

The Cavernicolous Cockroaches of the Ryukyu Islands*

By

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朝比奈正二郎** : 琉球列島産の洞窟性ゴキブリ類

Among the insects of the order Blattaria, there are a number of forms described from various caves of warm countries. A peculiar group of these cockroaches is Nocticolidae in the suborder Blattoidea, members of which are widely, though sporadically, distributed in the Old World tropics. Other groups of cavernicoles are represented by several genera of the family Blattellidae in the suborder Epilamproidea and by *Apotrogia* of Gynopeltidae in the suborder Polyphagoidea. However, no cave-dwelling forms have ever been recorded from Japan.

In the summer of 1958, Dr. Shun-Ichi UÉNO obtained a considerable number of cockroaches in the limestone caves of the Ryukyu Islands. His collection was particularly noted for a long series of specimens apparently belonging to the family Nocticolidae. The northeastern limit of its distribution theretofore known is Kowloon and Hongkong in southern China (SILVESTRI, 1946, pp. 329-330) and the Island of Luzon in the Philippines (BOLÍVAR, 1892). Dr. UÉNO's discovery not only extended the nocticolid range further north beyond Taiwan, but was interesting in that it was made in such young islands as Okinoérabu and Yoron-tô. This means that though troglobiontic, the nocticolid is of a recent origin and that its ancestral stock must have settled down in those islands after the Pleistocene. This further supports SILVESTRI's view (1946, p. 323) that *Nocticola* is primarily endogean and later diverges in part into cavernicolous and in part termitophilous species, since endogean forms seem to have a better chance to cross water gaps than troglobiontic forms do.

Dr. UÉNO's collections have subsequently been enriched by further surveys made by himself and his co-workers. Thanks to this, our present-day knowledge has become much advanced concerning the cockroach fauna of the Ryukyuan caves. Now I am going to describe these interesting insects in the present paper.

Before going further, I should like to thank Dr. Shun-Ichi UÉNO for all of his arrangement for the present work and for kindly preparing the ecological notes inserted in this paper. All the material including the type-specimens will be deposited in the collection of the National Science Museum, Tokyo.

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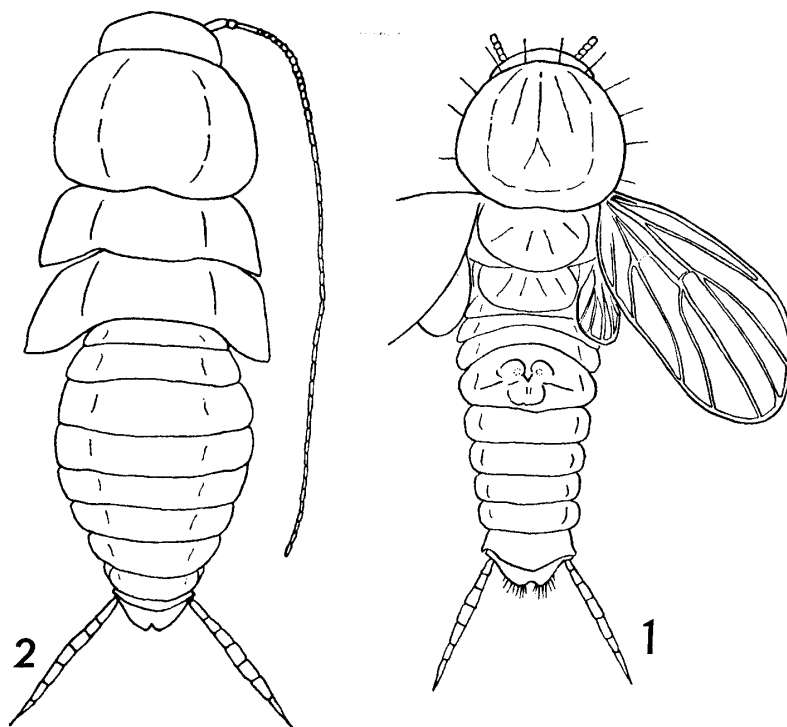
I. Suborder BLATTOIDEA — Family Nocticolidae

1. *Nocticola uenoi* sp. nov.

