

## The Noctuid Moth of the Genus *Trotosema*, with Special Reference to its Male Scent Organ<sup>1)</sup>

By

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Scent organs found in the male sex have been known in many Lepidoptera, occurring on almost any part of the body. Similar organs are sometimes found in different lepidopteran groups irrespective of their relationship.

On the other hand, very complex organs peculiar to certain limited groups were reported. For example, BIRCH (1970, 1972) intensively studied abdominal brush-organs of Noctuidae and put an emphasis on their taxonomic importance. WHALLEY (1974) described another type of scent organs in the *tibialia* species-group of *Striglina* (Thyrididae); they consist of two parts, a pair of hair-pencils from hindwings and a pair of scale pouches on the lateral sides of abdomen. In this paper, I am going to deal with new types of scent organs, which lie on labial palpi and are associated with modifications of heads and thoraces.

*Trotosema sordidum* was described by BUTLER (1879) on the basis of a single specimen (Fig. 1) from Japan [Yokohama, Pryer coll. (LEECH, 1889)]. However, this species was not correctly identified by Japanese researchers because of the inadequacy of the original description and the poor illustration by WARREN (1913). Fortunately, I had an opportunity to examine the photograph taken by Professor H. INOUE of the type-specimen preserved in the British Museum (Natural History), and became aware of the fact that this species was nothing but the unidentified species having the Japanese name "Fusakiba-Atsuba" (WATANABE, 1973). In this paper, therefore, *Trotosema sordidum* BUTLER is redescribed on the basis of materials from Japan and Korea. Accounts are also given of the specialized male labial palpi of this genus and the related genera, *Hadennia*<sup>2)</sup> and *Cidariplura*.

### Genus *Trotosema* BUTLER, 1879

*Trotosema* BUTLER, 1879, Ann. Mag. nat. Hist., (5), 4: 488; type-species: *Trotosema sordidum*

1) This study is supported by the Grant-in-aid for Scientific Research from the Ministry of Education, No. 374246, 1978.

2) The following three species have been known from Japan. They will be revised in another opportunity.

1. *Hadennia incongruens* (BUTLER, 1879), sp. riv. & comb. nov.

*Bocana incongruens* BUTLER, 1879, Ann. Mag. nat. Hist., (5), 4: 448.

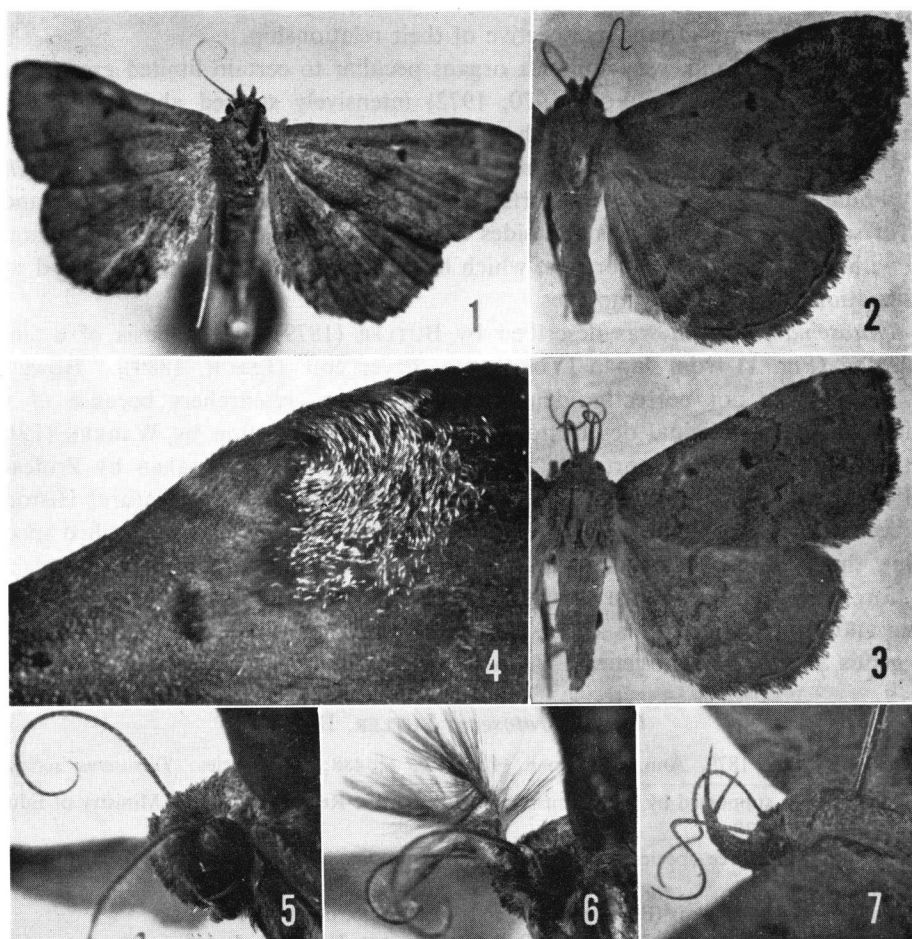
2. *Hadennia obliqua* (WILEMAN, 1911), comb. nov.

