual dimorphism as in Fig. 1, 2a-c, elongated and with greatly modified pattern; frontal setae usually enlarged and blunt-tipped.
Host: Species of *Helianthus* and other genera of Asteraceae .....
..... *S. longipennis* (Wiedemann)

*Strauzia arculata* (Loew), new status
(Fig. 4, 5, 12)

*Trypeta longipennis* (Wied.), var. *arculata* Loew, 1873: 242.
*Straussia longipennis* var. *arculata* (Loew) Phillips, 1923: 127, pl. 18, fig. 7.

This species has often been confused with *S. longipennis*, to which it is indeed more similar than to other species. I have examined 370 specimens from New Mexico (Valencia Co., in UTA*), Colorado ("Colorado" in CUI), North Dakota (Hunter, in USNM), South Dakota (Brookings, in USNM), Wyoming (nr. Lander, in UKAL, Iowa (many localities. in ISU and USNM), and Illinois (McHenry Co., in USNM; "Illinois" holotype, in MCZ). Many were reared in Iowa from *Helianthus grosseserratus* M. Martens by W. Bryan Stoltzfus; the only other rearing (if indeed it is such) from a definite host is of a single specimen from Hunter, North Dakota "ex *H. annuus*."

The unique wing pattern described in the key and figured makes *S. arculata* relatively easy to recognize.

*Strauzia gigantei*, n. sp. (Fig. 15)

This species is most similar to *S. longipennis*, but differs most appreciably from all forms of that species in details of the female genitalia.

♀ Length of wing 5.1 - 5.3 mm. Thorax yellowish with following blackish markings: Submesal (only near anterior end and sometimes fused anteriorly), scutellar (at lateral ends of scutellum), adalar (on supra-alar declivity), wedge above halter pointing downward, roundish spot above hindcoxa, and most of metanotum (except anteromesally). Wing very similar to that of *S. longipennis* (Fig. 1) but hyaline spot below pterostigma in cell *br* with distal end rounded nearly at level of end of *R1* and without small spot in cell *2c*; *tp* virtually straight. Legs wholly yellowish.

Abdomen yellowish, with a few faint slightly darker areas; ovipositor sheath very narrowly blackish at apex; terminalia (Fig. 15) with spermathecae consisting of roundish, basally truncate terminal vesicle and preterminal vesicle about 0.6 as large in diameter; major rasper teeth virtually semicircular; ovipositor 2.0 mm long, greatest width 0.52 mm; tip unusually blunt, serrations distinct only in approximately apical 3/4 of tip, each serration 8-10 mm wide; ventral flaps apically rounded; signum faint, apparently of 2 apically convex groups of shallow striae and reticulations.

♂. Length of wing 5.0-6.4 mm. Similar to ♀, even in wing shape and pattern and structure of head.

Host: *Helianthus giganteus* L. The record of *S. intermedia* from this host by Novak et al. (1967) actually refers to *S. gigantei*. The species name is the genitive case of *giganteus*, meaning 'of *giganteus*.'

Holotype ♀, 1 mi. S. Kent, Portage County, Ohio, E (merged) 4/13/1966, Biol. Note No. 6552 (W. B. Stolzfus). with puparium in capsule, ovipositor and sheath on microslide. Paratypes (all with same locality and collection data as holotype): ♂ allotype, E 4/22/1966, note no. 6552; with puparium in capsule; ♀, E 3/24/1966 note no. 6604, with puparium in capsule; ♂, E 4/26/1965, note no. 6552; ♂, E 4/22/1965; ♂, 5/27/1966; all in USNM.

*See appended list of abbreviations.

Notes nos. 6552 and 6604 refer to the 1966 specimens as having been removed from the host as late larvae on 18 Sept. 1965, placed in refrigerator as puparia on 5 Oct. 1965, removed on 9 Dec. 1965, again placed in refrigerator on 4 March 1966, and finally removed on 28 March; the 1966 specimen with note no. 6604 emerged from a puparium found in soil about roots of the host on 5 March.

### *Strauzia intermedia* (Loew), new status
### (Fig. 6, 11, 18)

*Trypeta longipennis* (Wied.), var. *intermedia* Loew, 1873: 241.
*Straussia longipennis* var, *intermedia* (Loew) Phillips, 1923: 127, pl. 18, f. 7.

This species is relatively easy to recognize by its largely black last tarsal segment and the other characters cited in the key and shown in the figures. I have examined 170 specimens of *S. intermedia* from the following localities, as well as the holotype in MCZ from an unknown locality: Manitoba (Aweme and Minette, in CNC), Ontario (Beachville, Midland, and Ottawa, in CNC), South Dakota, Iowa, Michigan, Illinois, Indiana, Ohio, Pennsylvania, Connecticut, New Jersey, Maryland, District of Columbia, Virginia, and Georgia (Rabun County, in CNC).

Adults of this species appear earlier than other species; there is a specimen from Ag. Coll. (East Lansing), Michigan in MCZ with the date "3-30-1892" and one fro Midland, Ontario in CNC dated 2 May 1959. Several specimens from Indiana, Maryland, and New Jersey were taken in the first week of May. The latest were taken during the latter half of June.