Small delicate insects, body-size ca. 4.0–4.5 mm (♂), and ca. 4.5–5.0 mm (♀); not extremely flattened dorso-ventrally. Body entirely whitish or pale yellowish, with the eyes and wings either absent or vestigial; antennae and legs very long and slender.

Remarks. Of the seven described species of *Nocticola*, the following four, all known from the western Pacific area, are related to the present new species: *N. simoni* BOLÍVAR, 1892, from the Grotte de San-Mateo in Prov. Manila, Luzon, Philippines (♂♀); *N. caeca* BOLÍVAR, 1892, from the Grotte de Antipolo in Prov. Morong, Luzon, Philippines (♀); *N. sinensis* SILVESTRI, 1946, from Kowloon, S. China (“in nido *Odontotermes* sp.,” ♀), and also from Repulse Bay, Hongkong (“sub saxo cum termitis (*Termes* sp.) operariis,” “exemplum alium”); and, *N. termitophila* SILVESTRI, 1946 (= *N. termitofila* SILVESTRI, 1946 [err.]), from Yen-Bay, Tonkin (“in nido *Termes malaccensis*, forma *minor*,” ♂♀), and also from Insula Penang (“in nido *Odontotermes* sp.,” ♀ & larva). However, *N. uenoi* seems to be distinguished from these southern species by the following characters:

- 1) The eyes are extremely vestigial or entirely absent.
- 2) The prothoracic tergite is flattened in both sexes, the largest width of male tergite being situated posterior to the middle.
- 3) The paranotal lobes of meso- and metathoraces are conspicuous in the female.
- 4) There is a very prominent male tergal gland opening in the 4th abdominal seg-



Figs. 1–2. *Nocticola uenoi uenoi* sp. et subsp. nov. — 1. ♂, Taniyama-no-kuragô Cave, Okinoérabu Island. — 2. ♀, same locality.

ment. This structure has never been recognized in any of the *Nocticola* species.

- 5) The cerci are always slender in both sexes.
- 6) The wing of the male is characteristic in shape.
- 7) The male supraanal plate and hypandrium are probably of characteristic feature.
- 8) The left phallosome of the male is of peculiar shape.
- 9) Troglobiontic, not termitophilous.

The females of *N. uenoi* are closely similar to those of *N. sinensis* from Kowloon and Hongkong, and probably also to those of *N. caeca* from Luzon. Unfortunately, however, these species were described only upon the female sex.

One of the most interesting features of the present new species may be the expanded ovipositor valves in the female. When this part is expanded, as seen in some alcoholic specimens, it shows a close resemblance to the broad hypandrium of a blattellid female. However, this lobe can be folded within the subgenital plate as soft folds. In this condition, it cannot be seen from outside and is alike that of the ovipositor valves usual for a blattid. I have checked the same part of some blattids and found that if the valves are expanded by pressing, that part is not essentially different from that of *Nocticola* females. Because of this reason, Nocticolidae may be included in the suborder Blattoidea. In his Catalogue, PRINCIS (1966, p. 602) suggested that Nocticolidae would be moved to Polyphagoidea though no reason was given for this proposal.

Nocticola uenoi has been found in five islands at the central and southern parts of the Ryukyus. It has not been met with in the islands of the Yaéyama group, but may occur there, in particular in Ishigaki-jima Island, where many limestone caves exist. The insect is no doubt troglobiontic, being confined in the dark zone of limestone caves. It is divided into three geographical races, the first being from Kikai-jima Island, the second from the Islands of Okinoérabu, Yoron-tô and Okinawa of the central part, and the third from Miyako-jima Island of the Sakishima group.

1 a. *Nocticola uenoi uenoi* subsp. nov.

