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Antennal Sensory Plaque Organs of the Fulgoridae (Homoptera: Fulgoroidea)【Research report】

蠟蟬科之觸角瓦楞感覺器（同翅目：蠟蟬總科）【研究報告】

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Abstract

The antennal sensory plaque organs of 46 species of Fulgoridae were examined. Type I (including subtype 1 and subtype 2) and Type II sensory plaque organs were observed. Type I: denticles with smooth surfaces. Subtype 1: cuticular ring obviously elevated. Denticles cone-shaped, incurved or erect, more or less longer on one side, gradually shortening to opposite side. Between cuticular ring and plate surface grooved. Subtype 2: cuticular ring not elevated. Denticles somewhat laterally curved, at apices distinctly directed mesad. Between cuticular ring and plate surface not grooved. Type II: denticles with ridged outer surface. The evolutionary trend of this organ in Fulgoridae is proposed to be Type I to Type II, but the relationship is unclear between the 2 subtypes. An assessment of the phylogenetic relationship of Fulgoridae according to the character of the antennal sensory plaque organ indicates that the Poiocerinae and Phenacinae, and the Fulgorinae and Aphaeninae are 2 subfamily-groups.

摘要

本文共檢查蠟蟬科46個種之觸角瓦楞感覺器，發現感覺器共有二型，第一型包括二亞型。第一型：錐狀突表面平滑。第一亞型：表皮環明顯昇高；錐狀突錐狀，端部內彎或直立，大致由一邊向另一邊逐漸變短；表皮環與盤面間具有溝。第二亞型：表皮環不昇高；錐狀突側方彎曲，端部指向中央；表皮環與盤面間不具溝。第二型：錐狀突外表面具有脊起。此科感覺器之演化趨勢認知為第一→二型，然亞型間之演化狀況仍未清楚。依據觸角瓦楞感覺器特徵之顯示，蠟蟬科之類緣關係建議分為Poiocerinae+Phenacinae和Fulgorinae+Aphaeninae兩個亞科類群（taxa）。

Key words: Fulgoridae, antennae, sensory plaque organs.
關鍵詞: 蠟蟬科，觸角，瓦楞感覺器。

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Antennal Sensory Plaque Organs of Fulgoridae (Homoptera: Fulgoroidea)

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ABSTRACT

The antennal sensory plaque organs of 46 species of Fulgoridae were examined. Type I (including subtype 1 and subtype 2) and Type II sensory plaque organs were observed. Type I : denticles with smooth surfaces. Subtype 1: cuticular ring obviously elevated. Denticles cone-shaped, incurved or erect, more or less longer on one side, gradually shortening to opposite side. Between cuticular ring and plate surface grooved. Subtype 2: cuticular ring not elevated. Denticles somewhat laterally curved, at apices distinctly directed mesad. Between cuticular ring and plate surface not grooved. Type II: denticles with ridged outer surface. The evolutionary trend of this organ in Fulgoridae is proposed to be Type I to Type II, but the relationship is unclear between the 2 subtypes. An assessment of the phylogenetic relationship of Fulgoridae according to the character of the antennal sensory plaque organ indicates that the Poiocerinae and Phenacinae, and the Fulgorinae and Aphaeninae are 2 subfamily-groups.

Key words: Fulgoridae, antennae, sensory plaque organs.

Introduction

Fulgoridae is one of the large families in Fulgoroidea, containing 5 subfamilies, 108 genera, and 543 species (Metcalf, 1947; O'Brien and Wilson, 1985). This family includes the largest and most bizarre species in the Fulgoroidea (Metcalf, 1947). These fulgorids have relatively larger antennae than any other fulgoroids, particularly in their pedicels. Most of the fulgorids' antennal pedicels have morphologically complex sensory plaque organs covering their entire surface.

Sensory plaque organs in Fulgoridae were first studied by Bugnion (1908) in the fulgorid *Fulgora maculata* Olivier (=*Laternaria maculata*). Then, the ultrastructure of the antennal plaque organ of *Pyrops candelaria* L. was described in detail (Lewis and Marshall, 1970; Marshall, 1973). The sensory plaque organs of *P. candelaria* showed Y-shaped structure of ridges which were surrounded by fluted denticles as in Type II (Lewis and Marshall, 1970; Marshall and Lewis, 1971; Baker and Chandrapatya, 1993). Recently, Bourgoin and Diess (1994) also described the antennal plaque organ of *Phenex variegata* Olivier, and its sensory plaques showed the Y-shaped structure of ridges encircled by acute tooth-like den-

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ticles as in Type I.

Extensive structural variations of the antennal plaque organs not only occur in different families of Fulgoroidea, but also within a single family, for example, in Tettigometridae, Fulgoridae, Flatidae, Issidae and Derbidae (unpublished data). This paper presents the variational conditions of antennal plaque organs in Fulgoridae, because many structural variations of plaque organs have not been described hitherto.

Materials and Methods

Dried specimens of 46 species belonging to 29 genera of 4 subfamilies of Fulgoridae were examined in this study (Table 1). Specimens of Amyclinae were not available for this study.

The antennae were amputated and treated in a hot solution of 10% KOH for 25 min, then dissected and pressed in glycerin in order to check the number of sensory plaque organs through a light microscope. For scanning electron microscopic observation, the antennae were first soaked in acetone for 15 min, then an ultrasonic cleaner was used for 10 sec with 70% alcohol. Next, the samples were placed in a 45-50℃ oven to dry for 3d, coated with gold, and examined with a Hitachi S-450 scanning electron microscope.

Results

Antennal sensory plaque organs in Fulgoridae are similar to those in the family Dictyopharidae of Fulgoroidea; their morphological structures are more complex than those in Tettigometridae. They consist of a cuticular ring with denticles and a folded cuticle with multiporous plaques. Two types, Type I with 2 subtypes and Type II, are described below.

Type I: Denticles with smooth surfaces.

Subtype 1: Cuticular ring obviously elevated. Denticles cone-shaped, incurved, or erect, more or less longer on one side, gradually shortening to opposite side. Between cuticular ring and plate with grooved surface.

1. *Desudaba psittaca* Walker (Figs. 1-3)

Denticles incurved, the longest about 12.3μm, as high as associated sensory plaque. Sensory plaque elongated oval in dorsal view, about 4.6μm wide, distinctly separated into peripheral and central layers, peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicel with about 113 sensory plaque organs.

2. *Paralystra* emma White (Figs. 4-6)

Denticles slightly incurved, the longest about 12.5μm, as high as associated sensory plaque. Sensory plaque stripe-shaped, thin in dorsal view, about 2.5μm wide, roughly separated into peripheral and central layers, peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicel with about 205 sensory plaque organs.

3. *Leiftinckana fuscata* (Spinola) (Figs. 7-9)

Denticles slightly incurved, the longest about 15μm, as high as associated sensory plaque. Sensory plaque stripe-shaped in dorsal view, about 3.1μm wide, distinctly separated into peripheral and central layers, rather densely distributed centrally, peripheral layer always protruding to outer margin of cuticular ring. Each pedicel with about 94 sensory plaque organs.

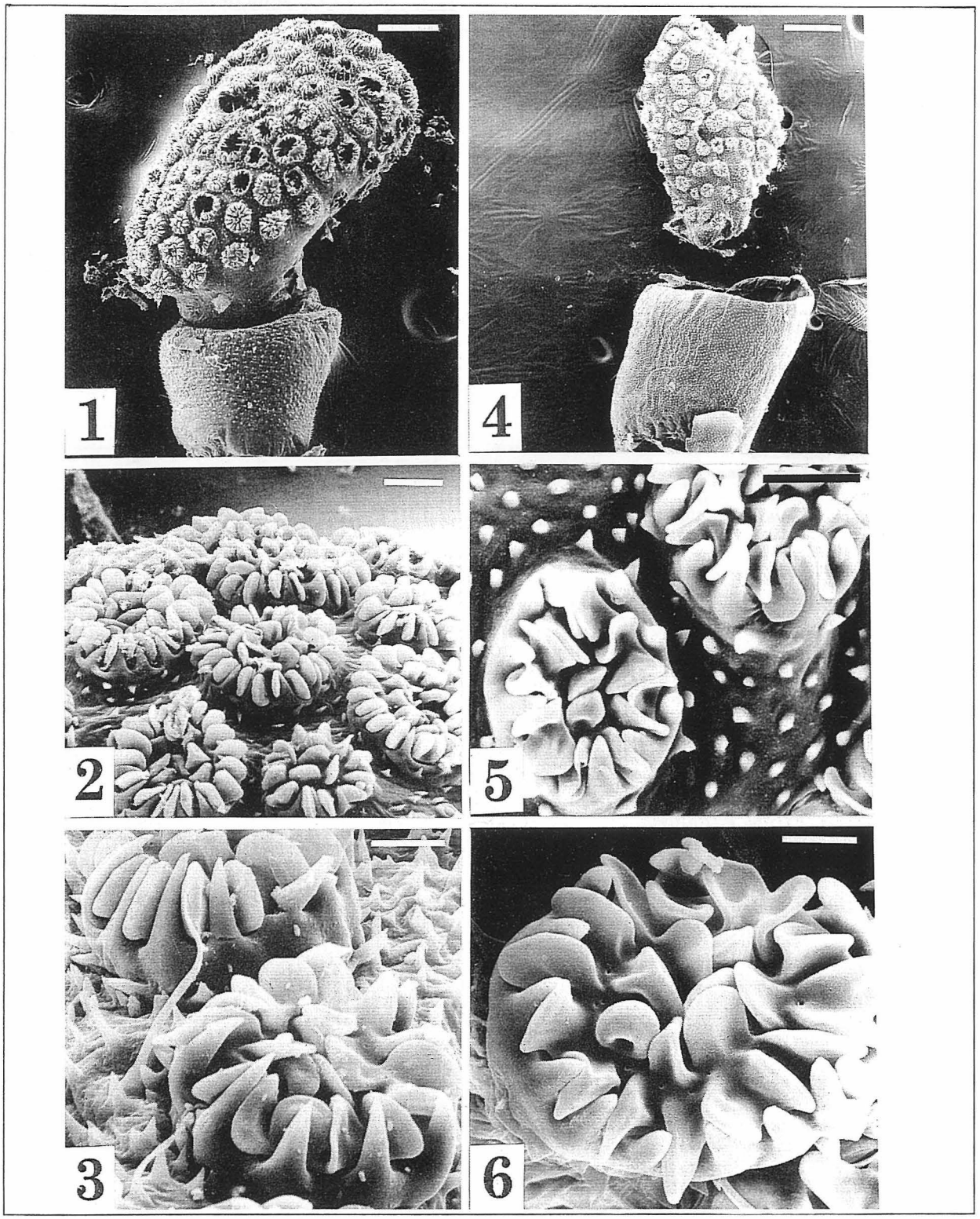
4. *Acraephia perspicillata* Fabricius (Figs. 10-12)