Host: *Rudbeckia laciniata* L. Stoltzfus reared *S. intermedia* from this plant in central Iowa, where he found 1 to 3 puparia in the crowns of the plant as early as 28 July, apparently having done little damage. The report of *S. intermedia* in *Helianthus giganteus* by Novak et al. (1967) is erroneous and refers actually to *S. gigantei*.

### *Strauzia longipennis* (Wiedemann)
### (Fig. 1, 2a-c, 16a-g, 21)

*Tephritis longipennis* Wiedemann, 1830: 483.
*Strauzia inermis* Robineau-Desvoidy, 1830: 718.
*Strauzia armata* Robineau-Desvoidy, 1830: 719.
*Tephritis trimaculata* Nacquart, 1843: 383 (sep. 226), pl. 31, fig. 3.
*Trypeta cornigera* Walker, 1849: 1010.
*Trypeta cornigera* Walker, 1849: 1011.
*Trypeta longipennis* (Wied.) Loew, 1862: 59, 65, pl. 2, fig. 2, 3; 1873: 238, pl. 10, fig. 2, 3.
*Trypeta longipennis* (Wied.), var. *typica* Loew, 1873: 240.
*Trypeta longipennis* (Wied.), var. *longitudinalis* Loew, 1873: 240. N. SYN.
*Trypeta longipennis* (Wied.), var. *confluens* Loew, 1873: 241.
*Trypeta longipennis* (Wied.), var. *vittigera* Loew, 1873: 241.
*Strauzia longipennis* (Wied.), var. Cresson, 1907: 99, pl. 1, fig. 1 (first combination).

Wiedemann's type series consisted of an unstated number of specimens of both sexes, "in Von Winthem's and my collections." Loew (1862: 59) stated that "26. *longipennis* Wied. will be more accurately described in the sequel. The name of it is acertained from the inspection of the originals. It is surprising that Wiedemann does not mention the thickening of the frontal bristles in the male, though the males in his collection show it. Perhaps he had specimens enough to satisfy himself that this peculiarity is not constant." Then in "the sequel" (p. 65, pl. II, fig. 2, 3) he gives the figures and description upon which the traditional concept of the species is based.

Loew (1862: 58-60) also synonymized the 2 Robineau-Desvoidy names, the original publication of which provides very little of moment; the Macquart name, based upon a very sketchy description and a wing figure agreeing well with those of Loew; and the 2 Walker names. Walker's notoriously inadequate descriptions are based upon males; notes on them kindly furnished by C. W. Sabrosky show that they have the *longipennis* male wing pattern fairly well developed.

Of the 4 varieties erected by Loew and still remaining in synonymy, I feel confident of synonymizing only one, var. *longitudinalis*. A male specimen in MCZ bearing the labels "Sharon / Loew coll. / var. longitudinalis / Type 13286" was furnished by me in 1971 with a lectotype label. The male wing pattern is so well developed in this specimen that it can only be *longipennis*.

A female specimen of var. *typica* Loew in MCZ bearing the labels "Penn Auxer /

Loew coll. / Type 13290" was furnished by me in 1983 with a lectotype label. Additional specimens (2 ♂, 1 ♀) are also in MCZ bearing the same original labels. It is quite doubtful that var. *typica* Loew is *S. longipennis longipennis* (Wied.). A microslide of the abdomen of the lectotype has been returned to MCZ with the remainder of the specimen. Fig. 16g in the present work was made from that preparation. The ovipositor somewhat resembles that of *S. arculata* (Fig. 12), but the wing pattern is much like that of a *longipennis* with rather expanded dark pattern. It is possible that when more material and some biological data on this entity is available, it may prove to be a distinct species. No dark mark is present above the hindcoxa.

Loew's var. *confluens*, as he originally stated, is represented by a single ♂ "Connecticut; Mr. Norton." I examined in 1971 a specimen in MCZ which had only the labels (plain white circle) / Loew coll. / var. confluens / type 13284. It is a small specimen; Loew said "it is one of the smallest specimens in my collection." I would interpret it as a small, heavily colored specimen of *S. longipennis* with poorly developed dimorphic male characteristics of head bristles and wing pattern. The two arms of the F-mark in the apical part of the wing are so broad that, as Loew stated, they fuse for a short distance in their middle. The ♂ surstyli, as I noted in 1971, are similar to those of other *S. longipennis*.

Loew's var. *vittigera* was described from "a male and a female from Nebraska (Dr.Heyden)"; they were examined by me in 1983 and furnished with a lectotype label on the pin with the female specimen. Both specimens in MCZ, have labels "Neb. / Loew coll. / Type # 13287." The lectotype is rather small, wing 4.4 mm long, and somewhat shrunken. A slide preparation of the lectotype (basis of Fig. 16f) was made and returned to MCZ. I see no reason for considering it as other than a rather commonly found variation in Midwestern populations, viz., occasional specimens with well developed dark sublateral stripes.