(Figs. 1-16; Pl. 18: 1-2)

Material examined. OKINOÉRABU ISLAND: 3♂♂, 5♀♀ & 12 larvae (including holotype and allotype), Tamina-no-hô Cave, Tamina, China-chô, 7-VIII-1958, leg. S.-I. UÉNO & Y. MORIMOTO; 4 larvae, same locality, 3-VIII-1958, leg. S.-I. UÉNO & Y. MORIMOTO; 1♂, 1♀ & 1 larva, Taniyama-no-kuragô Cave, Taniyama, Wadamari-chô, 4-VIII-1958, leg. S.-I. UÉNO & Y. MORIMOTO; 1♀ & 1 larva, Agari-gô Cave, Nagaminé, Wadamari-chô, 8-VIII-1958, leg. S.-I. UÉNO; 1♀, Tanata-gô Cave, Uchijiro, Wadamari-chô, 17-VIII-1958, leg. S.-I. UÉNO; 1♂, 1♀, Amefuya-yô Cave, Uchijiro, Wadamari-chô, 17-VIII-1958, leg. S.-I. UÉNO; 3♀♀, Tanaga-buchi Cave, Kurosé, Kunigami, Wadamari-chô, 16-VIII-1958, leg. S.-I. UÉNO.

YORON-TÔ ISLAND: 1♂, Shiruka-abu Cave, Nama, 6-VIII-1972, leg. M. SHIMOJANA; 5♀♀ & 3 larvae, Shiruka-abu Cave, Nama, 11-VIII-1958, leg. S.-I. UÉNO; 1♀ & 1 larva, Tuminari-abu Cave, Nama, 11-VIII-1958, leg. S.-I. UÉNO & Y. MORIMOTO; 1♀ & 2

larvae, Ya-gô Cave, Gusuku, 12-VIII-1958, leg. S.-I. UÉNO.

OKINAWA ISLAND: 1♀, Mayaa-gama Cave, Uezu, Gushikawa-shi, 23-VII-1972, leg. S.-I. UÉNO; 3 larvae, Futenma-dô Cave, Futenma, Ginowan-shi, 25-VII-1972, leg. S.-I. UÉNO; 1♀, Amachijô-gama Cave, Eekibaru, Tamashiro-son, 29-VII-1972, leg. S.-I. UÉNO.

Description. ♂: Head typically of *Nocticola*-shape, with the eyes represented by dark spot which is composed of 40-70 ommatidia arranged in an arc or streak. Maxillary and labial palpi as shown in Figs. 3-5, the fourth segment of maxillary palpus being shorter than the third. Antennae composed of 37-51 segments; scape, pedicel and the first flagellal segment, and about 30 distal segments longer than the remainings.

Prothoracic tergite as shown in Fig. 1, broadest at a level behind the middle; marginal area subhyaline, posterior margin with a slight depression in the centre.

Forewings hyaline, shaped as shown in Figs. 1 and 6; when folded the wing apex only reaching middle abdominal segments; venation clear, with some individual variation (Fig. 6). Hindwing scale-like, veins degenerated but the rudiments are still recognizable.

Legs slender; foreleg the shortest, its femur armed with ventro-cephalic marginal bristles as shown in Fig. 8 (so-called B-type). Tibial spurs 3, one large and two small.

Abdomen cylindrical; a very prominent tergal gland opening present on segment 4 which is greatly enlarged (Figs. 1, 9). This kind of structure has never been found in the other species of *Nocticola*!