Denticles obliquely erect, the longest about 18.6μm, as high as associated sensory plaque. Sensory plaque stripe-shaped in dorsal view, about 1.6μm wide,

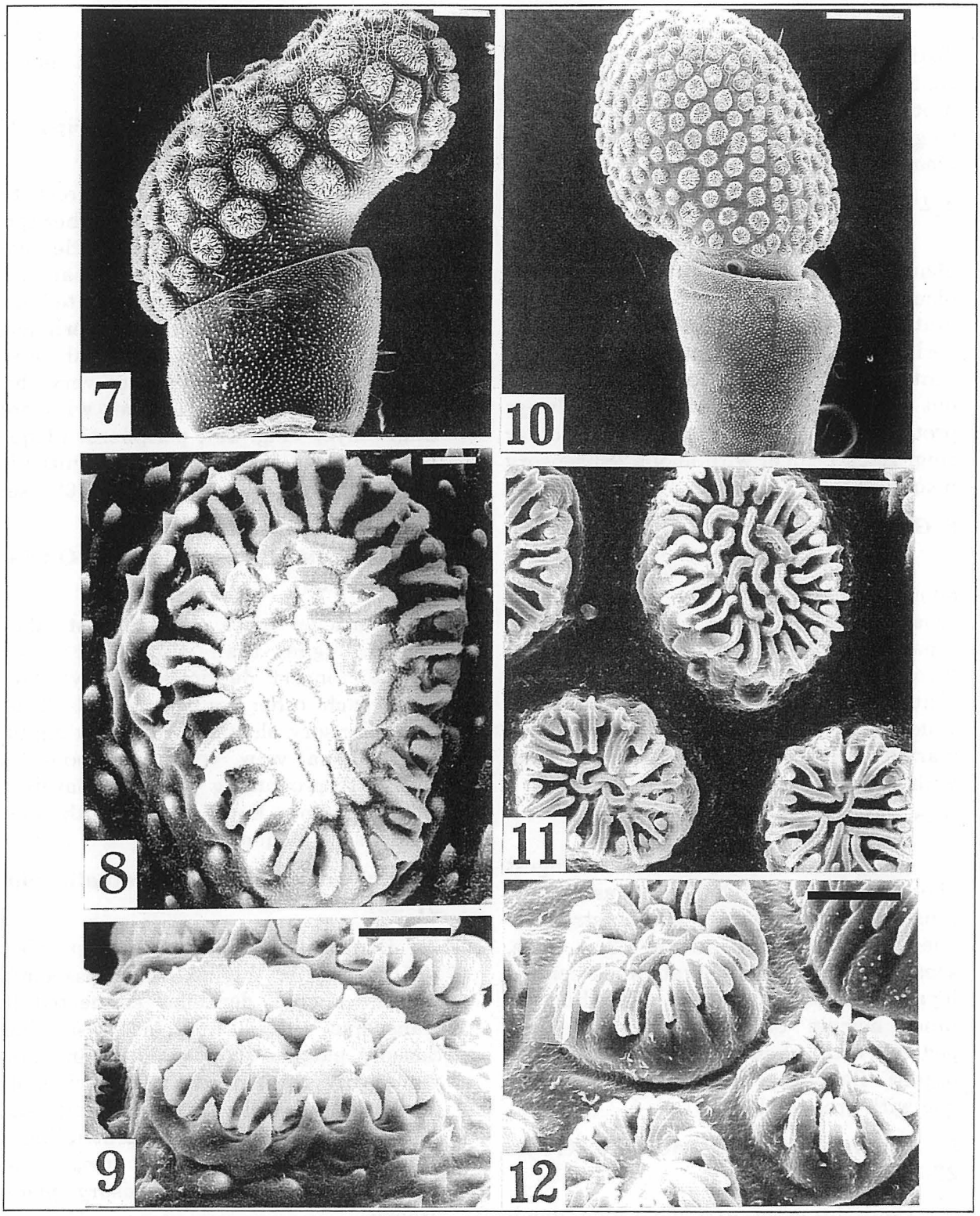
Table 1. Types, subtypes and total number of antennal sensory plaque organs in Fulgoridae.

Taxa	Sensory plaque organs		
	Type	Subtype	number
1. Poiocerinae			
(1) Paralystrini			
Paralystra emma	I	1—2*	205
Paralystrini sp.	I	1—6	295
(2) Lystrini			
Lystra lanata	I	1—5	283
(3) Poiocerini			
Acraephia perspicillata	I	1—4	267
Alphina glauca	I	1—8	89
Alaruasa violacea	I	1—9	243
Crepusia sp.	I	1—7	118
Desubaba psittaca	I	1—1	113
Guhydria brachialis	I	1—6	283
(4) Diloburini			
Aracynthus sanguineus	I	1—10	126
2. Phenacinae			
Menenia terebrifera	I	1—4	282
Phenax variegata	I	1—10	522
Pterodicttya reticularis	I	1—11	163
Cerogenes auricoma	I	2—2	907
3. Fulgorinae			
(1) Fulgorini			
Fulgora lampetis	I	1—8	720
Fulgora castresii	I	1—9	1084
Fulgora laternaria	I	1—9	630
Odontoptera carenoi	I	1—6	55
Phrictus diadema	I	1—11	380
Phrictus tripartitus	I	1—11	449
(2) Zannini			
Zanna servillei (*terminalis*)	I	1—6	316
Zanna comoriensis	I	2—1	90
Zanna madagascariensis	I	2—3	235
Zanna natalensis	I	2—4	204
(3) Laternarini			
Laternaria candelaria	II—7*		259
Laternaria pyrorhyncha	II—4		110
Laternaria watanabei	II—5		200
Pyrops candelaria	II—5		264
Pyrops lathburii	II—5		233
Pyrops spinolae (*condorina*)	II—7		157
Saiva cultellata	II—5		232
4. Aphaeninae			
(1) Enchophorini			
Enchophora subviridis	I	1—4	254
(2) Aphaenini			
Leiftinckana fuscata	I	1—3	94
Anecphora sumptuosa	II—2		402
Aphaena discolor	II—5		252
Lycorma meliae	II—3		242
Lycorma olivacea	II—1		172
Malfeyttia hilaris	II—4		196
Metaphaena basilactea	II—5		144
Metaphaena cruenta	II—5		160
Omalocephala cincta	II—8		203
Penthoides caja	II—7		165
Penthoides nearea	II—6		211
Penthoides pulchella	II—?		90
Penthoides variegata	II—7		285
Aphaenini sp.	II—7		140

*Indicates that the morphology of sensory plaque organs of the species are nearly the same as the described species (orderly number).



Figs. 1-3 *Desudaba psittaca* Walker. 1. Whole feature of antenna. 2. Sensory plaque organs near base. 3. Sensory plaque organs near apex. (Scale: 1=100μm, 2=20μm, 3=10μm) 4-6 *Paralystra emma* White. 4. Whole feature of antenna. 5. Sensory plaque organs near base. 6. Sensory plaque organ near apex. (Scale: 4=200μm, 5=20μm, 6=10μm)



Figs. 7-9 *Leiftinckana fuscata* (Spinola). 7. Whole feature of antenna. 8. Sensory plaque organ near base. 9. Sensory plaque organ near apex. (Scale: 7=100μm, 8=10μm, 9=20μm) Figs. 10-12 *Acraephia perspicillata* Fabricius. 10. Whole feature of antenna. 11. Sensory plaque organs near base. 12. Sensory plaque organs near apex. (Scale: 10=200μm, 11=20μm, 12=20μm)

distinctly separated into peripheral and central layers, peripheral layer always protruding to outer margin of cuticular ring. Each pedicel with about 267 sensory plaque organs.

5. *Lystra lanata* Linn'e (Figs. 13-15)

Denticles obliquely erect, the longest about 29μm, as high as associated sensory plaque. Sensory plaque distinctly separated into peripheral and central layers, peripheral sensory plaques stripe-shaped, central layer slightly stripe-sinuated, about 1.6μm wide. Peripheral layer always protruding to outer margin of cuticular ring. Each pedicel with about 283 sensory plaque organs.