The more typical wing patterns and female genitalic structures are shown in Fig. 1 (♀) and 2a-c (♂) of wings and Fig. 16a-c of ♀ genitalia. Of the wings, Fig. 2a and b are of specimens from a single population on *Helianthus tuberosus* in Bethesda, Maryland. Most of the males of this population had wings nearly as extreme in pattern dimorphism as in Fig. 2c, which is of a specimen from northern Ohio. Of the female genitalia, Fig. 16a was made from a specimen of the Bethesda population on *Helianthus tuberosus*, Fig. 16b from *H. annuus* in Ames, Iowa, and Fig. 16c from *H. hirsutus* in Ames, Iowa. Two further series, represented by Fig. 16d from *Smallanthus uvedalia* (L.) in Elkton, Virginia and Fig. 16e from *Ageratina altissima* (L.) R. H. King and H. Robinson in Wadsworth, Ohio are somewhat more doubtful, although they seem to be well within any kind of morphological variation of the *Helianthus*-feeding forms. The mentioned series are deposited in USNM.

*Strauzia longipennis* may be expected to occur throughout the North American range of the genus *Helianthus* or even beyond, and therefore farther west than any other species of the genus. I have seen specimens from the western States of Arizona, Colorado, New Mexico, and Utah. Because of possible recognition of distinct species within this complex, detailed description of the range is not given.

*Strauzia perfecta* (Loew), n. comb.
(Fig. 3, 9, 10, 20)

*Trypeta longipennis* (Wied.), var. *perfecta* Loew, 1873: 239, pl. x. fig. 2.

*Straussia longipennis* var. perfecta (Loew) Phillips, 1923: 126.

No other species of *Strauzia* is as obviously distinct and of specific rank as *S. perfecta*. It varies but slightly and may be easily recognized by the lack of dark markings in the lateral corners of the scutellum and in the ♀ (Fig. 9) by the broad apical black ring on the ovipositor sheath. This latter character was first noted by Snow (1894: 169) but not recognized as specific. The definitely angulate preapical corners of the ovipositor are also characteristic; the only other species of *Strauzia* with such angulations is *S. verbesinae*, but that species is quite different otherwise and even the angulations are somewhat different (cf. key and Fig. 10 and 13). It should be noted that Loew used the same figure of the male wing for *longipennis* and the var. *perfecta*.

I have examined the holotype (in MCZ with locality data) and about 660

specimens from the following localities: Ontario (Point Pelee, in CNC), New Mexico (Pecos, in USNM), Colorado ("Colorado", in USNM; Castle Rock, in ISu; Fort Collins, in MCZ), South Dakota (Brookings, in USNM; Jefferson, in ISu), Nebraska (Valentine and Holdrege, in ISU; Overton, in CNC); Kansas (Douglas County, in UKaL; Lawrence, in CNC), Iowa, Illinois, Michigan (southern: Saginaw, Berrien, Kalamazoo, St. Joseph, Branch, Ingham, Wayne, and Monroe Counties), Ohio, Kentucky, Tennessee, New York (Ithaca), Connecticut, Massachusetts, New Jersey, Pennsylvania, West Virginia, Maryland, Virginia.

Dates of capture of adults extend from the last week of May to about mid-July, with a few later stragglers.

Host: *S. perfecta* has been reared only from *Ambrosia trifida* L. (first reported by Novak et al. (1972). In a vacant lot in Bethesda, Md., in which numerous plants of both *A. trifida* and *Helianthus tuberosus* were growing, no *Strauzia* specimens were taken on the "wrong" plant - *S. perfecta* was always on *A. trifida* and *S. longipennis* always on *H. tuberosus*.

### *Strauzia verbesinae*, n. sp. (Fig. 13)

This species is evidently fairly closely related to *S. longipennis*, but it differs most decidedly in the obviously angulate preapical corners (shoulders) of the ovipositor (Fig. 13), the very small, spherical preterminal vesicle of the spermathecae, and the lack of specialized wing pattern in the male. The only other species of *Strauzia* with angulate preapical corners on the ovipositor is *S. perfecta* (Loew), q. v.

♀. Length of wing 4.64 - 5.50 (average 4.95) mm. Thorax yellowish with only following brown to black markings: pair of submesal spots above neck, sometimes fused mesally; spot above wing base; basilateral scutellar spots; lower and lateral borders of metanotum. Wing virtually as in *S. longipennis*. Legs wholly yellowish.

Abdomen yellowish, often with ill-defined brownish patches; ovipositor sheath narrowly blackish at tip; terminalia as in Fig. 13; spermathecae with globular terminal vesicle and very small preterminal vesicle oblate spherical in shape and of yellowish color; major rasper teeth mucronate, concave laterally; ovipositor 1.8 mm long, greatest width 0.4 mm, tip virtually equilaterally triangular beyond rather suddenly slightly projecting shoulders, side of ovipositor basad thereof nearly straight; ventral flaps apically coarctate and ending near (before or beyond) level of shoulders; signum present, consisting of semicircular ridges and striae; lateral serrations of tip 28 - 35, extending nearly to shoulders.

♂. Similar to ♀. Wing length 4.37 - 5.18 (average 4.76) mm, pattern similar to that of ♀, but tip sometimes a little more tapering; upper fronto-orbital setae enlarged and blunt or uncate.