*Nodaria obliqua* WILEMAN, 1911, Trans. ent. Soc. Lond., 1911: 255, pl. 31, fig. 15.

3. *Hadennia* sp. (undescribed species).

BUTLER, 1879, by monotypy. — WARREN, 1913, in SEITZ, *Gross-Schmett. Erde*, **3**: 423. — INOUE & SUGI, 1958, *Check List Lepidopt. Japan*, part 5, 594. — NYE, 1975, *Generic name of Moths of the World*, 1: 459.

Proboscis well developed. Antenna in male ciliated, with a pair of long bristles on each segment; in female ciliated, bristles of each segment slenderer and shorter than in male. Labial palpus in male (Figs. 5, 6 & 15) elongated; 1st segment upcurved along frons, reaching vertex, covered with ordinary scales on the exterior surface; 2nd segment straight, reaching occiput along the median line of vertex, bearing long hairs arising from the under surface of distal half, outer surface with ordinary scales; 3rd segment very long, reaching middle of mesoscutellum, with long hairs



Figs. 1-7. *Trotosema sordidum* BUTLER. — 1. Holotype. — 2. Male. — 3. Female. — 4. Male forewing, showing androconia. — 5-6. Male head; labial palpi concealed (5), and labial palpi exposed (6). — 7. Female head.

except for apical 1/3, which is slender and without scales. Labial palpus in female (Fig. 7): 1st segment short; 2nd segment upcurved, reaching far above vertex; 3rd segment slender, a little shorter than 2nd, pointed; external surfaces of all segments covered tightly with ordinary scales. Eye naked without lash. Ocellus present. Vertex in male flattened, occiput flattened and developed posteriorly (Fig. 12); in female not specialized, covered with scales. In male, large longitudinal groove present on the median line of mesoscutum and mesoscutellum (Figs. 10 & 12), being covered with specialized scales on both sides of the groove; in female mesonotum normal. Legs long, slender, smoothly scaled. Abdomen smoothly scaled, without tuft of scales. Forewing rather broad; costa of male slightly concave in middle and that of female not concave, termen moderately rounded,  $R_3$  and  $R_4$  stalked,  $R_5$  from areore, with androconia on the upper surface of costal half between postmedial and subterminal lines in male (Fig. 4), without androconia in female. Hindwing broad, termen rounded,  $M_3$  developed, arising from middle of discocellular.

Male genitalia (Fig. 8):— Uncus long, rather broad, pointed, ventral surface slightly rounded; tegmen somewhat narrow; valva slender, with a sclerotized process on costa and succulus respectively; process on costa slender and pointed, that on succulus rather broad and rounded at apex, black short spines on process on succulus; vinculum V-shaped; aedoeagus long, slightly curved; vesica scobinate, without prominent cornutus.

Female genitalia (Fig. 9):— Papilla anales and 8th segment normal; ductus bursae flattened at the basal portion, with two lateral sclerites, with many microspines at caudal end; corpus bursae ovoid, internally scattered with microspines, a sclerotized ovate signum with short spines; ductus seminalis coiled once at the basal portion, arising from right shoulder of corpus bursae.

### *Trotosema sordidum* BUTLER, 1879

*Trotosema sordidum* BUTLER, 1879, Ann. Mag. nat. Hist., (5), 4: 448. — LEECH, 1889, Proc. zool. Soc. Lond., 19: 554; 1900, Trans. ent. Soc. Lond., 1900: 618. — WARREN, 1913, in SEITZ, Gross-Schmett. Erde, 3: 423, pl. 74-1. — INOUE & SUGI, 1958, Check List Lepidopt. Japan, part 5, 594.