6. *Guhydria brachialis* (Figs. 16-18)

Denticles obliquely erect, the longest about 23.9μm, as high as associated sensory plaque. Sensory plaques distinctly separated into peripheral and central layers, peripheral plaques stripe-shaped, central layer stripe-sinuated, about 1.6μm wide. Peripheral layer protruding to outer margin of cuticular ring. Each pedicel with about 283 sensory plaque organs.

7. *Crepusia* sp. (Figs. 19-21)

Denticles obliquely erect, the longest about 10.8μm, as high as associated sensory plaque. Sensory plaque stripe-shaped in dorsal view, about 1.3μm wide, separated into peripheral and central layers, peripheral layer protruding to inner margin of cuticular ring. Each pedicel with about 118 sensory plaque organs. Between cuticular ring and plaque with groove (Fig. 20).

8. *Alphina glauca* Metcalf (Figs. 22-24)

Denticles erect, extremely long, much higher than associated sensory plaque, the longest about 19.4μm. Sensory plaques irregular, rather thin in dorsal view, about 1.4μm wide, not protruding over inner margin of cuticular ring. Each pedicel with about 89 sensory plaque organs.

9. *Alaruasa violacea* Distant (Figs. 25-27)

Denticles slightly obliquely erect, the longest about 25.5μm, slightly higher than associated sensory plaque, denticles connected by smooth area at basal half. Sensory plaque distinctly separated into peripheral and central layers, peripheral plaques stripe-sinuated, central layer irregularly angulated. Plaques very thin, about 1μm wide, some plaques with only single layer (Fig. 26), peripheral plaques protruding to inner margin of cuticular ring. Each pedicel with about 1084 sensory plaque organs.

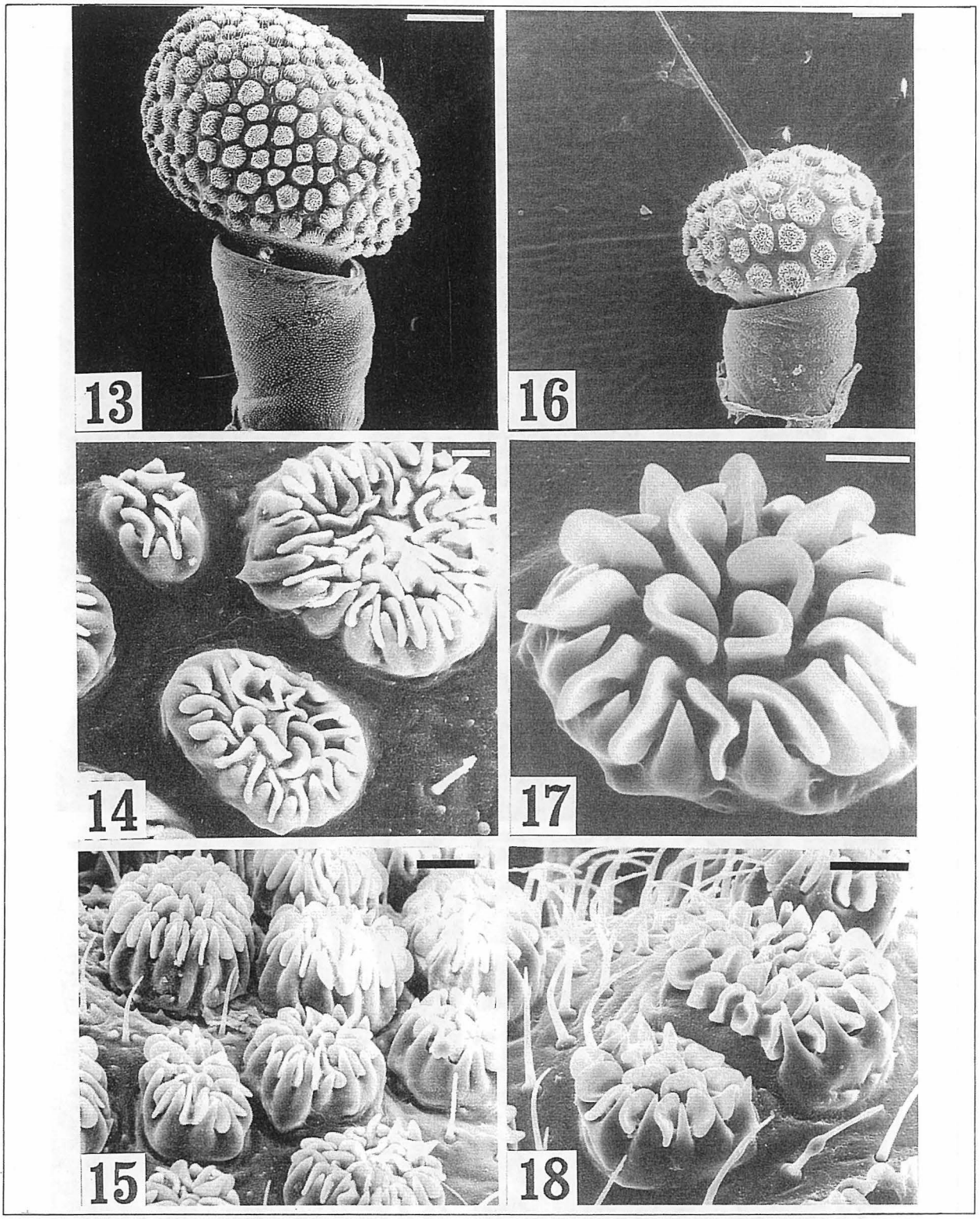
10. *Aracynthus sanguineus* (Olivier) (Figs. 28-30)

Denticles erect, the longest about 27.5μm, higher than associated sensory plaque, longest denticles closely contacting each other, only apical 1/4 isolated. Sensory plaques irregularly angulated in dorsal view, very thin, about 1μm wide, not protruding to inner margin of cuticular ring. Each pedicel with about 126 sensory plaque organs.

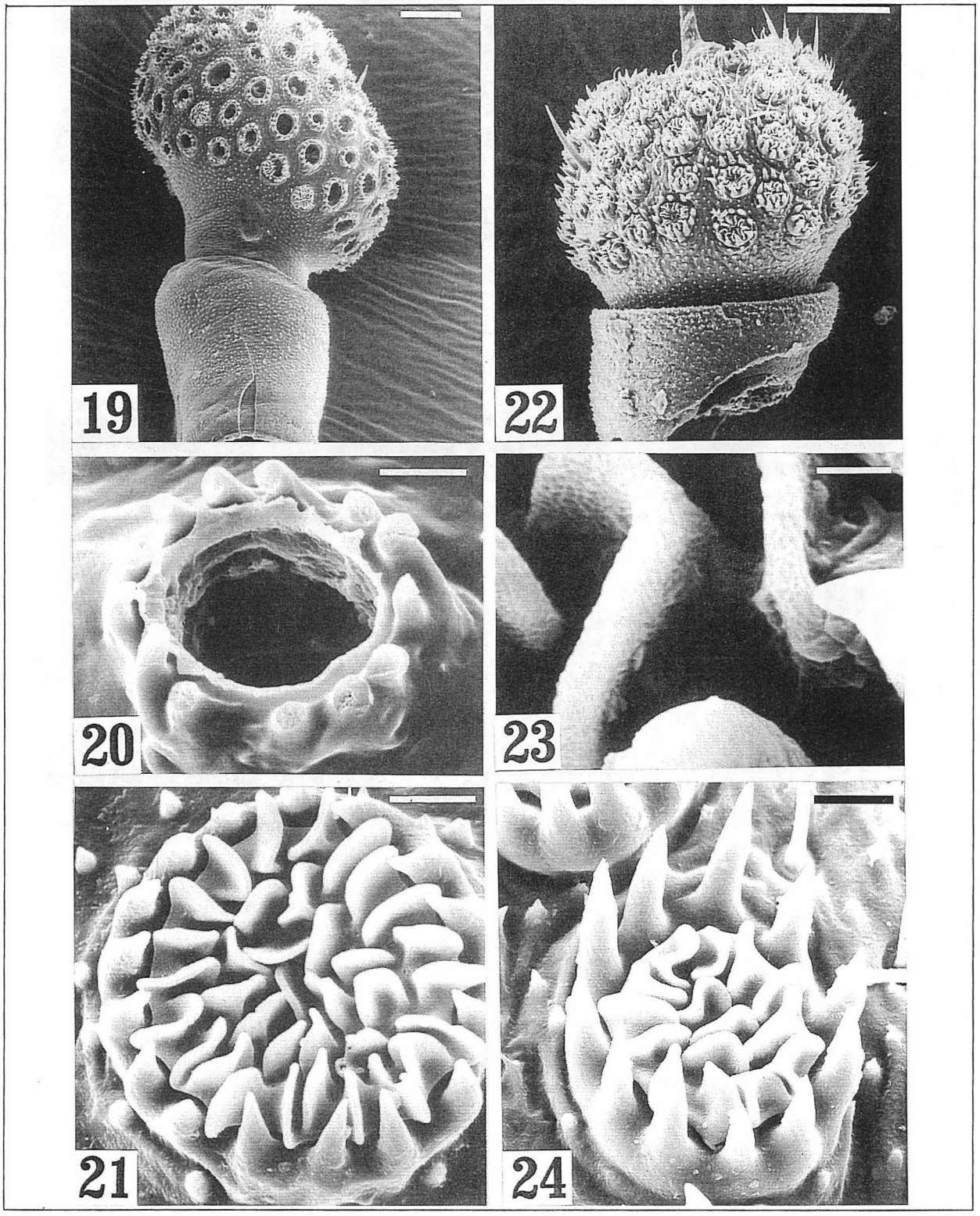
11. *Phrictus tripatitus* Metcalf (Figs. 31-33)

Denticles erect, the longest about 24.5μm, rather higher than associated sensory plaque, denticles connected by transverse ridged area at basal half. Sensory plaques stripe-sinuated in dorsal view, very thin, about 1.1μm wide, difficult to distinguish peripheral and centrral layers, sensory plaques protruding to outer margin of cuticular ring. Each pedicel with about 449 sensory plaque organs.