Host: *Verbesina occidentalis* (L.) Walter, reared by W. B. Stoltzfus.

The species name is that of the genus of its host in the genitive case.

Holotype: ♀, 5 mi E Harrisonburg, Rockingham County, Virginia, E(merged) 10.IV.1967, Biol. Note 6701 (puparia removed from stalks of host on 25.III.1967), abdomen on microslide, puparium in microvial (W. B. Stoltzfus). Paratypes: 4 ♀ and 2 ♂ (including allotype ♂), same data as holotype; 1 ♀, 3 ♂, same locality, 11.VI.1967; 1 ♂, same locality, with puparium, E 25.II.1968; 2 ♀, same locality, with puparium, E 8.III.1968; 4 ♂, same locality, 21.V.1968 (all collected and/or reared by W. B. Stoltzfus); 1 ♀, 9 ♂, Claytor Lake State Park, Pulaski County, Virginia, 5.VI.1971 (Wm. H. Robinson); 1 ♂, Petersburg, Prince George County, Virignia, 1.VI.1917 (R. C. Shannon); 1 ♀, Lexington, Kentucky, 23-25.V.1971, Malaise trap (P.H. Freytag, G. Leppert); all in USNM.

### *Strauzia stoltzfusi*, n. sp. (Fig. 14)

There is much more extensive darkening on the body of this species than in any other in the genus, but the last segment of the tarsi is not darkened, as they are in *S. intermedia*, which is probably the next most darkened species. Characters of the female terminalis bring *S. stoltzfusi* into relationship with *S. gigantei*, a very pale species, especially by the rather blunt tip of the ovipositor.

♀. Length of wing 4.75 mm. Head yellowish with brown area on occiput at each side of neck, narrow brown stripe along upper part of dorsal occipital sutures; and black ocellar triangle. Thorax yellowish with following dark brown to black markings: narrowly separated pair of continuous submesal black stripes from

neck to 2/3 distance from transverse furrow to scutellum; broad presutural part narrowly disjunct from narrowed postsutural part of pair of sublateral black stripes; narrow pair of subalar black stripes and pair of roundish black adalar blotches; small brown mark just lateral to each anterior notopleural seta; pair of black basilateral marks on scutellum; each side of thorax with dorsal border of propleuron and its posterior edge alongside spiracle blackish; broad border nearly all around mesopleuron; lower 2/3 of sternopleuron; entire hypopleuron and sclerotic connections with metanotum; entire metanotum and all except narrow dorsal edge of postscutellum. Legs wholly yellowish. Wing as in *S. longipennis*, markings rather deep-colored.

Abdomen with ill-defined but broad and conspicuous brown crossbands on tergites; ovipositor sheath nearly wholly blackish; terminalia (Fig. 14) with terminal vesicle of spermathecae collapsed in only available specimen, preterminal vesicle large, longitudinally oval, light brown; major teeth of rasper minute, round-tipped, short, obtusely triangular; ovipositor 2.0 mm long, greatest width 0.55 mm; ovipositor tip rather blunt, serrations very fine and shallow, about 40 on each side, becoming evanescent about 2/3 distance from tip to shoulder; shoulders very obtusely angulate; ventral flaps extending to shoulder level; signum faint, in single mesal row of apically concave ridges and striae.

♂. Similar to ♀. Length of wing 4.55 mm. Head with frontal setae well developed but neither enlarged nor blunt-tipped.

Host: Unknown.

I take pleasure in dedicating this species to W. Bryan Stoltzfus (genitive case, *stoltzfusi*) in token of his very considerable and significant work on *Strauzia* species.

Holotype ♀ and 1 ♂ paratype (allotype): St. Anthony Park (Ramsey County, St. Paul, Minnesota, no date (Lugger), ♀ abdomen and 1 wing of each specimen on microslides; in USNM.

ACKNOWLEDGMENTS

I am most grateful to the many who have generously assisted in the preparation of this paper, and three persons should be especially acknowledged, viz., Richard H. Foote, who has given constant help and encouragement; W. Bryan Stoltzfus, who in relinquishing work on the Tephritidae magnanimously turned over to the Systematic Entomology Laboratory, USDA, the exceedingly important results of his work on the genus; and John T. Schulz, who was very encouraging in the early stages of the problem. And far from least, I am grateful to Linda Heath for making true art out of my pencil sketches.

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ABSTRACT

Of the 7 presently accepted varieties of the single species of the genus, *Strauzia longipennis* (Wiedemann), 4 are given species status: *S. longipennis* Wiedemann) (type), S. *arculata* (Loew), *S. intermedia* (Loew), and *S. perfecta* (Loew). Three new species, all from the United States, are proposed: *S. gigantei*, *S. stoltzfusi*, and *S. verbesinae*. A key to species is given and the female terminalia of all species and other details of some of them are given. Known host plants are also cited. The genus is considered as one of unusual difficulty and one that still requires extensive work on the biology of its members before meaningful type examination can lead to better solution of their systematics.

