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Two New Species of the Genus *Eurema* (Lepidoptera, Pieridae) from Indonesia and the Philippines

Takashi SHIRÔZU and Osamu YATA

Biological Laboratory, College of General Education, Kyushu University, Ropponmatsu, Fukuoka 810, Japan

Synopsis Two new pierid butterflies, *Eurema timorensis* sp. nov. from Timor and *E. hiurai* sp. nov. from Mindanao, are described and figured. Brief notes on their systematic positions and biogeography are given.

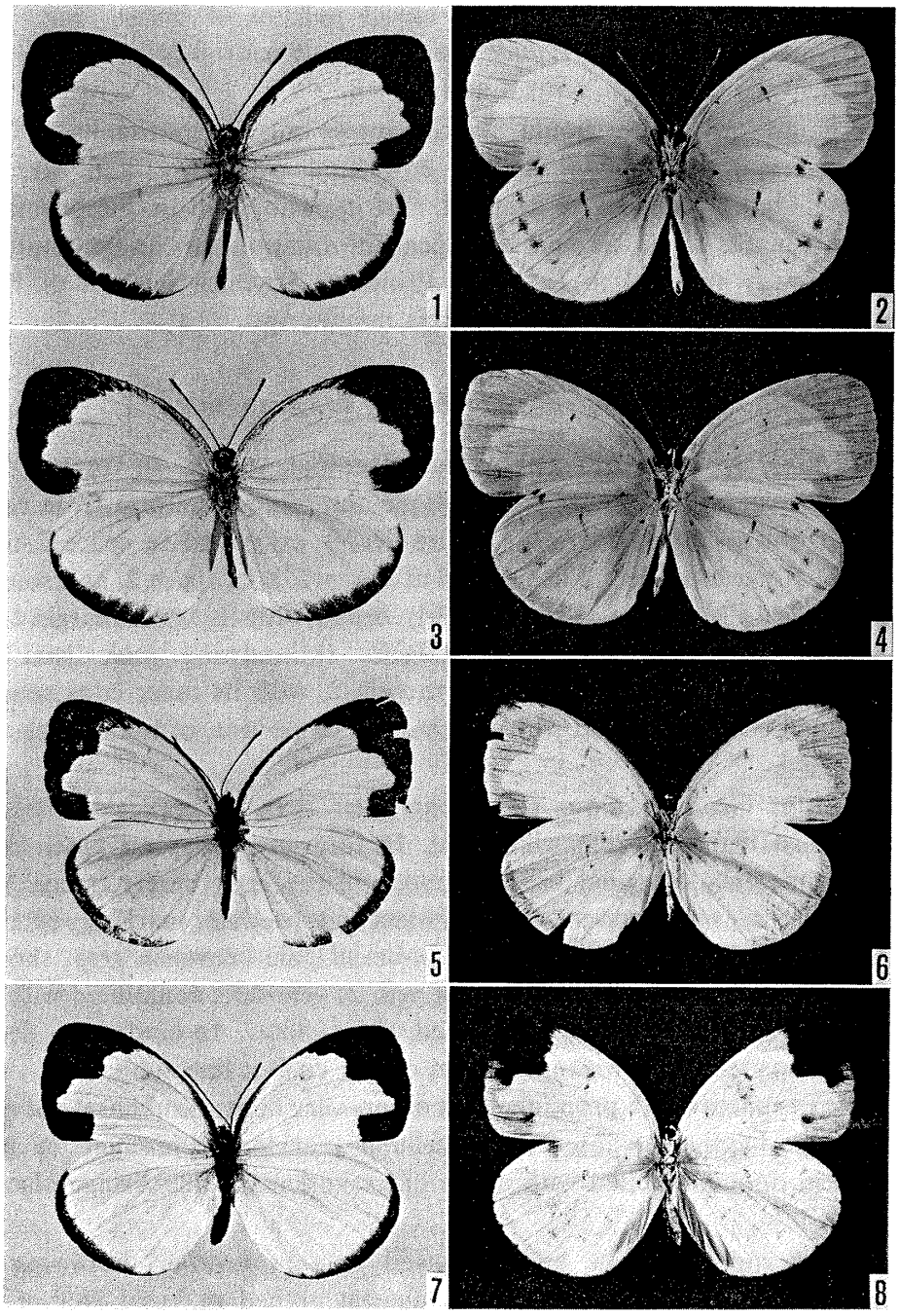
Introduction

The *hecabe* group of the genus *Eurema* is a comparatively advanced monophyletic group comprising 21 known species, which are dominate almost exclusively in the Old World tropics. In the course of our revisional research on the Old World *Eurema*, we found two new species of this group which were discovered in Indonesia and the Philippines respectively. We deal with the descriptions of these two new species in this paper.