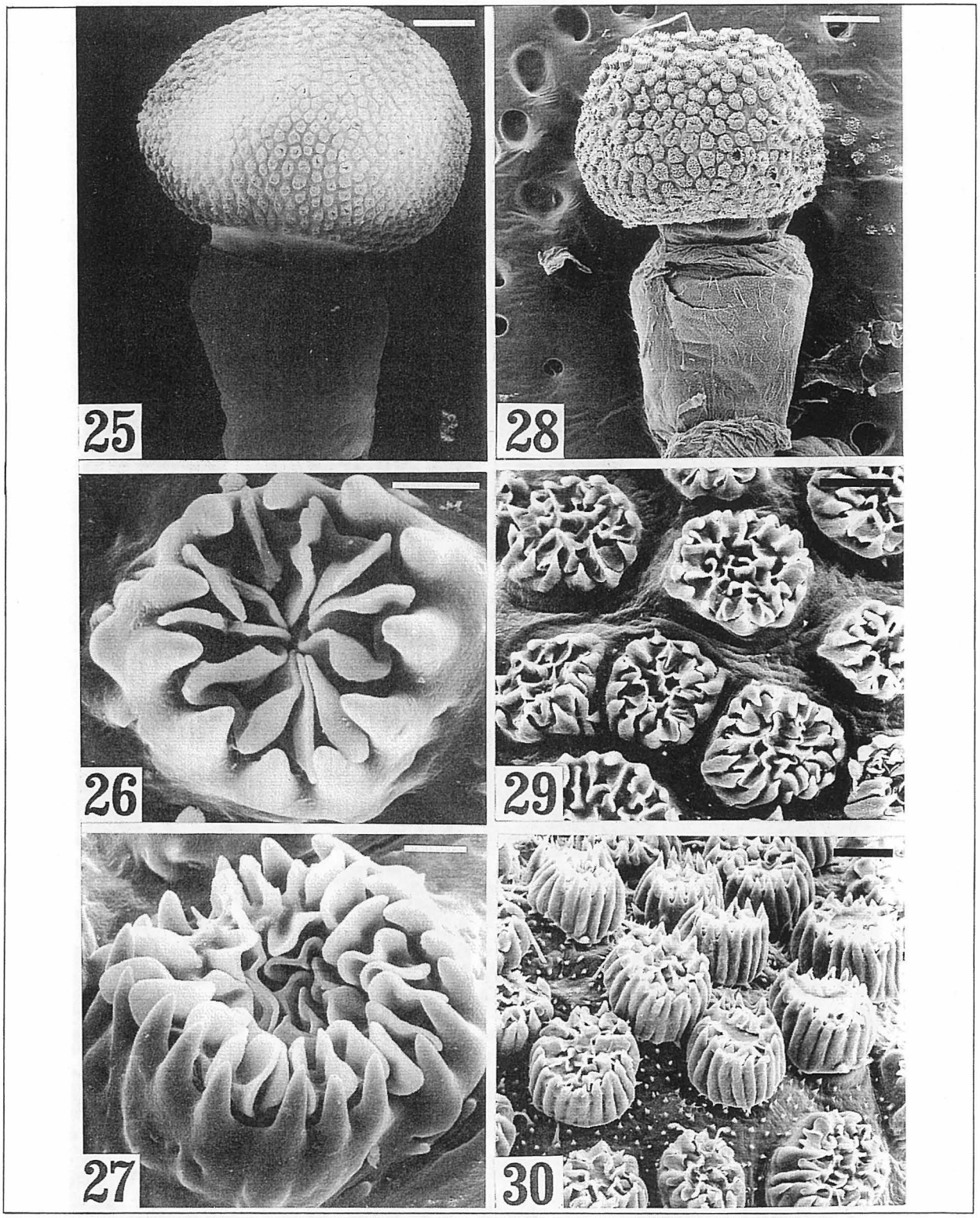
Subtype 2: Cuticular ring not elevated. Denticles somewhat laterally curved, distinctly directed mesad at apices. Sensory plaques distinctly separated into peripheral and central layers. Between



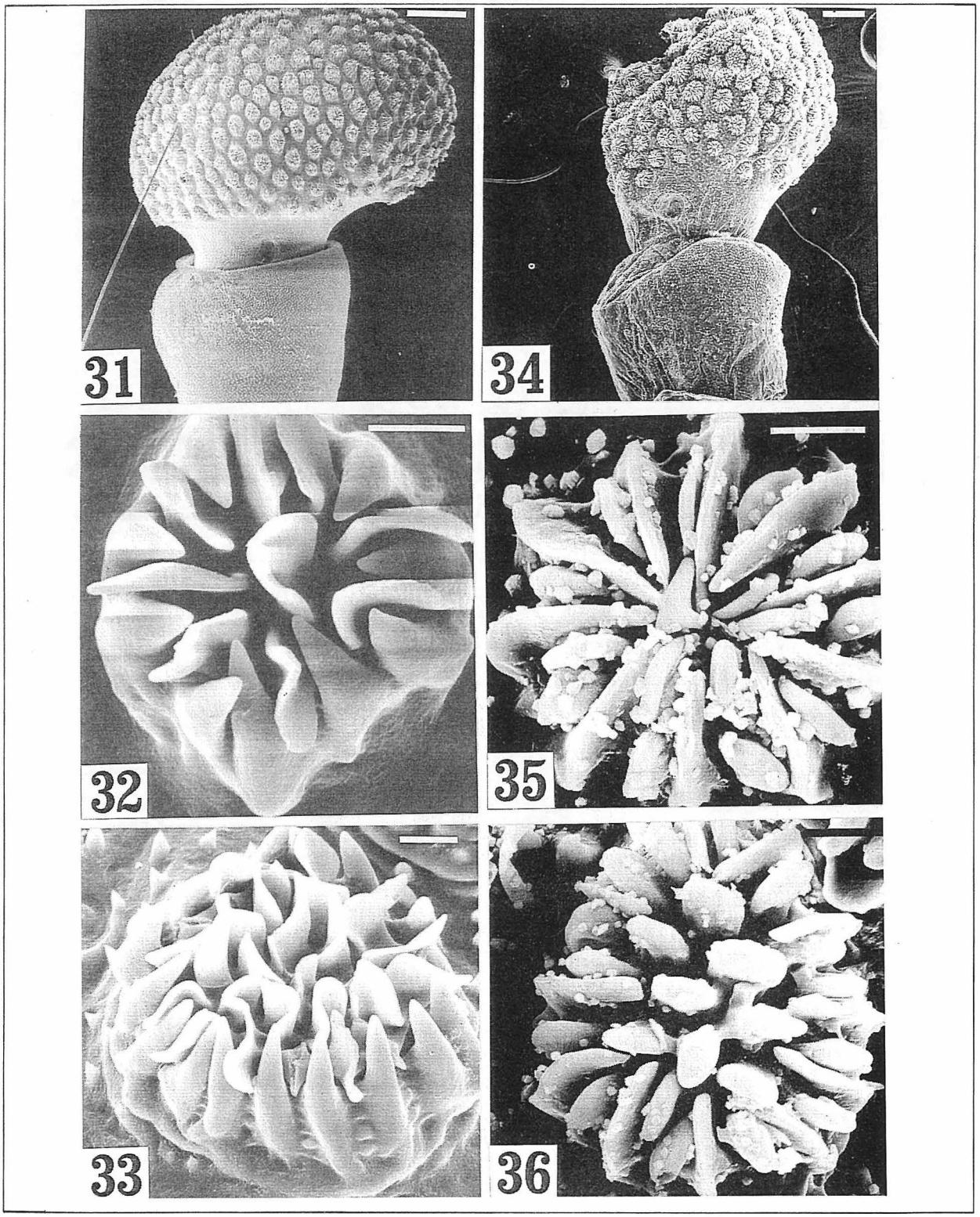
Figs. 13-15 *Lystra lanata* Linné. 13. Whole feature of antenna. 14. Sensory plaque organs near base. 15. Sensory plaque organs near apex. (Scale: 13=200μm, 14=10μm, 15=20μm) Figs. 16-18 *Guhydria brachialis.* 16. Whole feature of antenna. 17. Sensory plaque organ near base. 18. Sensory plaque organs near apex. (Scale: 16=100μm, 17=10μm, 18=20μm)



Figs. 19-21 *Crepusia* sp. 19. Whole feature of antenna. 20. Broken sensory plaque organ. 21. Sensory plaque organ near base. (Scale: 19=100μm, 20=10 μm, 21=10μm) Figs. 22-24 *Alphina glauca* Metcalf. 22. Whole feature of antenna. 23. Partial magnification of sensory plaque organ. 24. Sensory plaque organ near middle. (Scale: 22=100μm, 23=2μm, 24=10μm)



Figs. 25-27 *Alaruasa violacea* Distant. 25. Whole feature of antenna. 26. Sensory plaque organ near base. 27. Sensory plaque organ near apex. (Scale: 25=300μm, 26=10μm, 27=10μm) Figs. 28-30 *Aracynthus sanguineus* (Olivier). 28. Whole feature of antenna. 29. Sensory plaque organs near base. 30. Sensory plaque organs near apex. (Scale: 28=200μm, 29=30μm, 30=30μm)



Figs. 31-33 *Phrictus tripatitus* Metcalf. 31. Whole feature of antenna. 32. Sensory plaque organ near base. 33. Sensory plaque organ near apex. (Scale: 31=200μm, 32=10μm, 33=10μm) Figs. 34-36 *Zanna comoriensis*. 34. Whole feature of antenna. 35. Sensory plaque organ near base. 36. Sensory plaque organ near apex. (Scale: 34=100μm, 35=10μm, 36=10μm)

cuticular ring and plate surface not grooved.