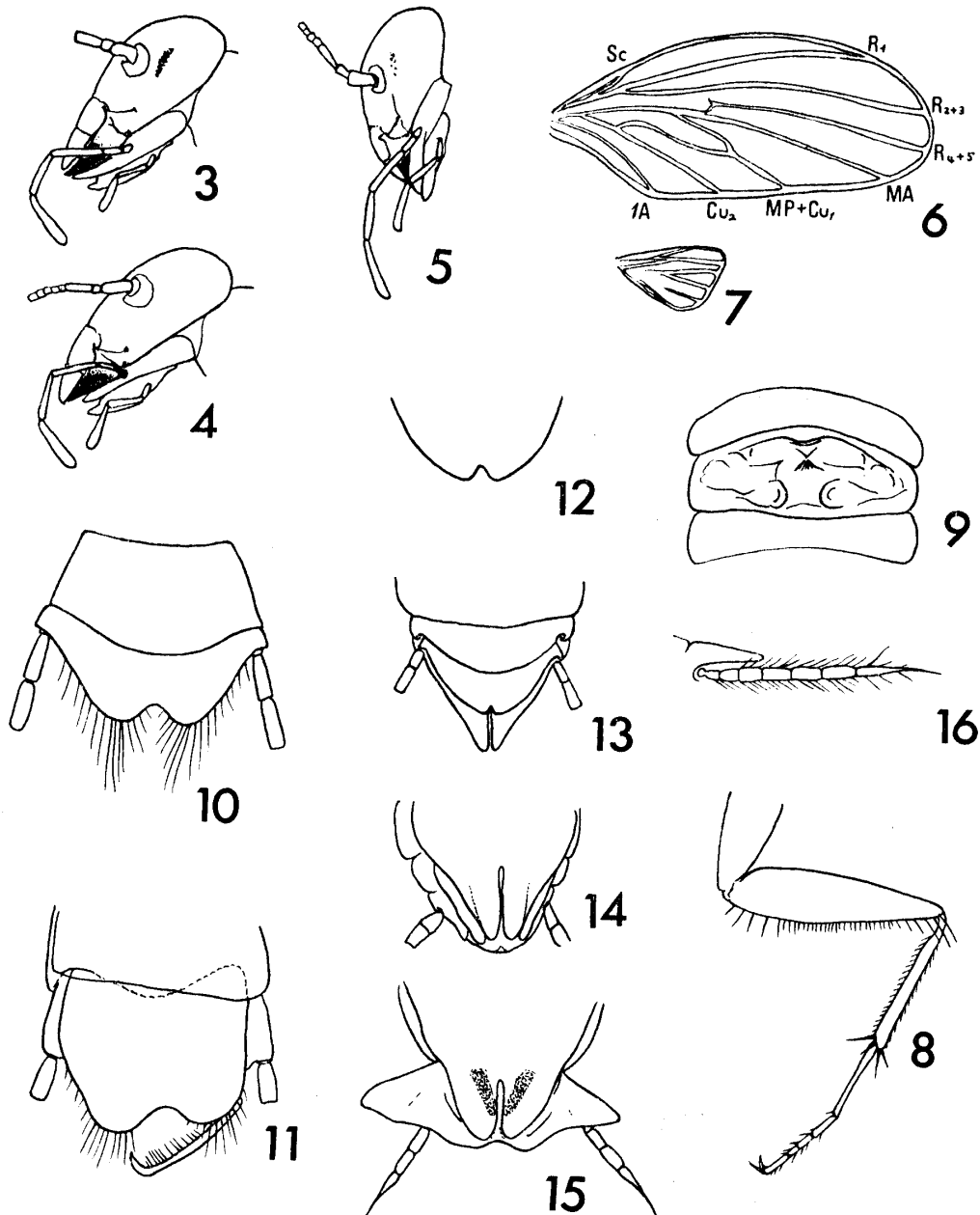
Supraanal plate broadly bilobed, with long marginal bristles on the prominent ends (Fig. 10). Hyandrium formed by a broad, somewhat asymmetrical plate (Fig. 11), broadly bilobed, with marginal bristles like the supraanal plate. The extended left phallosome is usually seen in alcoholic specimens, ending in a curved claw with a row of bristles on the stem (Fig. 11).

♀: Eyes much more degenerated than those in the male, either represented by 6-10 ommatidia or entirely absent. Antennal segments 44-56 in number, basal three and about 30 distal segments being longer than the others.

Prothoracic tergite as shown in Fig. 2, somewhat broader than that of the male. Both the wings are degenerated into paranotal lobes which are laterally produced and subhyaline.

Abdomen solid, and spindle-shaped in outline; abdominal segments simple, broadest at middle segments which are as broad as the metathorax (Fig. 2); supraanal plate with a median invagination (Figs. 2, 12). Cercus as shown in Fig. 16, 7-segmented, with long bristles. Viewed from the dorsal side, subgenital valves typically bilobed (Fig. 14); this is a feature of a female blattid insect. However, several specimens show a peculiar broad lobe, and the median furrow disappears as seen in Fig. 15. This reminds us of the subgenital plate of a blattellid, but it seems certain that such a strange shape of the subgenital valves is resulted from deformation in preservative liquid. If we carefully check the structure, we can find that the bilobed appearance of this part (Fig. 13) is due to a deep median furrow made by closed valves (Fig. 14).