One of the new species from Timor was found in the materials collected in 1973–74 by the members of the research project of "Zoogeographical studies on the dipterous insects (two-winged flies) of medical importance in the South Pacific area" (representative of the research project: Professor Rokuro KANO of Tokyo Medical & Dental University). The new species is most closely related to *E. lombokiana* (FRUHSTORFER, 1897) and these two are probably allopatric in distribution, but considering the differences of general appearance and male genital structure among their allied species, the former should be treated as a distinct species rather than a subspecies within the latter species.

Another new species from Mindanao is based on the specimens collected by the members of "The co-operative survey by the Osaka Museum of Natural History and the National Museum of the Philippines, 1969", and they were recorded as a local race of *E. lacteola* (DISTANT, 1886) by HIURA and ALAGAR (1974), but subspecific name was not given. After carefully examining the general appearance and male and female genitalia of the *tilaha-lacteola* complex, we came to the conclusion that the "*lacteola*" specimens from Mindanao represent a distinct new species which has never been described, even as a subspecies of the known species.

The following abbreviations are used in the descriptions and illustrations of the male genitalia and the hindwing venation. P_1–P_5: processes of valva of the male genitalia. P_1: a process near the middle of ventral margin of costa+ampulla region. P_2: a process beyond the middle of dorsal margin of costa+ampulla region. P_3: apical process of valva. P_4: two processes at the basal portion or



Figs. 1–4. *Eurema timorensis* SHIRÔZU et YATA, sp. nov. —— 1. ♂ Holotype, Pariti, West Timor, 19. xii. 1973, S. SHINONAGA leg. —— 2. Ditto, underside. —— 3. ♀ Paratype, same data as holotype. —— 4. Ditto, underside. Figs. 5–8. *Eurema hiurai* SHIRÔZU et YATA, sp. nov. —— 5. ♂ Holotype, Palan-Capatagan, Mt. Apo, Mindanao, 26. xi. 1969, I. HIURA leg. —— 6. Ditto, underside. —— 7. ♂ Paratype, Sisinon-Palan, Mt. Apo, Mindanao, 26. xi. 1969, I. HIURA leg. —— 8. Ditto, underside.

middle of harpe. P_5: a process at the apical portion of harpe. *udc*: veinlet between origins of veins 6 and 7. *mdc*: veinlet between origins of veins 5 and 6. *ldc*: veinlet between origins of veins 4 and 5.

Before going further, we should like to express our sincere thanks to Dr. Satoshi SHINONAGA of the Tokyo Medical & Dental University, and Mr. Isamu HIURA of the Osaka Museum of Natural History who gave us opportunities to examine the valuable materials and biological information on the new butterflies. We are also much indebted to Associate Professor Toyohei SAIGUSA of Kyushu University for his kind help in preparing this manuscript.

Eurema timorensis SHIRÔZU et YATA, sp. nov.

♂. (Figs. 1, 2, 9) Upperside: Ground colour yellow. In forewing black distal border broad with its inner edge oblique and almost uniform from costa to vein 4, much obtuse-angled at vein 4, more deeply excavated in space 2 than in space 3, unusually even at vein 2 but angled at the middle of space 2, and somewhat diffused in space 1; black costal border fairly broad with its inner margin sharply defined; black basal border absent; fringe black. In hindwing black distal border broad and increasing in width from apex to vein 2, with its inner edge somewhat diffused; fringe black, but mixed with yellow. Basal portion of both wings almost not black dusted.

Underside: Ground colour somewhat paler than in upperside, not black dusted and most markings somewhat faint. In forewing subapical patch entirely absent, but sometimes marginal brown smudge in the apex barely traceable; cell spot usually absent, even if present very indistinct; discocellular marking represented by a faint black bar; tornal spot absent; sex-brand pale brownish grey, short and very narrow, ending slightly before origin of vein 2; vein-dots conjointed with a fine black anticiliary line; fringe black, but mixed with yellow. In hindwing a series of discal spots in spaces 1 to 8 arranged in an evenly curved line subparallel to wing margin, those in spaces 4 to 8 prominent but others very faint; a subbasal dot each in spaces 1 and 7; basal spot absent; discocellular marking represented by a faint black bar; vein dots conjointed with a fine black anticiliary line; fringe black, but mixed with yellow.

Both wings more elongate and narrowed than in *hecabe*. Forewing fairly arched along distal margin. Hindwing somewhat arched in basal half of costal margin; distal margin evenly rounded; vein 7 usually stalked with vein 6; if these veins separated, *udc* less than half length of *mdc*; *mdc* less than 1/4× as long as *ldc*. Antenna somewhat less than half length of forewing, black, white-checkered except on posterodorsal surface and a few apical segments; club cylindrical. Thorax and abdomen yellow, much darkened above, clothed with yellow hairs on thorax and base of abdomen, a black longitudinal line appearing along lateral margins of abdominal terga.