1. *Zanna comoriensis* (Figs. 34-36)

Sensory plaque organs at basal part of pedicel with denticles extremely long in dorsal view, the longest about 23.9μm. Peripheral sensory plaques elongated oval, central elongated oval or triangular, about 2.4 and 3.1 μm wide, respectively. Sensory plaque organs at apical part of pedicel with denticles relatively short in dorsal view, the longest about 16.4μm. Sensory plaques elongated oval, about 5μm wide. Each pedicel with about 90 sensory plaque organs.

2. *Cerogenes auricoma* Burmeister (Figs. 37-39)

Sensory plaque organs at basal part of pedicel with denticles rather long in dorsal view, the longest about 17μm. Peripheral sensory plaques stripe-shaped, very thin, central one V-shaped, about 1.2 and 1.3μm wide, respectively. Sensory plaque organs at apical part of pedicle with denticles relatively long in dorsal view, the longest about 25.7μm. Sensory plaques stripe-shaped in peripheral and V-shaped in central, about 1 and 1.3μm wide, respectively. Each pedicel with about 907 sensory plaque organs.

3. *Zanna madagascariensis* Signoret (Figs. 40-42)

Sensory plaque organs at basal part of pedicel with denticles rather long in dorsal view, the longest about 20.6μm. Sensory plaques stripe-shaped in peripheral and slightly stripe-sinuated in central in dorsal view, about 2. 2 and 2.9μm wide, respectively. Sensory plaque organs at apical part of pedicle with denticles relatively long in dorsal view, the longest about 25.8μm. Sensory plaques stripe-shaped in peripheral, stripe- sinuated or Y-shaped in central, about 2.2 and 2.4μm wide, respectively. Each pedicel with about 235 sensory plaque organs.

4. *Zanna natalensis* Distant (Figs. 43-45)

Sensory plaque organs at basal part of pedicel with denticles rather long in dorsal view, the longest about 23μm. Denticles with lateral ridge. Sensory plaques stripe-shaped in peripheral and irregularly angulated or Y-shaped in central in dorsal view, about 2.1 and 2.3μm wide, respectively. Sensory plaque organs at apical part of pedicle with denticles relatively long in dorsal view, the longest about 28.9μm. Sensory plaques stripe-shaped in peripheral, irregularly angulated or Y-shaped in central, about 1.9 and 2.4 μm wide, respectively. Each pedicel with about 204 sensory plaque organs.

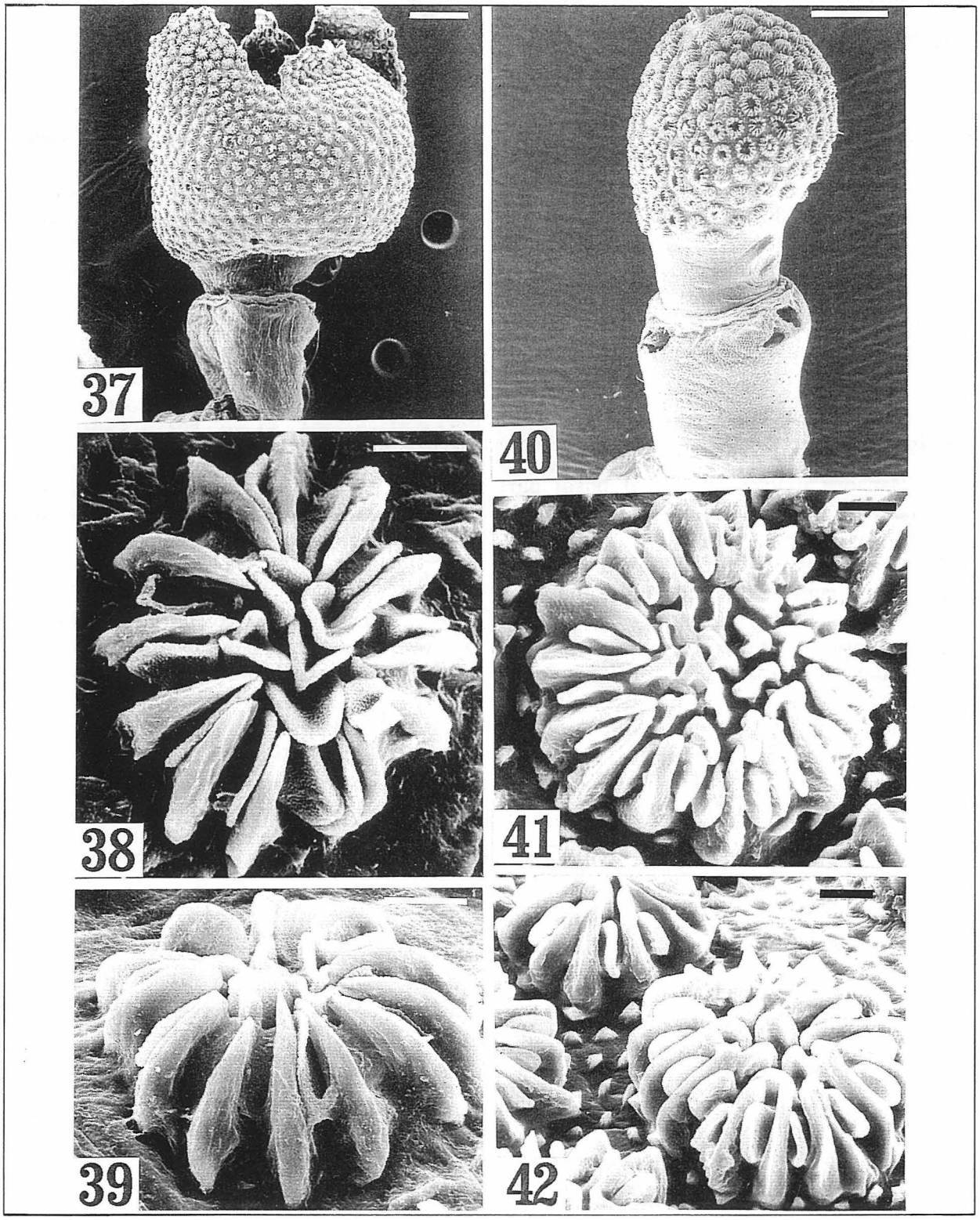
Type Ⅱ: Denticles with outer surface ridged. Outer basal portion more or less produced laterad and ridged.

1. *Lycorma olivacea* Kato (Figs. 46-48)

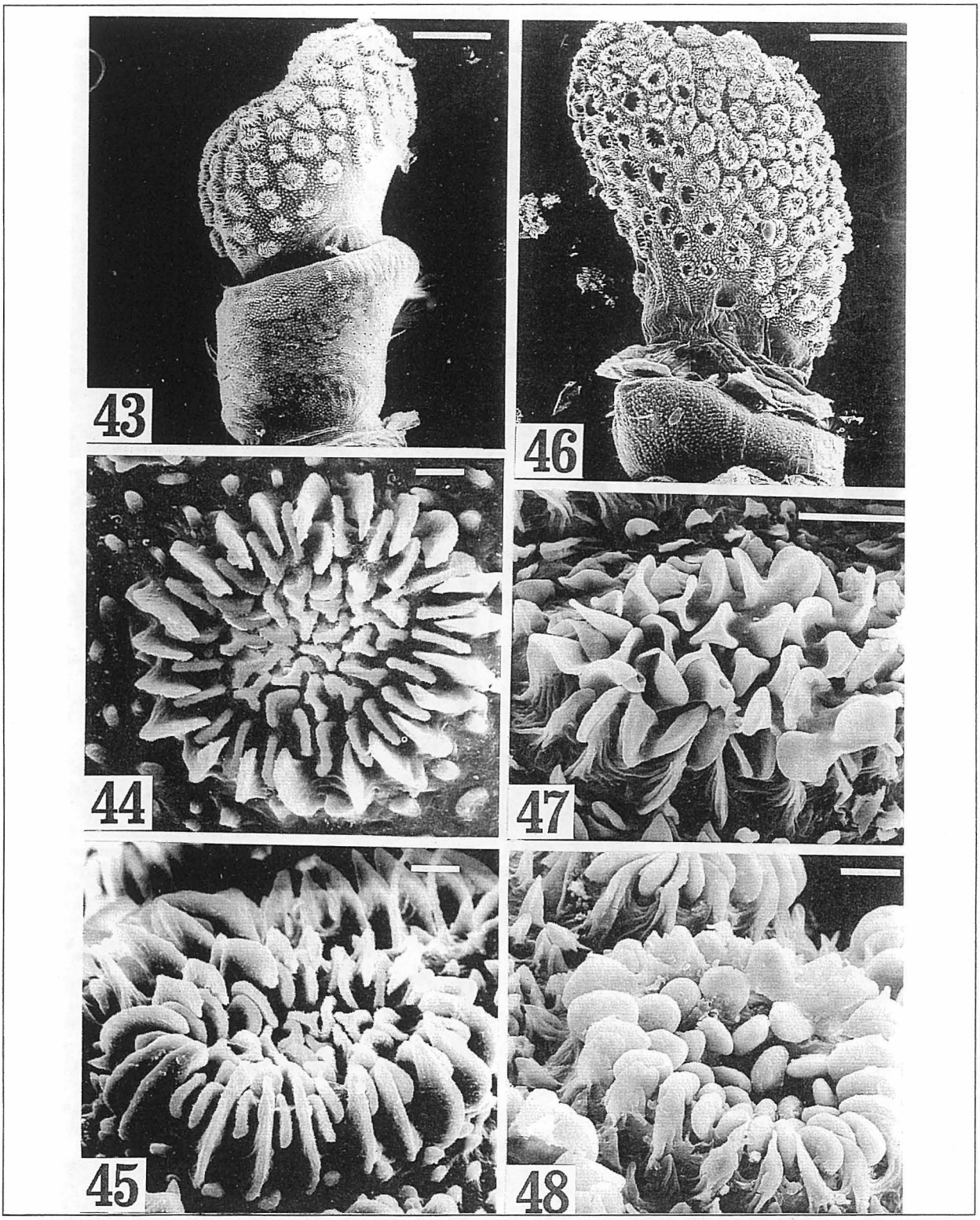
Denticles relatively small, always lower than associated sensory plaque, laterally depressed, outer basal portion distinctly produced laterad, the longest about 22.3μm. Most sensory plaques with same shape in peripheral and central layers, elongated oval in dorsal view, widest part about 5.1μm, but at basal portion some sensory plaques with mixed Y-shaped, triangular, elongated oval, and striped. Peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicel with about 172 sensory plaque organs.