Remarks. As was noticed before, the nominate subspecies of *N. uenoi* occurs in the three neighbouring islands of the central Ryukyus. It is rather common in the caves of Okinoérabu Island, the northernmost one of the three, but is rare in the other two. In



Figs. 3-16. *Nocticola uenoi uenoi* sp. et subsp. nov., Okinoérabu Island. — 3. Head ♂. — 4, 5. Head ♀. — 6. Forewing ♂. — 7. Hindwing ♂. — 8. Foreleg ♀. — 9. Tergal gland ♂. — 10. Supraanal plate ♂. — 11. Hypandrium and left phallosome. — 12. Supraanal plate ♀. — 13. Abdominal end ♀. — 14. Ovipositor valves ♀. — 15. Ovipositor valves with extended inner lobes. — 16. Cercus ♀, lateral view.

Tamina-no-hô Cave, the type-locality, the cockroach is found among gravel on the banks of a subterranean stream, where bats' excreta exist. When disturbed, adult insects run very quickly and readily take refuge under stones. They look like long-legged trechine beetles because of the coloration and habits. Larval insects are less agile and can easily be caught by an aspirator.

In the other caves of the Islands of Okinoérabu and Yoron-tô, the insect is usually

found from under stones lying on muddy floors. It can be met with only in the dark zone, where organic matters are relatively abundant. In Okinawa, *N. uenoi* has been known only in the caves at the southern part of the island. In Mayaa-gama Cave of that island, the single female was taken from under a large stone at the twilight zone, but in the other caves, the specimens were obtained at the depths.

1 b. ***Nocticola uenoi kikaiensis*** subsp. nov.

(Fig. 17)

Material examined. 1♂, 1♀ (holotype and allotype), Shichitei-gama Cave, Takigawa, Kikai-jima Island, 31-VII-1972, leg. M. SHIMOJANA.

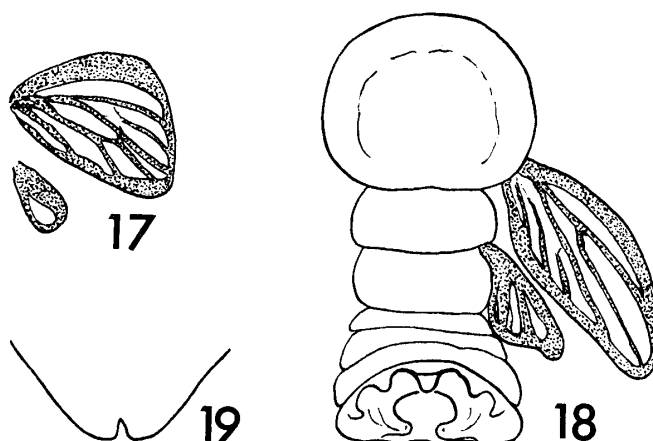
Description. Body-size ca. 4.0 mm (♂), 4.5 mm (♀). Closely similar to the nominate subspecies. In the male, the eyes are degenerated to a dark streak, consisting of about 50 ommatidia; in the female, it is represented by 10 ommatidia. Antenna composed of 45 segments in the female. Fore- and hindwings in the male greatly degenerated and scale-like. Female supraanal plate with deeper median cut. Cercal segments 8 in number in both sexes. Other structures are similar to those of the nominate subspecies.

Remarks. This is probably an isolated form of *N. uenoi* established in the caves of Kikai-jima Island, which lies at the northeastern end of the central Ryukyus, about 160 km northeast of Okinoérabu Island. The type-locality has not been visited by Dr. UÉNO, but it is said to be the largest cave in the young island.

1 c. ***Nocticola uenoi miyakoensis*** subsp. nov.