Male genitalia: Tegumen narrow, trapezoidal in dorsal aspect; Valvenansatz strongly curved anteriorly on apical half; saccus somewhat long; uncus short, extending posteroventrally, uncal projection strongly developed, very long and projecting upward, with its apex strongly bicuspid. Valva broad gradually narrowed posteriorly; P_1 projecting almost laterally or slightly posteriorly; P_2 broadly produced and appearing as a large protuberance; P_3 slender, parallel-sided, its apex bluntly ended; P_4 represented by two processes, which are almost same in length and shape, and their apices curved ventrally; P_5 much flattened. Phallus long, slender and strongly arched dorsally, subzonal portion about 1/4× as long as phallus or shorter. Juxta membranous, heart-shaped in posterior aspect, with a short median stalk.

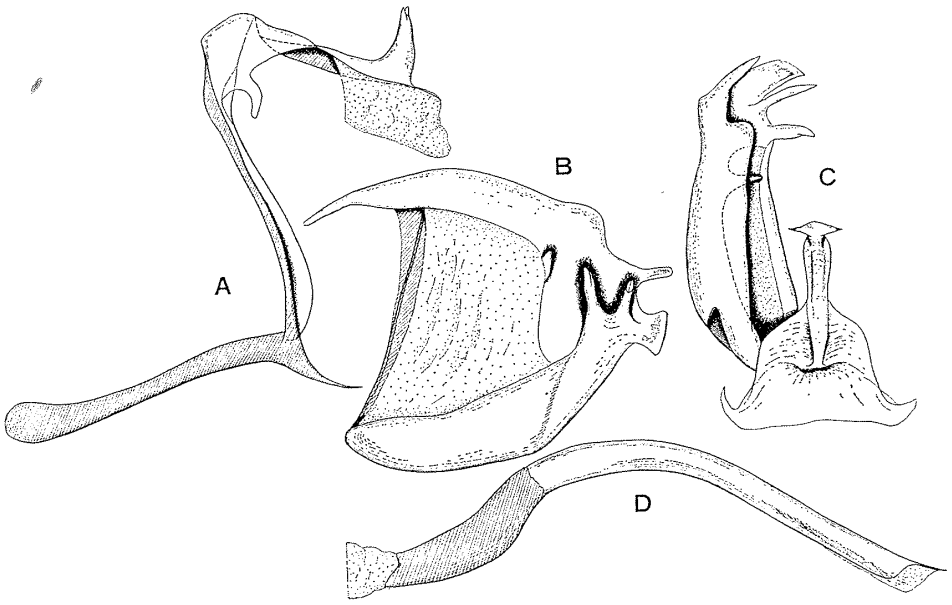


Fig. 9. Male genitalia of *Eurema timorensis* sp. nov., Timor. A: Lateral aspect of ring. B: Inner aspect of right-hand valva. C: Dorsal aspect of dorsum and right-hand valva. D: lateral aspect of phallus.

Length of forewing: 15.5–17.3 mm.

♀. (Figs. 3, 4, 10) Similar to male, but ground colour pale yellow. In forewing upperside black costal border very indistinct. In hindwing black distal border somewhat broader, more strongly widening towards vein 2. Most markings in underside fainter.

Female genitalia: Seventh abdominal sternum trapezoidal with straight hind margin; lamella antevaginalis represented by a narrow and shallow groove; ostium bursae exposed and opening on anterior portion of genital plate, broad and weakly sclerotized protubelances in either side of ostium bursae; ductus bursae long and slender, 2.5× as long as neck of bursa, weakly sclerotized for about 1/5 from the anterior end; lamella postvaginalis represented by a rather broad and deep longi-