2. *Anecphora sumptuosa* Gerstaecker (Figs. 49-51)

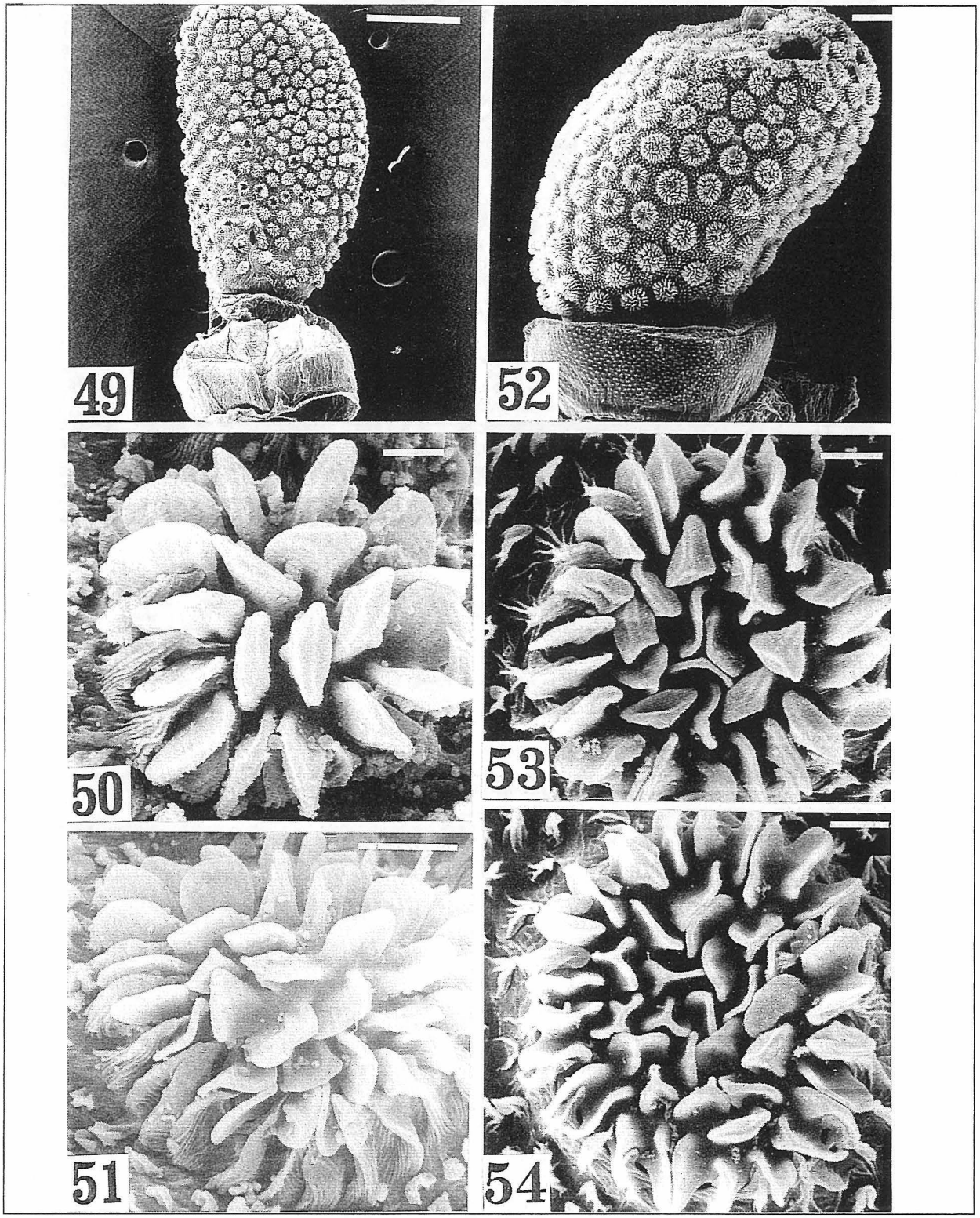
Denticles moderate sized, always lower than associated sensory plaque, laterally depressed, outer basal portion somewhat produced laterad, the longest about 21.8μm. Sensory plaques with same shape in peripheral and central layers at basal half, elongated oval, ridged in dorsal view, widest part about 7.3μm. At api-



Figs. 37-39 *Cerogenes auricoma* Burmeister. 37. Whole feature of antenna. 38. Sensory plaque organ near base. 39. Sensory plaque organ near apex. (Scale: 37=200μm, 38=10μm, 39=10μm) Figs. 40-42 *Zanna madagascariensis* Signoret. 40. Whole feature of antenna. 41. Sensory plaque organ near middle. 42. Sensory plaque organs near apex. (Scale: 40=200μm, 41=10μm, 42=10μm)



Figs. 43-45 *Zanna natalensis* Distant. 43. Whole feature of antenna. 44. Sensory plaque organ near base. 45. Sensory plaque organ near apex. (Scale: 43=100μm, 44=10μm, 45=10μm) Figs. 46-48 *Lycorma olivacea* Kato. 46. Whole feature of antenna. 47. Sensory plaque organ near base. 48. Sensory plaque organ near apex. (Scale: 46 =200μm, 47=20μm, 48=10μm)



Figs. 49-51 *Anecphora sumptuosa* Gerstaecker. 49. Whole feature of antenna. 50. Sensory plaque organ near base. 51. Sensory plaque organ near apex. (Scale: 49=400μm, 50=10μm, 51=20μm) Figs. 52-54 *Lycorma meliae* Kato. 52. Whole feature of antenna. 53. Sensory plaque organ near base. 54. Sensory plaque organ near apex. (Scale: 52=100μm, 53=10μm, 54=10μm)

cal-half portion, sensory plaques with same shape in peripheral and central layers, stripe-shaped, very thin in dorsal view, about 1. 2μm wide. Peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicle with about 402 sensory plaque organs.

3. *Lycorma meliae* Kato (Figs. 52-54)

Denticles rather small, always lower than associated sensory plaque, outer basal portion more or less protruding laterad, the longest about 12.7μm. Sensory plaques in peripheral layer stripe-shaped and elongated oval in dorsal view, about 1.4μm wide, but mixed with elongated oval, triangular, stripe-shaped, and Y-shaped in central layer, about 5.9, 9.1 and 1.8μm wide, respectively, elongated oval or triangular in dorsal surface ridged. Peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicel with about 242 sensory plaque organs.

4. *Laternaria pyrorhyncha* Donovan (Figs. 55-57)

Denticles ridged profoundly, the longest about 22.8μm, as high as or slightly higher than associated sensory plaque. Sensory plaques with same shape in peripheral and central layers, stripe-shaped, slightly sinuated, about 1.7μm wide. Each pedicel with about 110 sensory plaque organs.

5. *Metaphaena cruenta* Gerstaecker (Figs. 58-60)

Denticles rather small, the longest about 20.8μm, as high as associated sensory plaque, outer basal portion only slightly produced laterad. Sensory plaques stripe-shaped in peripheral and stripe-sinuated in central layer, about 1.5 and 1.8μm wide, respectively. Peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicel with about 160 sensory plaque organs.

6. *Phenthoides nearea* (Figs. 61-63)

Denticles moderate sized, the longest about 25.4μm, as high as associated sensory plaque, outer basal portion protruding laterad. Sensory plaques stripe-shaped in peripheral and stripe-sinuated or Y-shaped in central layer, about 1.4 and 2μm wide, respectively. Peripheral sensory plaques always protruding to outer margin of cuticular ring. Each pedicel with about 211 sensory plaque organs.