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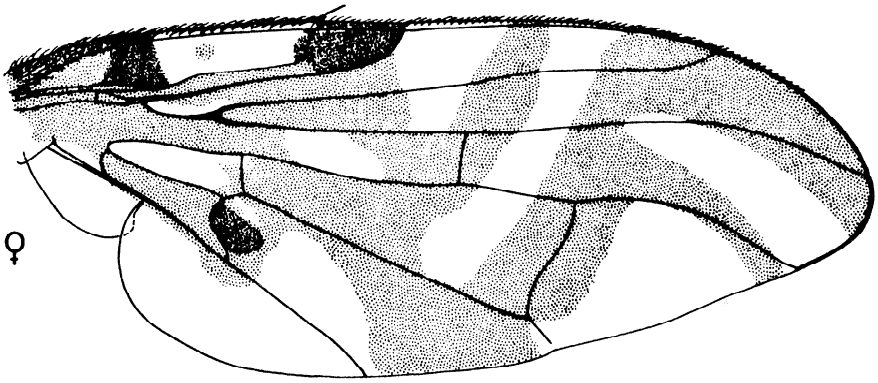
ABBREVIATIONS OF NAMES OF DEPOSITORIES

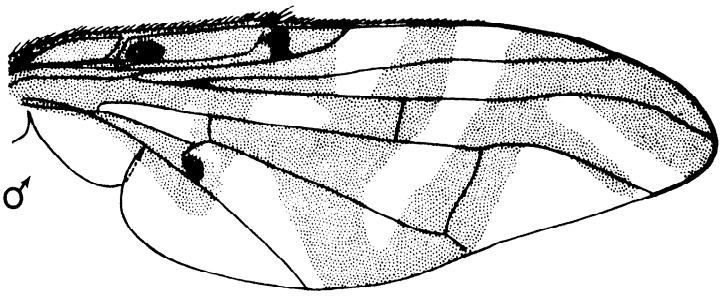
CNC - Canadian National Collection, Ottawa
CUI - Cornell University, Ithaca, New York
ISU - Iowa State University, Ames
MCZ - Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
UKaL - University of Kansas, Lawrence
USNM - United States National Museum of Natural History, Washington, D.C.
UTA - University of Texas, Austin.

EXPLANATION OF FIGURES

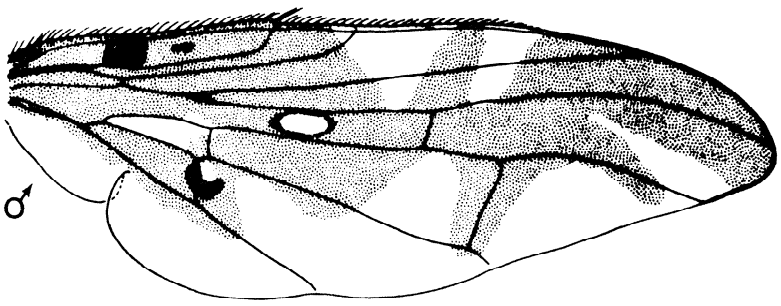
The names of the species appear with each figure. Figs. 1-7 - wings; 8 - scheme of thoracic chaetotaxy and pattern; 9 - ovipositor sheath and ovipositor; 10-16 (left to right) spermatheca (appressed spinules shown only in fig. 10; they are directed equatorially in all others), outline of largest rasper spicule, ovipositor; 17-19 - ovipositor sheath in profile; 20-21 - median dorsal view of head, showing setae.