*Zanclognatha leechi*: OGATA (nec SOUTH, 1905), 1958, in ESAKI, Icon. Het. Jap. in Color. Nat., 2: 193, pl. 118, fig. 2490.

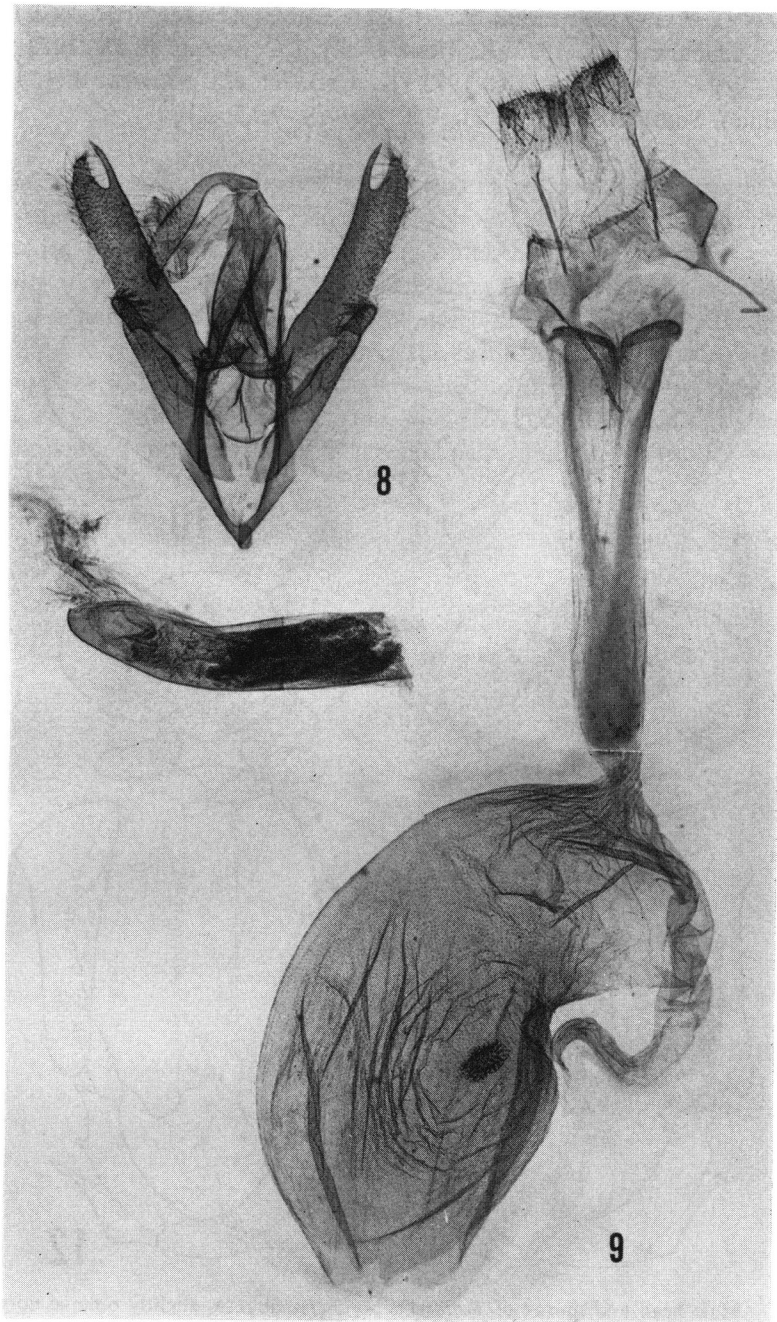
Gen. et sp. [Japanese name, Fusakiba-Atsuba]: WATANABE, 1973, Lepidopt. of Miyagi Pref., p. 263, pl. 10, fig. 164.

♂ (Fig. 2) & ♀ (Fig. 3). Expanse 25–28 mm in the first brood (May–August), 20–22 mm in the second brood (September). Body greyish brown. Forewing greyish brown; antemedial line dark brown, strongly waved; orbicular stigma dark brown, prominent small dot; reniform stigma dark brown, prominent ovate dot or slightly angled slender line; median shade slightly darker than ground colour, dull, oblique from costa to reniform stigma and then straightly down to dorsum; postmedial line dark brown, irregularly dentate, from costa outwardly, concave in the cell between veins 5 and 6, oblique inwardly to vein 2, protruding outwardly on vein 1b; sub-

terminal line pale ochreous, shaded inwardly with dark brown, irregularly dentate, arched outwardly from costa to vein 2, protruding outwardly on vein 1b; terminal line interrupted, forming a series of dark brown dots between veins; cilia dark brown. Hindwing greyish brown, slightly pale at basal portion; discocellular line dark brown; median shade slightly darker than ground colour, indistinct; postmedial line dark brown, irregularly dentate; subterminal line pale ochreous, shaded inwardly with dark brown, sinuate, vanished toward costa; terminal line and cilia almost same as in forewing. Underside of wings darker than upperside; maculations similar to those on the upperside, faint in forewing and conspicuous in hindwing.