7. *Penthicodes candelaria* Linn'e (Figs. 64-66)

Denticles rather small, the longest about 15.8μm, as high as associated sensory plaque, outer basal portion strongly protruding laterad and profoundly ridged. Sensory plaques stripe-shaped in dorsal view, strongly sinuated in peripheral and strong Y- or H-shaped in central, about 2 and 1.5μm wide, respectively. Each pedicel with about 259 sensory plaque organs.

8. *Omalocephala cincta* Fabricius (Figs. 67-70)

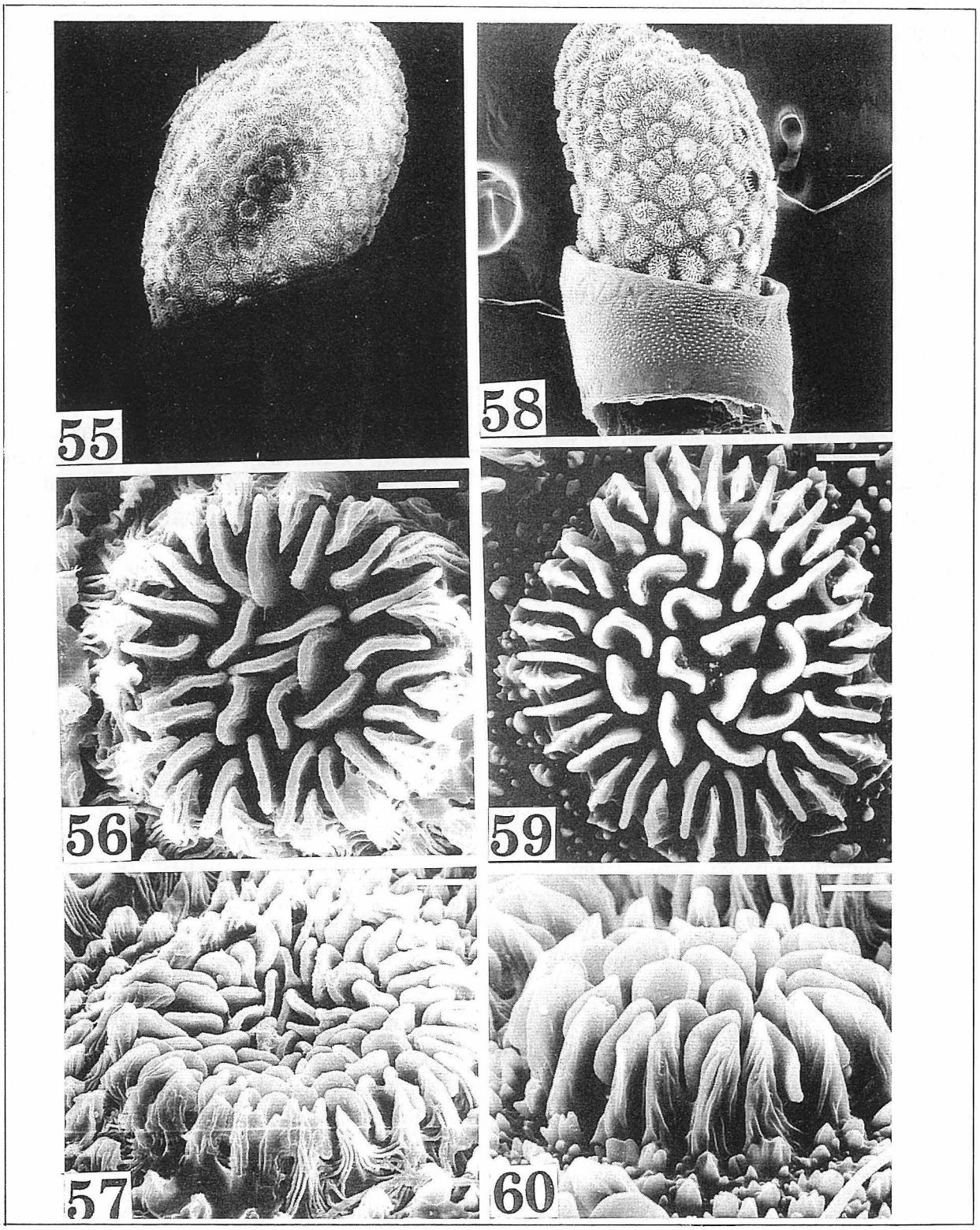
Denticles large, stout, distinctly higher than associated sensory plaque, whole surface ridged, the longest about 21.7μm. Sensory plaques stripe-shaped in dorsal view, strongly sinuated or angulated, about 1.6μm wide. Each pedicel with about 203 sensory plaque organs.

In addition to these descriptions, the types, subtypes, and the number of sensory plaque organs in each pedicel of 46 species are given in Table 1.

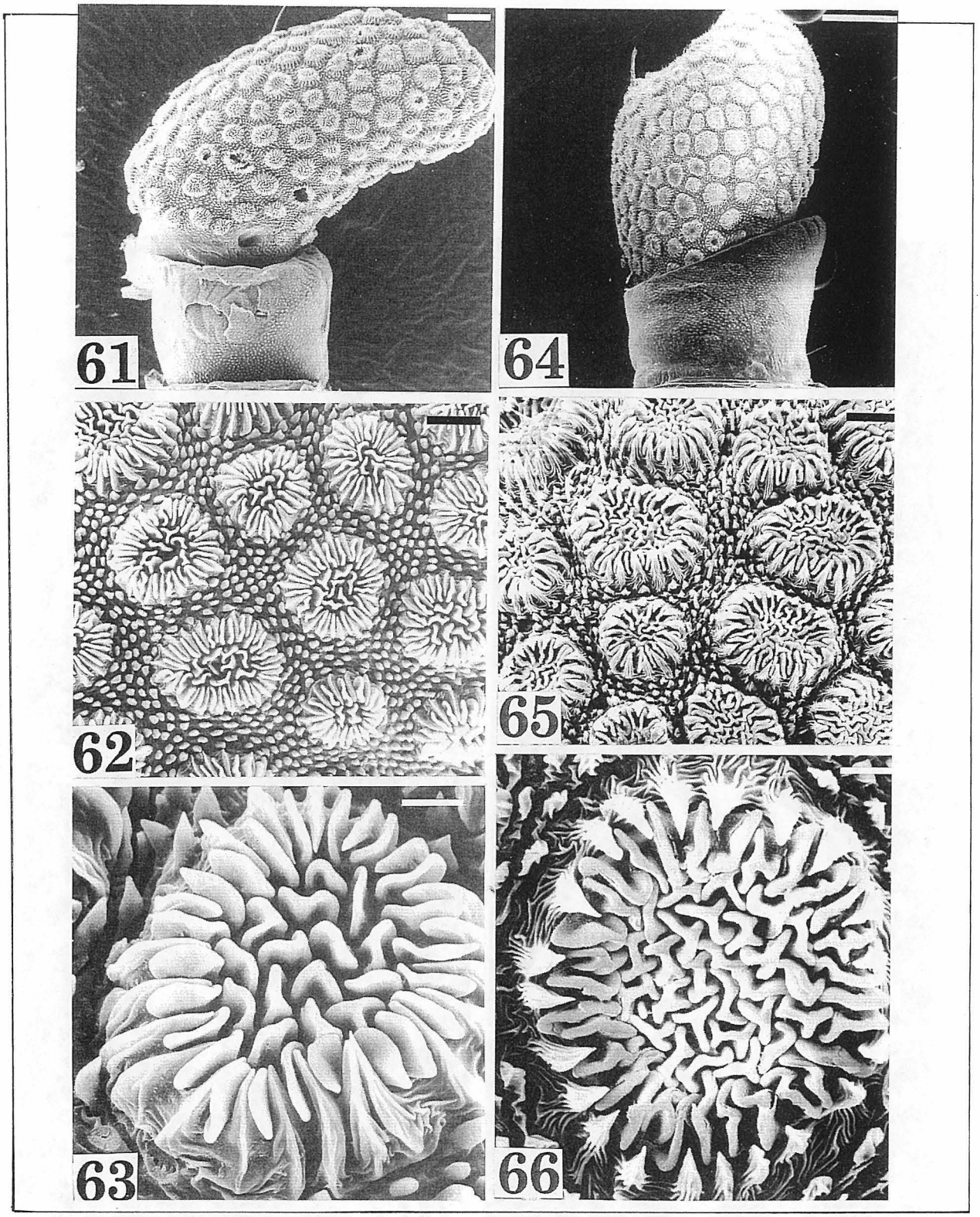
Discussion

Based on the examined species of Fulgoridae, we conclude that their sensory plaque organs have three main morphological variations.