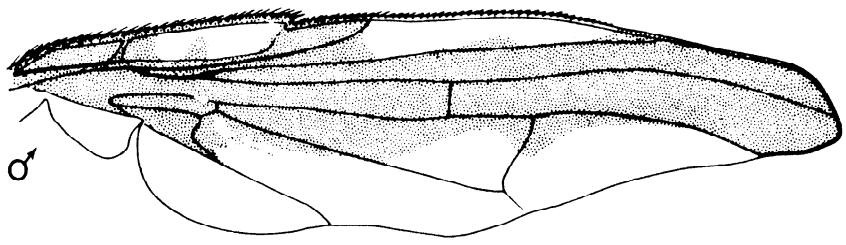
1 longipennis ♀



2a longipennis ♂

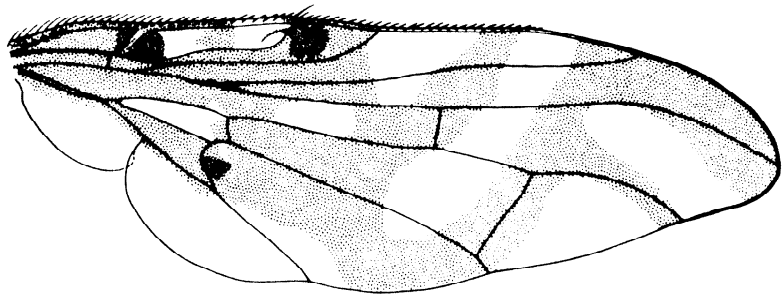


2b longipennis ♂

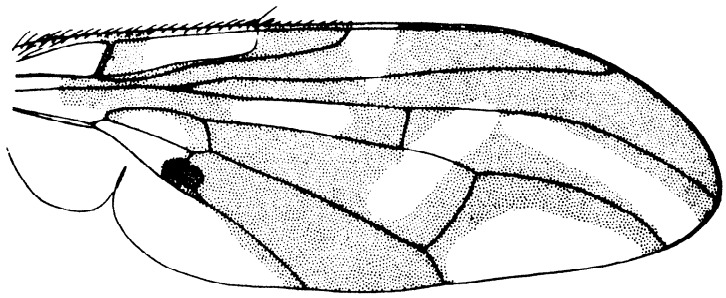


2c longipennis ♂

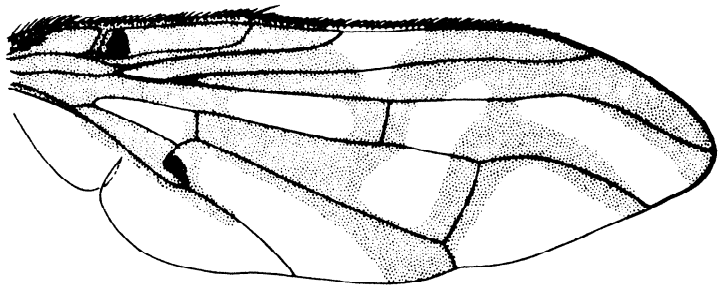
3 perfecta ♀



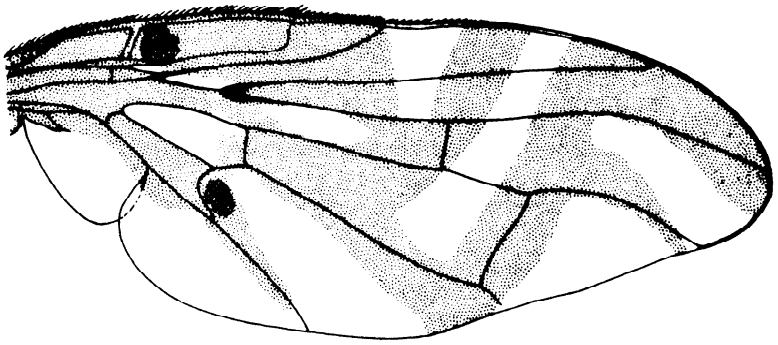
4 arculata ♀



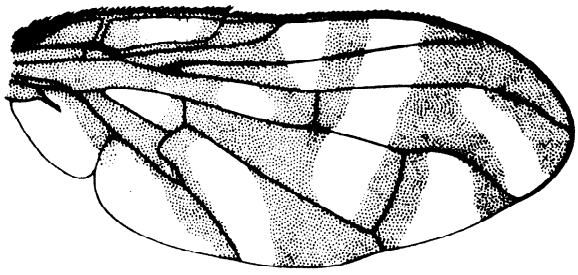
5 arculata ♂



6 intermedia ♂



7 stoltzfusi ♀



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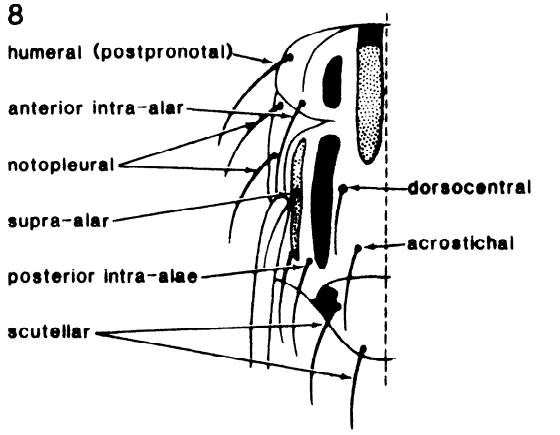
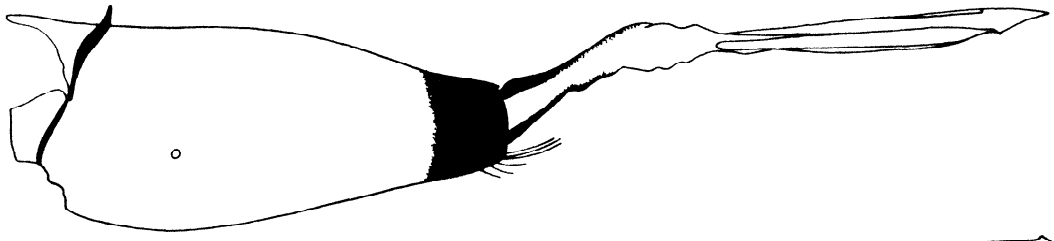



Dorsal Thoracic Chaetotaxy and Pattern

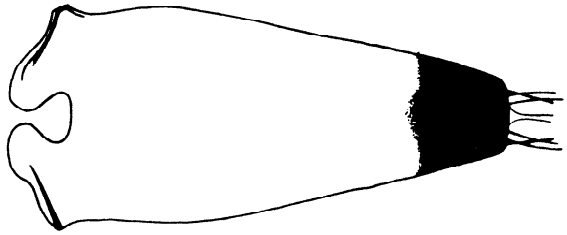
Primary pattern:
submesal (usually only anteriorly), subiateral, and scutellar (exc. in S. perfecta)