Male and female genitalia. See the descriptions under the heading of the genus.

*Specimens examined.* Japan: Hokkaido — 1 ♀, Akagawa-Suigenchi, Hakodate, 14. VIII. 1969 (T. INOKO). Honshu — 6 ♂, 3 ♀, Mt. Funagata-yama, Miyagi Pref., 28. VII. 1967 (T. WATANABE); 1 ♀, Kanayama, Miyagi Pref., 28. VII. 1962 (T. WATANABE); 1 ♂, Futakuchi, Miyagi Pref., 27. VII. 1964 (T. WATANABE); 1 ♂, 1 ♀, Nukuyu, Miyagi Pref., 12. VIII. 1969 (T. WATANABE); 1 ♀, same locality, 5. VIII. 1968 (T. WATANABE); 2 ♂, Tôgatta, Miyagi Pref., 2. VIII. 1969 (T. WATANABE); 1 ♀, same locality, 15. VIII. 1969 (T. WATANABE); 1 ♂, Izumi-ga-take, Miyagi Pref., 22. VII. 1967 (T. WATANABE); 1 ♂, Kita-Karuisawa, Gunma Pref., 14–15. VIII. 1951 (S. SUGI); 1 ♂, 1 ♀, Kumantaira, Gunma Pref., 27. VII. 1959 (H. INOUE); 1 ♂, 1 ♀, Iwamoto, Gunma Pref., 3. VII. 1969 (S. SHIMEKI); 1 ♂, Kamimaki, Gunma Pref., 7. VIII. 1968 (S. SHIMEKI); 1 ♂, Mt. Mikabo-san, Gunma Pref., 3. VIII. 1969 (H. FUSE); 1 ♀, same locality, 17. VIII. 1968 (S. SHIMEKI); 1 ♂, Mt. Takao-san, Tokyo Pref., 21. VII. 1963 (K. JINBO); 4 ♂, 3 ♀, Tera, Ina, Nagano Pref., 14–18. VIII. 1971 (M. OWADA); 1 ♂, Todai, Kami-Ina, Nagano Pref., 7–11. VII. 1973 (T. SAKURAI); 2 ♀, same locality, 11. VII. 1971 (M. OWADA); 1 ♂, Kagosaka-tôge, Yamanashi Pref., 13. VIII. 1969 (H. INOUE); 2 ♀, Odaru, South Izu, Shizuoka Pref., 4. VII. 1959 (S. SUGI); 13 ♂, 6 ♀, same locality, 8. VII. 1962 (S. SUGI); 4 ♂, 1 ♀, Nashimoto, South Izu, Shizuoka Pref., 5. VII. 1959 (H. INOUE); 1 ♀, Umegashima, Shizuoka Pref., 3. VIII. 1963 (Y. NAGAI); 1 ♀, Katsuta, Haibara, Shizuoka Pref., 1. VII. 1972 (T. SAKURAI); 1 ♂, same locality, 10. VII. 1972 (T. SAKURAI); 1 ♂, same locality, 6. VIII. 1972 (T. SAKURAI); 1 ♂, 1 ♀, Yamazumi, Iwata, Shizuoka Pref., 2. VIII. 1970 (S. OHTA); HATOGAYU, Ono, Fukui Pref., 2. VIII. 1951 (I. IZAKI); 4 ♂, 1 ♀, same locality, 11–12. VIII. 1961 (I. IZAKI); 1 ♀, Tsubaki-onsen, Wakayama Pref., 8. VII. 1973 (K. TANAKA); 1 ♂, Taiji, Wakayama Pref., 28. VII. 1971 (S. NAKATANI); 1 ♂, Kii-Shinjô, Wakayama Pref., 14. VII. 1968 (S. NAKATANI); 5 ♀, Mt. Kôya-san, Wakayama Pref., 3. VIII. 1970 (S. NAKATANI). Shikoku — 3 ♂, 1 ♀, Shôsanji, Myôzai, Tokushima Pref., 31. VII. 1971 (M. OWADA); 3 ♂, 12 ♀, Nametoko, Kita-Uwa, Ehime Pref., 16. VII. 1971 (M. OWADA); 6 ♂, Morigauchi, Takaoka, Kôchi Pref., 20–21. VII. 1971 (M. OWADA); 1 ♂, Mt. Yokokura, Kôchi Pref., 1. VIII. 1959 (Y. KAWAKAMI); 5 ♂, Befu, Mika, Kôchi Pref., 22–23. VII. 1971 (M. OWADA). Kyushu — 1 ♀, Shiibarû, Fukuoka, Fukuoka Pref., 21. V. 1975 (K. OHARA *et al.*); 2 ♀, Hikosan, Fukuoka Pref., 12. VIII. 1956 (H. KUROKO); 4 ♂, Ômuta, Saga Pref., 18–23. VI. 1973 (T. SATA); 1 ♂, same locality,