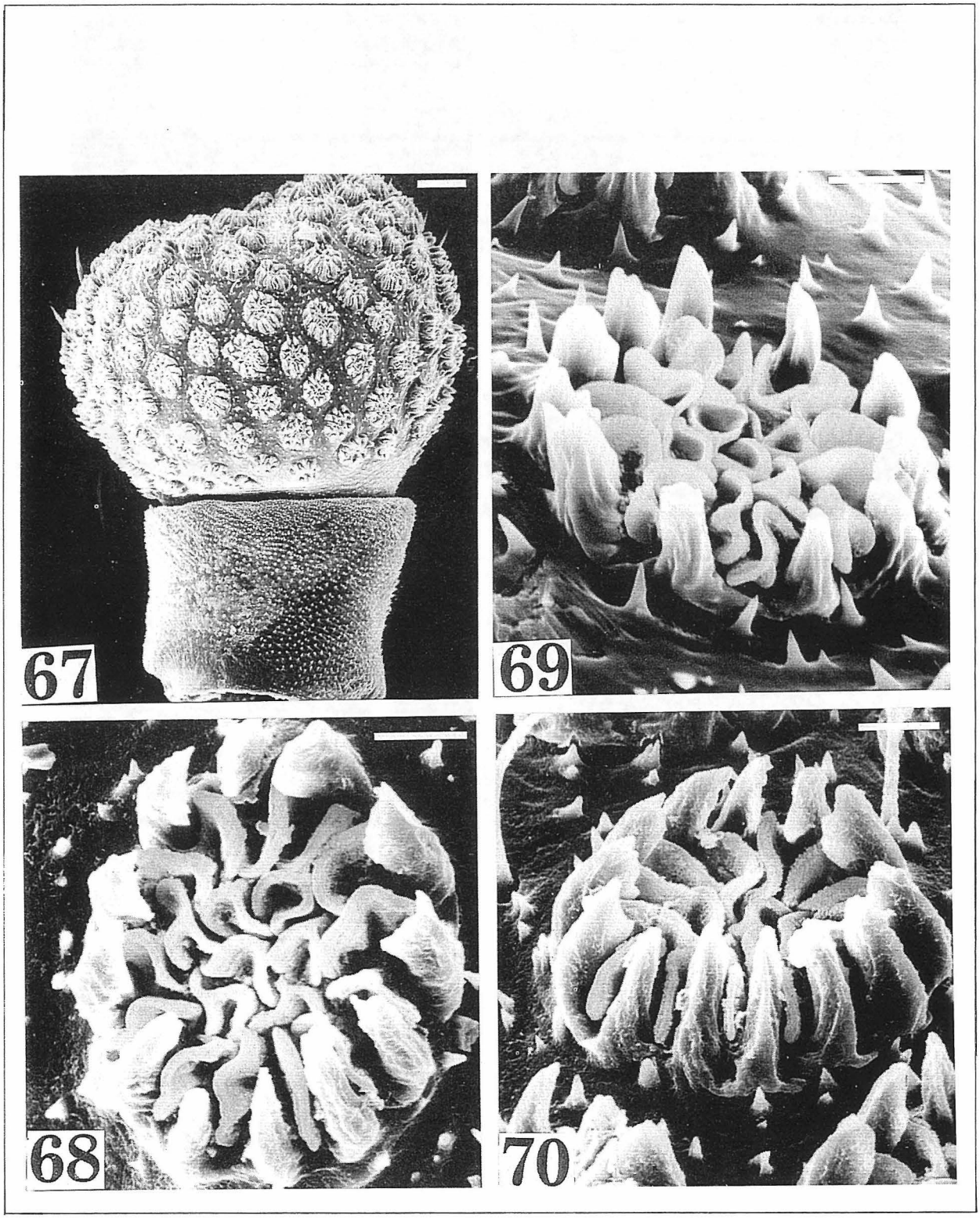
(1) Cuticular ring obviously elevated (in subtype 1 of Type Ⅰ, and Type Ⅱ) or



Figs. 55-57 *Laternaria pyrorhyncha* Donovan. 55. Whole feature of antenna. 56. Sensory plaque organ near base. 57. Sensory plaque organ near apex. (Scale: 55=200μm, 56=10μm, 57=10μm) Figs. 58-60 *Metaphaena cruenta* Gerstaecker. 58. Whole feature of antenna. 59. Sensory plaque organ near base. 60. Sensory plaque organ near apex. (Scale: 58=200μm, 59=10μm, 60=10μm)



Figs. 61-63 *Phenthoides nearea* Linné. 61. Whole feature of antenna. 62. Sensory plaque organs near base. 63. Sensory plaque organ near apex. (Scale: 61=100μm, 62=30μm, 63=10μm) Figs. 64-66 *Phenthoides candalaria* Linné. 64. Whole feature of antenna. 65. Sensory plaque organs near apex. 66. Sensory plaque organ near base. (Scale: 64=200μm, 65=30μm, 66=10μm)



Figs. 67-70 *Omalocephala cincta* Fabricius. 67. Whole feature of antenna. 68. Sensory plaque organ near base. 69. Sensory plaque organ near lateral side. 70. Sensory plaque organ near apex. (Scale: 67=50μm, 68=10μm, 69=10μm, 70=10μm)

not elevated (in subtype 2 of Type I).

(2) Denticle surfaces smooth (in Type I), outer surface slightly ridged (type II, in part) or distinctly ridged (in most of type II). Direction of extension of denticles erect (subtype 1 of Type I and Type II, in part), incurved (in most of subtype 1 of Type I and Type II), or distinctly directed mesad (subtype 2 of Type I). Besides, denticles always better developed in distal portion of every pedicel than in basal portion.

(3) Plaques usually separated into peripheral and central layers; peripheral plaque singly radiates outwards, not reaching or reaching outer margin of cuticular ring; central plaques exhibit complex changes, elongated oval (subtype 1 of Type I and Type II, in part), striped or stripe-sinuated (Type I and Type II, in part), V-shaped (subtype 2 of Type I, in part), and Y-shaped or irregularly angulated (Type I and Type II, in part).

According to the above character variations, the sensory plaque organs of Fulgoridae are grouped into 2 types, Type I and Type II. Type I can be devided into 2 subtypes. In the cuticular rings, on the superfamily level, the elevated ones are less general and should be the advanced character state. In denticles, the smooth surfaces on the superfamily level are more general, and they most likely have evolved gradually into ridged outer surfaces.

In plaques, however, the elongated oval form has been observed in both types, so the condition might be considered a parallel change. The character state which is more general should be the primitive state. In Type I, the striped, stripe-sinuated, Y-shaped, or irregularly angulated forms should be derived from the elongated oval form but their mutual relationships are difficult to be elucidate. The plaques gradually change from thick to thin. However, in Type II the elongated oval form might have derived in two directions. One of the derived forms is the elongated oval form as in Type I; another derived form is the dorsal surface which is elongated oval, and/or the triangular plaques exhibiting ridges, which then reduced to striped or Y-shaped plaques, or which went from triangular to Y-shaped plaques. The widths of plaques gradually change from thick to thin. The striped, stripe-sinuated, Y-shaped, and irregularly angulated forms are found in Types I and II. These character states are also considered as parallel evolutionary changes. Sometimes, two structures can be found in a single pedicel, for example, in *F. castresii, L. olivacea,* and *Z. madagascariensis.* Two or three structures can occur in a plaque organ, for example, in *L. meliae, L. olivacea,* and *Z. comoriensis.* This may imply an intermediate process in the evolution of the plaques.

Antennal sensory plaque organs of the fulgorids are usually distributed in the apical 2/3 or 3/4 portion, or over the entire whole surface of the pedicels. The number of plaque organs differs in different species. In all examined species, the majority of plaque organs numbered from 110 to 300. However, the smallest number (55) was found in *O. carenoi,* and the greatest number (1084) was found in *F. castresii.* These 2 species represent the subtype 1 of Type I. The number of sensory plaque organs in subtype 2 of Type I ranged from 204 to 907; those of Type II ranged from 90 to 402. The above data indicate that the total number of plaque organs is not related to the types which have been assigned in the paper.

Based on the above analyses, the evolutionary trend of the sensory plaque organ is proposed to be Type I →Type II. The relationship of subtypes in Type I is still ambiguous.

In spite of the extensive structural variations of sensory plaque organs in the family Fulgoridae, in the subfamilies Poiocerinae and Phenaciinae, the sensory plaque organs totally belong to Type I,

and all plaque organs in Poiocerinae belong to subtype 1 of Type Ⅰ. In the subfamily Fulgorinae, all plaque organs in the tribes Fulgorini and Zannini totally belong to Type Ⅰ, and the plaque organs of Fulgorini all belong to subtype Ⅰ of Type Ⅰ. In addition, the plaque organs of the tribe Laternarini in Fulgorinae all belong to Type Ⅱ. In 15 species of the subfamily Aphaeninae, sensory plaque organs of 13 species belong to Type Ⅱ; those of the other 2 species may bear a reversed status. The data indicate that the Poiocerinae possesses a primitive character state in Fulgoridae, derived states are in Phenacinae, then Fulgorinae, and Aphaeninae in that order, and Aphaeninae bears the most advanced character state.

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蠟蟬科之觸角瓦楞感覺器(同翅目：蠟蟬總科)

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摘 要

本文共檢查蠟蟬科46個種之觸角瓦楞感覺器，發現感覺器共有二型，第一型包括二亞型。第一型：錐狀突表面平滑。第一亞型：表皮環明顯昇高；錐狀突錐狀，端部內彎或直立，大致由一邊向另一邊逐漸變短；表皮環與盤面間具有溝。第二亞型：表皮環不昇高；錐狀突側方彎曲，端部指向中央；表皮環與盤面間不具溝。第二型：錐狀突外表面具有脊起。此科感覺器之演化趨勢認知為第一→二型，然亞型間之演化狀況仍未清楚。依據觸角瓦楞感覺器特徵之顯示，蠟蟬科之類緣關係建議分為Poiocerinae＋Phenacinae和Fulgorinae＋Aphaeninae兩個亞科類群(taxa)。

關鍵詞：蠟蟬科，觸角，瓦楞感覺器。

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