(Figs. 18-19)

Material examined. 3♂♂, 6♀♀ & 8 larvae (including holotype and allotype), Abucha-



Figs. 17-19. *Nocticola uenoi* subsp. — 17. *N. uenoi kikaiensis* subsp. nov., Shichitei-gama Cave, Kikai-jima Island; ♂ wings. — 18. *N. uenoi miyakoensis* subsp. nov., Abucha-dô Cave, Miyako-jima Island; ♂ thoraces, wings and four proximal segments of abdomen. — 19. The same subspecies, ♀ supraanal plate.

dô Cave (=Abucha-gaara Cave), Nakabari, Tomori, Gusukubé-chô, Miyako-jima Island, 18-X-1963, leg. S.-I. UÉNO; 2♀♀ & 2 larvae, same locality, 2-VIII-1972, leg. S.-I. UÉNO; 1♀, Rinkô-abu Cave, Narikaa, Hirara-shi, Miyako-jima Island, 3-VIII-1972, leg. S.-I. UÉNO.

Description. Body-size ca. 4.5 mm (♂) and 5.0 mm (♀). Eyes streak-like or absent in both sexes; antenna of 51–56 segments. Wings in the male much degenerated (Fig. 18), but not so much as in the preceding subspecies from Kikai-jima Island. Male tergal gland on the 4th abdominal segment more deeply sculptured than that in the nominate subspecies (Fig. 18). Median invagination of the female supraanal plate also deeper (Fig. 19). Other structures of both sexes are similar to those of the nominate subspecies.

Remarks. The present new subspecies could be regarded as a full species when the range of geographical variation is satisfactorily known for all the species of the genus. For the time being, it is treated as a race of *N. uenoi* isolated in the caves of Miyako-jima Island.

Abucha-dô Cave, previously called Abucha-gaara, is the largest known limestone cave in the island. However, the fauna has been largely destroyed since the cave was open for tourists. In former days, the cockroach was not rare in its depth, running about on muddy floor or on rotten boards. At present, it has become very scarce owing to destruction of the habitats.

II. Suborder EPILAMPROIDEA — Family Blattellidae

2. *Symploce okinoerabuensis* sp. nov.

(Figs. 20–25; Pl. 18: 3–4)

Material examined. 1♂, 1♀ (holotype and allotype), “a cave, Is. Okinoérabu,” 21-II-1972, leg. I. SUZUKI; 1 larva (ultimate instar)?, Taniyama-no-kuragô Cave, Taniyama, Wadamari-chô, Okinoérabu Island, 4-VIII-1958, leg. S.-I. UÉNO.

Description. Closely allied to *Symploce japonica* (SHELFORD), but distinguished from the epigeal species by the following characters:

1) Body smaller, ♂ ca. 15 mm, ♀ ca. 13.5 mm; forewing length ♂ 11 mm, ♀ 11 mm. In *S. japonica*, the body length is ♂ 17–18 mm, ♀ 17–19 mm, forewing ♂ 14.5 mm, ♀ 11 mm.