Figs. 8-9. Genitalia of *Trotosema sordidum* BUTLER. — 8. Male. — 9. Female.

24. VI. 1974 (T. SATA). Tsushima Is. — 3 ♂, 1 ♀, Mt. Ariake, 5. IX. 1973 (K. UEDA *et al.*); 2 ♀, Izuhara, 6. IX. 1973 (K. UEDA *et al.*); 1 ♀, Sasuna, 7. IX. 1973 (K. UEDA *et al.*); 1 ♂, 3 ♀, Tsutsu, 8. IX. 1973 (K. UEDA *et al.*). Korea: 1 ♂, 1 ♀, Koje Is., Chishindo, South Korea, 1 & 21. VII. 1969 (S.-W. PAK).

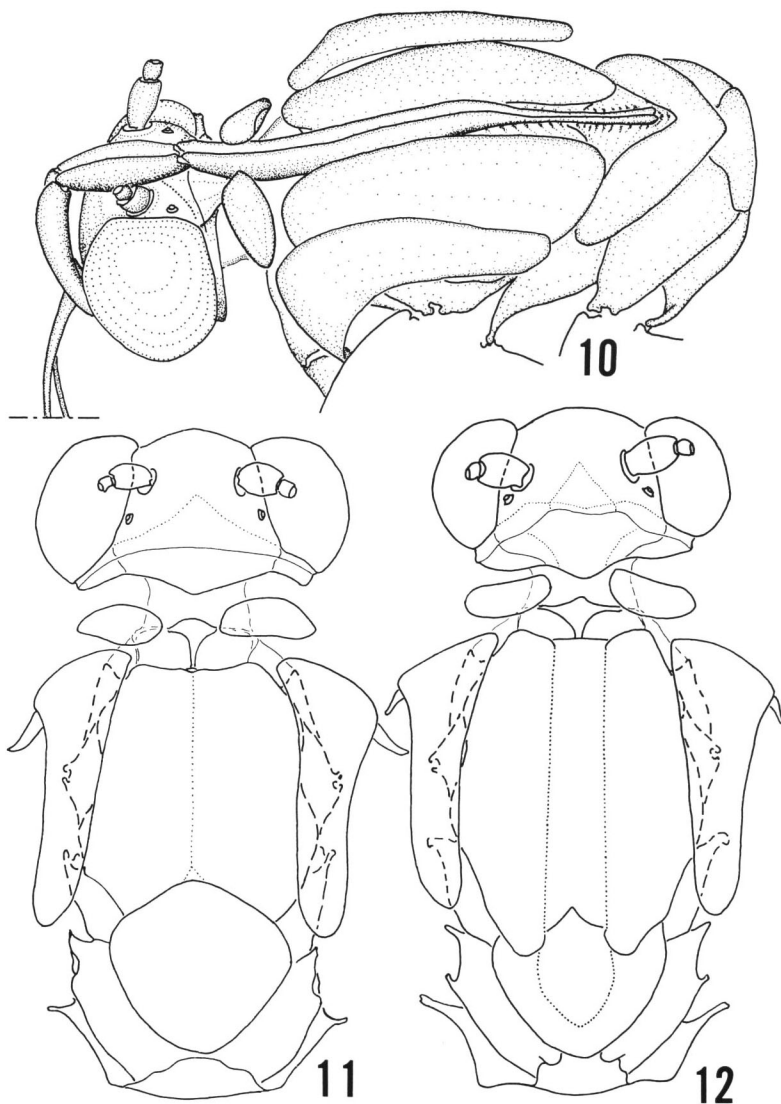


Fig. 10. Male head and thorax of *Trotosema sordidum* BUTLER, slightly oblique dorsal view, all scales removed.