Secondary pattern:
supra-alar and extended submesal

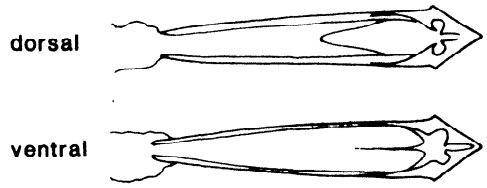
Not shown: adalar



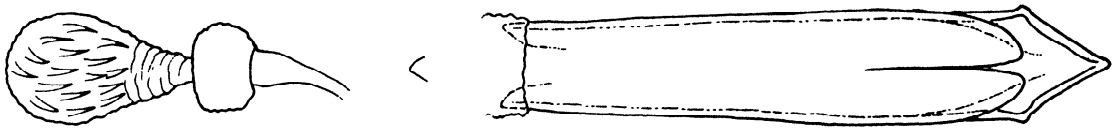
9a perfecta



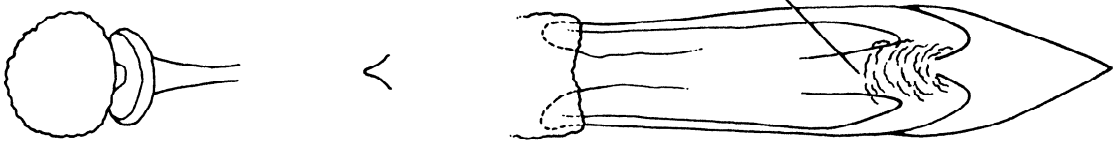
9b perfecta



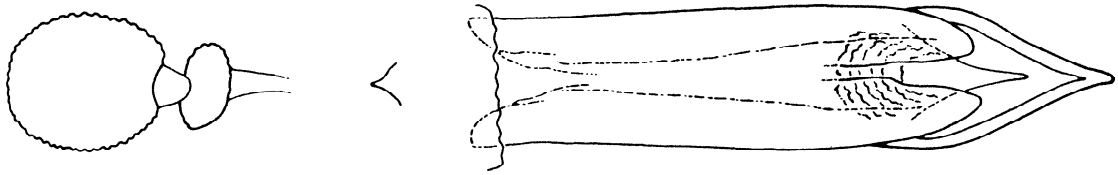

9c perfecta



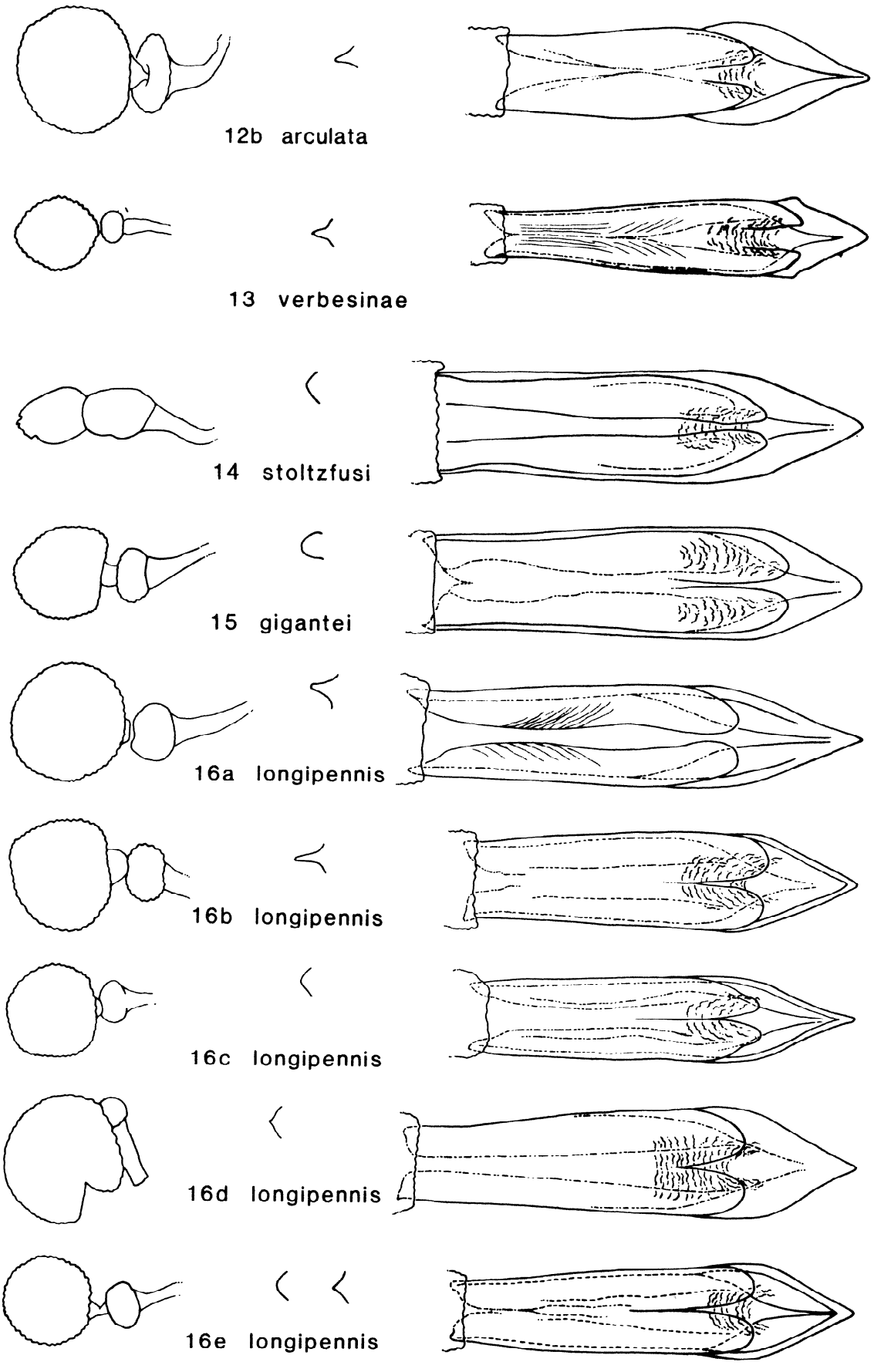
10 perfecta

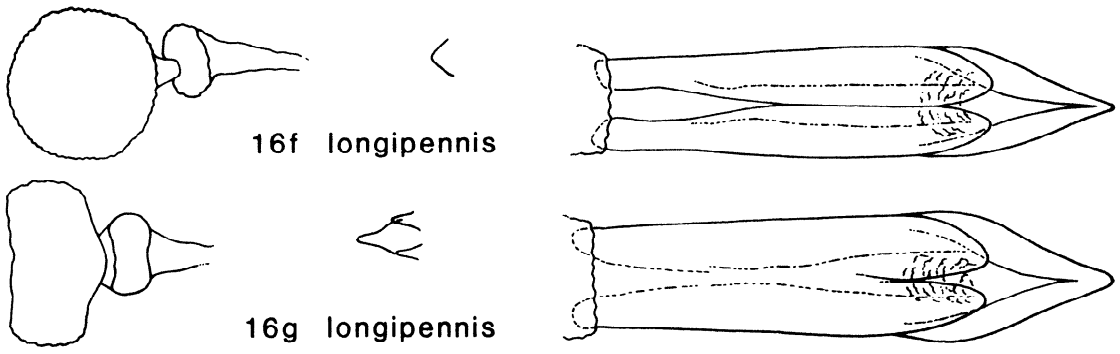



11 intermedia



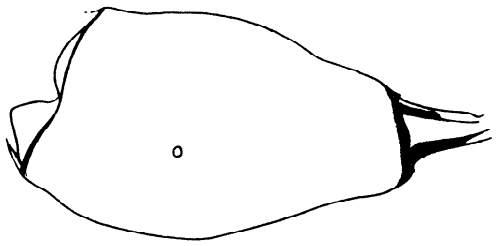