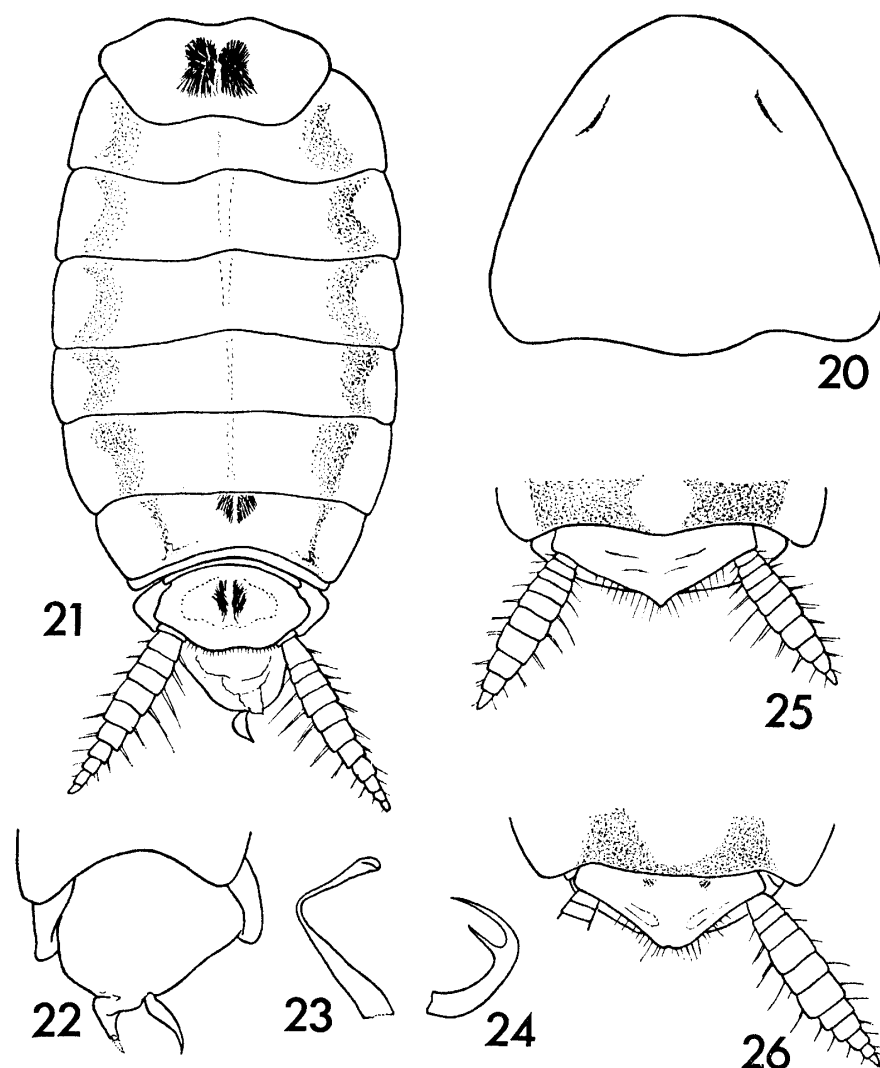
2) Prothoracic tergite markedly narrowed anteriorly (Fig. 20).

3) Forewing narrower; costal margin not much produced, even with a slight depression at distal 1/3 in the male. In *S. japonica*, the costal border is gently produced in an arc.

4) Male supraanal plate less produced posteriorly (Fig. 21); distal end of hypandrium less produced, bearing a spiny right stylus (Fig. 22).

5) Left phallosome (Fig. 23) very similar in shape to that of *S. japonica*, but the right phallosome (Fig. 24) ends in a divided spine in the present species. In *S. japonica*, the right phallosome is formed by a simple strong spine.

6) Female supraanal plate pointed at the end (Fig. 25), whereas it ends in a broad triangle in *S. japonica*.



Figs. 20–26. *Symploce* spp. — 20–25. *S. okinoerabuensis* sp. nov., Okinoérabu Island. — 20. Prothorax ♀. — 21. Abdomen ♂, dorsal view. — 22. Hypandrium, ventral view. — 23. Left phallosome. — 24. Left phallosome (L_{2vM}). — 25. Abdominal end ♀. — 26. *S. miyakoensis* sp. nov., Abucha-dô, Cave, Miyako-jima Island; abdominal end ♀.

Remarks. The actual type-locality of this new species is unfortunately not known. It is impossible even to conjecture its approximate position, since there are too many caves in Okinoérabu Island.

3. *Symploce miyakoensis* sp. nov.

(Fig. 26; Pl. 18: 5)

Material examined. 1♀ (holotype), Abucha-dô Cave, Nakabari, Tomori, Gusukubé-chô, Miyako-jima Island, 23–VII–1971, leg. M. SHIMOJANA; 10 larvae (nearly mature), Isagana-abu Cave, Nagahata, Higa, Gusukubé-chô, Miyako-jima Island, 18–X–1963, leg.

S.-I. UÉNO; ? 1 larva (dried specimen), Abucha-dô Cave, Nakabari, Tomori, Gusukubé-chô, Miyako-jima Island, 22-XI-1963, leg. K. KANEKO.