Figs. 11–12. Male head and thorax, dorsal view, all scales removed and labial palpi not drawn. — 11. *Hadennia incongruens* (BUTLER). — 12. *Trotosema sordidum* BUTLER.

*Distribution.* Japan (Hokkaido, Honshu, Shikoku, Kyushu and Tsushima Is.) and Korea.

### Scent Dispersal Mechanism in *Trotosema*

Normally, the male labial palpi are inserted in the pocket of mesothorax. Only the first segment of each labial palpus is visible, while the other segments are completely hidden by the scales of vertex, patagia and the specialized scales covering the groove of thorax. It is, therefore, quite likely that BUTLER (1879) overlooked the real structure of labial palpi and thorax, since he stated that this genus is “allied to *Echana*; palpi shorter, recurved, pressed close over the front of head. . .” (Fig. 1).

I have observed many living males attracted to light traps, but have never seen any males exposing their labial palpi (Fig. 5). However, some individuals killed in a cyanide-bottle were found exposing their labial palpi (Fig. 6). When the labial palpus

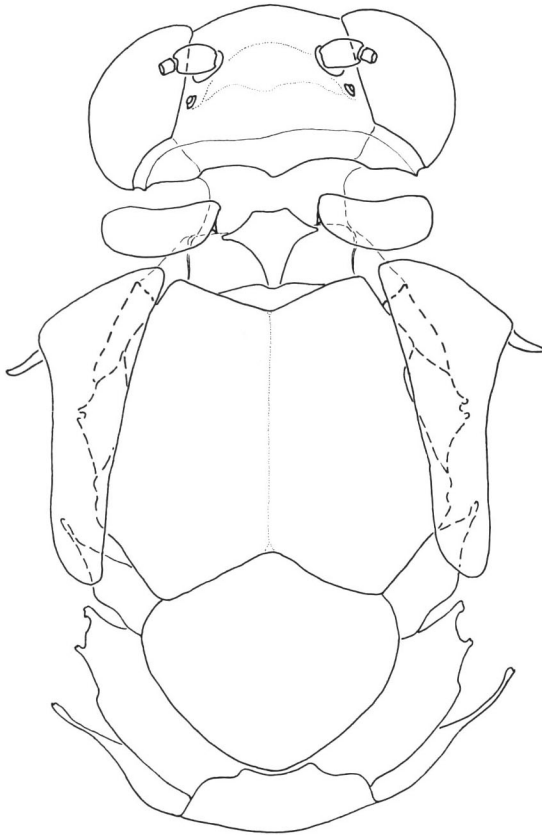


Fig. 13. Male head and thorax of *Cidariplura gladiata* BUTLER, dorsal view, all scales removed and labial palpi not drawn.

is exposed, the first segment remains in its usual position, the second segment is directed upright and the third segment is extended obliquely forwards, with the brushes radiating their hairs on all sides.

The labial palpi and the groove on thorax are basically the same in structure as the paired abdominal brush-organs of noctuid moths (BIRCH, 1970, 1972), which consist of brushes and their storage organs, though the glandular organs have not been studied in *Trotosema*.

From the fact described above, the following inference can be drawn: the male labial palpi are usually concealed in the pocket; in copulation, the labial palpi are exposed, the brushes are radiated and possibly play a role of dispersing the pheromone which presumably acts as an aphrodisiac on a female; when the copulation is completed they are put back into the pocket again. This assumption must be confirmed by further studies of mating behavior and also by the histological survey of glandular organs.