12a arculata


12b arculata
13 verbesinae
14 stoltzfusi
15 gigantei
16a longipennis
16b longipennis
16c longipennis
16d longipennis
16e longipennis

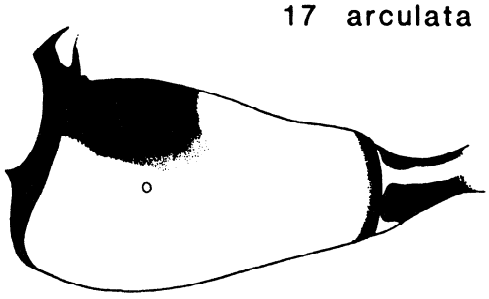


16f longipennis

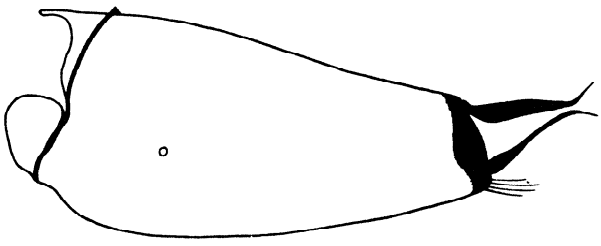
16g longipennis



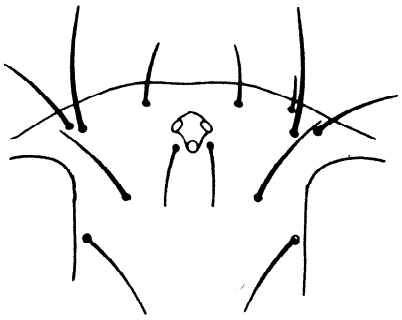
17 arculata



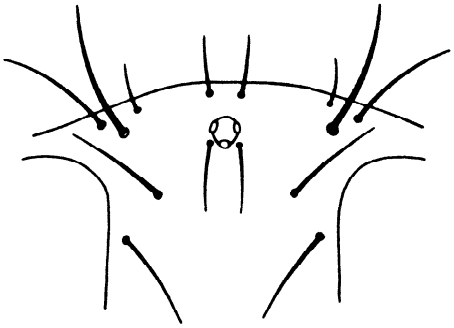
18 intermedia



19 longipennis



20 perfecta



21 longipennis