Description. The single mature female specimen of the body length ca. 13 mm, is very closely allied to the preceding species, but can be separated by:

- 1) Forewing very short, only 8.5 mm; hindwing 7 mm.
- 2) Supraanal plate ending in a round-headed triangle, the point being even very slightly divided (Fig. 26).

Remarks. The holotype was taken at the depth of Abucha-dô Cave. Larval specimens from Isagana-abu Cave were found running about on the muddy banks of an underground stream in the dark zone.

Besides the two new species described above, there are a number of other blattellid materials obtained in the caves of six different islands of the Ryukyus. As all these specimens are unfortunately in larval stage, I have not named them in the present paper. They are as listed below:

a) *Symploce* sp.: 1 larva (nearly mature), Shichitei-gama Cave, Takigawa, Kikai-jima Island, 31-VII-1972, leg. M. SHIMOJANA.

b) *Symploce* sp.: 3 larvae (mature), Shiruka-abu Cave, Nama, Yoron-tô Island, 11-VIII-1958, leg. S.-I. UÉNO; 1 larva, Gushika-yô Cave, Iba, Ritchô, Yoron-tô Island, 12-VIII-1958, leg. S.-I. UÉNO.

c) *Symploce* sp.: 1 larva (nearly mature), Mayaa-abu Cave, Mashiki, Ginowan-shi, Okinawa Island, 25-VII-1972, leg. S.-I. UÉNO; ? 1 larva, same locality, 7-VII-1972, leg. M. SHIMOJANA.

d) *Symploce* sp.: 2 larvae (nearly mature), Yajaa-gama Cave, Nakachi, Gushikawason, Kumé-jima Island, 4-VIII-1972, leg. S.-I. UÉNO.

e) *Symploce* sp.: 1 larva (immature), Sabichi-gô Cave, Ibaruma, Ishigaki-jima Island, 31-VII-1972, leg. S.-I. UÉNO.

f) *Margattea* (?) sp.: 1 larva (mature), Todoroki-yô Cave, Shinjô, China-chô, Okinoérabu Island, 6-VIII-1958, leg. S.-I. UÉNO.

要 約

世界の熱帯および亜熱帯の洞窟から、興味深いゴキブリ類が数多く知られている。わが国からは、このようなゴキブリ類は、従前まったく見つかっていなかったのであるが、1958年以降、主として上野俊一博士の努力によって、琉球列島の島じまの洞窟から、真洞窟性ゴキブリであるホラアナゴキブリ科 Nocticolidae の種類と、モリゴキブリ属 *Symploce* のうちおそらく好洞窟性と考えられる種類の標本が得られるにいたった。ここに、成虫が確認されたものについて次のような名称を与え、記載を行なった。

I. ホラアナゴキブリ科 Nocticolidae

1a. ホラアナゴキブリ (上野, 1964) *Nocticola uenoi* nov. (沖永良部島, 与論島, 沖縄本島)

1b. キカイホラアナゴキブリ (新称) *Nocticola uenoi kikaiensis* nov. (喜界島)

1c. ミヤコホラアナゴキブリ (新称) *Nocticola uenoi miyakoensis* nov. (宮古島)

II. チャバネゴキブリ科 Blattellidae

2. エラブモリゴキブリ (新称) *Symploce okinoerabuensis* nov. (沖永良部島)
3. ミヤコモリゴキブリ (新称) *Symploce miyakoensis* nov. (宮古島)

なお、モリゴキブリ属 *Symploce* のものと思われる幼虫が、喜界島、与論島、沖繩本島、久米島および石垣島より得られた。また、ツチゴキブリ属 *Margattea* と思われる1個の幼虫も、沖永良部島の洞窟より得られている。

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Explanation of Plate 18

- 1-2. *Nocticola uenoi uenoi* sp. et subsp. nov.; Okinoérabu Island. — 1, ♀; 2, ♂.
3-4. *Symploce okinoerabuensis* sp. nov.; Okinoérabu Island. — 3, ♂; 4, ♀.
5. *Symploce miyakoensis* sp. nov., ♀; Miyako-jima Island.

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