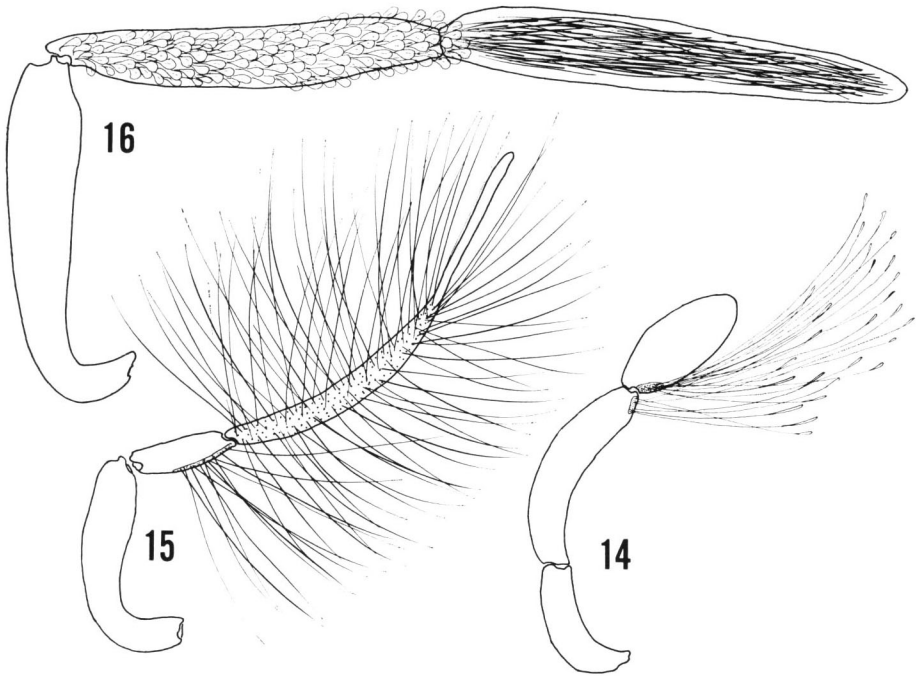
#### Other Brush-organs of Labial Palpi in Herminiinae

Besides *Trotosema*, two other genera, *Hadennia* and *Cidariplura* occurring in Japan, also possess brushes on the male labial palpi. However, they are quite different in conformation from one another.

In *Hadennia* (Fig. 14), the first segment is short; the second segment is upcurved along frons and vertex; the third segment is about a half as long as the second and ovate. The brushes, consisting of long yellowish brown hairs, arise from the distal end of the second segment and also from the base of the third. These brushes are usually hidden by the scales of vertex and patagia, which seem to play a role as a pocket. The vertex (Fig. 11) is flattened as in *Trotosema*, and the occiput is slightly broadened posteriorly but less developed than that of *Trotosema*. The thorax is not modified. When the brushes are spread, the second segment is slightly removed from the frons, the third segment is separated from the patagia and raised up anteriorly, and the brush hairs are spread over the vertex and cervix. This genus has another sexual modification, probably a scent organ, on the male forewing, which possesses a large wide costal fold on the underside.

In *Cidariplura* (Fig. 16), the first segment is very long and upcurved along frons, its distal end surpassing the vertex; the second segment is turned at a right angle from the first, being elongated posteriorly and reaching the middle of thorax; the third segment is as long as the second and terminates at the third tergite. The brushes arise from the inner surface of each of the second and third segments. The brush on the second segment consists of ochreous scales which are elongated and enlarged at their apices; that on the third segment is composed of blackish brown hairs which are very slender and about twice as long as the scales on the second segment. These brushes are usually folded in between the labial palpi put together, which act as a pocket. No morphological specialization is found in head and thorax (Fig. 13).





Figs. 14-16. Male labial palpus, with specialized scales.— 14. *Hadennia incongruens* (BUTLER), external view.— 15. *Trotosema sordidum* BUTLER, external view.— 16. *Cidariplura gladiata* BUTLER, internal view.

When the brushes are spread out, the second and third segments are rotated in a 180-degree arc, being twisted, exposing the brushes on the inner surfaces. In this genus, there is no sexual modification in the male wing.

### Discussion

The three genera cited above are closely related to one another in view of the similarity of genitalic characters. In the male genitalia, the valva of *Hadennia* is the simplest and has only one process on succulus. Valvae of the other genera have other processes at the distal end of costa, which is stronger in *Cidariplura* than in *Trotosema*. The aedoeagus of *Trotosema* is longer than that of *Hadennia*, and *Cidariplura* has the longest one. The vincula of the three genera also show a similar trend of changes from the U-shape in *Hadennia* to the V-shape in *Cidariplura*. In the female genitalia, the length of ductus bursae nearly corresponds to the length of aedoeagus. The corpus bursae of *Hadennia* and *Trotosema* possess many micro-spines and one signum which is a sclerotized plate with spines. In *Cidariplura*, variation according to species is found as follows: in *signata* BUTLER, the corpus bursae has many micro-spines and a weakly sclerotized plate, the latter of which is dissimilar to the signum in *Hadennia*

and *Trotosema*; in *gladiata* BUTLER and *brevivittalis* MOORE, signum is absent and many long spines exist instead of micro-spines. Other series of changes are also found in the genitalic structure of the three genera, and the changes are almost always directed from *Hadennia*, the most primitive, through *Trotosema* to *Cidariplura*.

The basic form of the labial palpi of the subfamily Herminiinae is summarized as follows: the first segment is short; the second segment is long, upcurved and blade-like; the third segment is slightly shorter than the second, slender, with its apex extending far beyond the vertex. The female labial palpi of the three genera accord well with this basic form, while the specialized male labial palpi must have been derived from it.

In my opinion, the structure of the male labial palpi is the most primitive in *Hadennia*, because they are the nearest in shape to the supposed basic form. In this genus, some modifications of head occur for the purpose of concealing the brushes of the labial palpi. Thus, it is reasonable to conclude that the labial palpi possessed by *Trotosema* have been derived from a form now seen in *Hadennia*. The vertex of *Trotosema* is flattened as in *Hadennia*, and in addition to that specialization, the other modifications found in *Trotosema*, the broadened occiput and the presence of the groove on thorax, are considered to be the features more derivative than those of *Hadennia*.

On the other hand, there is no trace of modification in the head and thorax of the male *Cidariplura*. It can be surmised that the male labial palpi of *Cidariplura* was specialized irrespective of *Hadennia* and *Trotosema*. However, this assumption cannot be supported by the fact that the morphological clines of the genitalic characters are in a direction from *Hadennia* to *Cidariplura*. Those clines suggest that *Cidariplura* was derived from more primitive genera, *Hadennia* or *Trotosema*. If the suggested sequence is correct, ancestor of *Cidariplura* should have had a specialized head or thorax in the male, but such specializations are not found in the existing species. Later degeneration must have occurred in the head and thorax. A similar phenomenon was also reported in the abdominal brush-organs of trifold Noctuidae (BIRCH, 1972). However, some differences are found in the process of modification. In the noctuid abdominal brush-organs, the reduction seems to have occurred in the following manner: at first it took place in the glandular organs (Stobbe's gland), then in the pheromone dispersing organs (the abdominal brushes), and finally in the secondary organs, the storage organs (the pockets) and the mechanical aids to evertion (the levers and the apodems). In this case, the partial presence of the organs is found in some existing species, but their brush-organs must have been functionally useless since the glandular organs were lost. The speed of the reduction would be enhanced after the loss of the glandular organs because of their uselessness. In *Cidariplura*, possible process of reduction is as follows: at first, the labial palpi were more specialized and elongated, then they filled the role of the pocket of brushes for their own, and finally the specialized head and thorax, which have been useless in this stage, returned to the shapes similar to those in the female. In the latter case, the brush-organs are always functional.

I believe that *Cidariplura* has been derived from a *Hadennia*-like ancestor, on the ground that the third segment of the labial palpi of *Hadennia* has a rounded apex as in *Cidariplura* and the head is not so profoundly modified. On the other hand, the labial palpi of *Trotosema* are highly specialized especially in the unique shape of the third segment fitting in the groove of the thorax. Therefore, it can safely be concluded that *Cidariplura* is not a direct descendant from a *Trotosema*-like ancestor.

### Acknowledgement

I wish to express my hearty thanks to Professor H. INOUE, Otsuma Woman's University, who kindly gave me the opportunity to examine and use the photograph of the type of *T. sordidum* BUTLER, and to Dr. I. W. B. NYE, British Museum (Natural History), who kindly informed me that the Japanese species of *Hadennia*, *incongruens* BUTLER and *obliqua* WILEMAN, are valid. I also wish to thank Professors S. ITO and H. KUROKO, University of Osaka Prefecture, for their constant guidance and encouragement, and Mr. S. SUGI, Tokyo, for his valuable advice and offering of the materials. My thanks are also due to Messers T. WATANABE, H. KOGI, T. INOKO, S. SHIMEKI, H. FUSE, K. JINBO, T. SAKURAI, S. OHTA, Y. ARITA, K. TANAKA, I. IZAKI (late), S. NAKATANI (late), Y. KAWAKAMI, K. UEDA, K. SETOYA and T. SATA for supplying with the materials. Finally I thank to Dr. S.-I. UÉNO of our museum for his kindness in reading the manuscript.

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