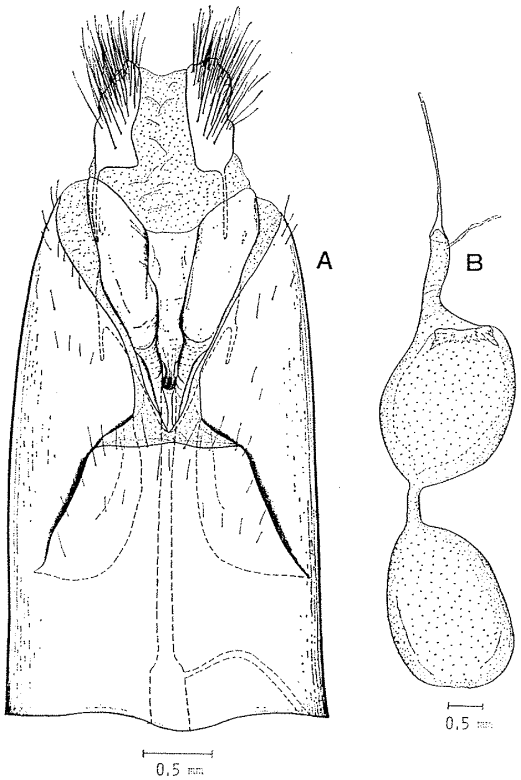


Fig. 10. Female genitalia of *Eurema timorensis* sp. nov., Timor. A: Ventral aspect. B: Genital ducts and bursa copulatrix.

tudinal groove; dike-like swellings of lateral margins of 8th tergum well developed, narrowed anteriorly and compressed near ostium bursae; apophysis anterioris straight, slightly hamulate upwards at the tip and longer than apophysis posterioris, with a small protuberance at dorsoproximal portion; apophysis posterioris straight and almost as long as papilla analis.

Length of forewing: 15.5–18 mm.

Type-locality. Pariti (10 m alt.), West Timor, Indonesia.

Geographical distribution. This species is known only from the type-locality.

Holotype: ♂, Pariti, 19. xii. 1973, Satoshi SHINONAGA leg. (Holotype will be deposited in the National Science Museum, Tokyo)

Paratypes: 2 ♂♂, 2 ♀♀, same data as holotype.

Remarks. Although there are distinct morphological differences between them, the new species seems to be most closely related to *E. lombokiana* from Lombok, Sumbawa and Flores in every respect. Moreover as the new species is allopatric to the latter in distribution, there remains the possibility that they represent local races of the latter species. But the following differences seem to be specific judging from the general criteria of morphological differences between sympatric species in the genus *Eurema*.

Differences in general appearances: 1) Length of forewing much shorter than

in *lombokiana* (22.5–23.0 mm). 2) Black distal border in hindwing upperside broad and increasing in width from apex to vein 2, while in *lomokiana* narrow and tapering near apex and tornus. 3) A cell spot in forewing underside nearly or completely obsolete, while in *lombokiana* rather distinct. 4) A series of discal spots in spaces 1 to 8 usually present, while in *lombokiana* almost disappearing in the materials before us.

Differences in male genitalia: 1) Apical portion of uncus strongly bicuspid, while in *lombokiana* weakly bicuspid. 2) P_1 of valva projecting almost laterally or slightly posterioly, while in *lombokiana* projecting anteriorly. 3) P_2 of valva broadly produced and appearing as a large protuberance, while in *lombokiana* barely traceable. 4) P_3 of valva slender, parallel-sided and its apex bluntly ended, while in *lombokiana* somewhat broad and its apex more or less pointed.

Eurema hiurai SHIRÔZU et YATA, sp. nov.

♂. (Figs. 5, 6, 11) Upperside: Ground colour lemon yellow. In forewing black distal border broad with its inner edge curved inwardly from costa to vein 4, rather obtuse-angled at vein 4, more deeply excavated in space 2 than in space 3, sharply defined in space 1; black costal border broad with its inner margin sharply defined; black basal border absent; fringe black. In hindwing black distal border somewhat narrow and tapering near apex and tornus, with its inner edge almost uniform and somewhat diffuse; fringe black, but mixed with yellow. Only the extreme bases of both wings blackish.

Underside: Gound colour somewhat paler than in upperside, not black dusted and most markings very faint. In forewing a series of subapical spots in spaces 5 to 8 and marginal brown smudge in the apex barely traceable; a single spot in discoidal cell; discocellular marking divided into an upper and a lower spots; tornal spot absent; sex-brand brown, short and very narrow, ending slightly before origin of each vein 2; vein-dots almost disappering; fringe yellow. In hindwing a series of discal spots reduced to faint ones in spaces 4 and 7; a black subbasal dot each in spaces 1 and 7; basal spot absent; discocellular spot of an irregular slender ring; vein-dots very small or almost disappearing; fringe yellow.

Forewing somewhat angulate at apex. Hindwing fairly arched in basal half of costal margin; distal margin evenly rounded. Vein 7 stalked with vein 6; *mdc* less than a half length of *ldc*. Antenna somewhat less than half length of forewing, black, white-checkered except on posterodorsal surface and a few apical segments; club cylindrical. Thorax and abdomen yellow, much darkened above, clothed with black and yellow hairs on thorax and base of abdomen.

Male genitalia: Tegumen narrow, trapezoidal in dorsal aspect; valvenansatz slightly curved; saccus moderately long; uncus fairly long, extending posteroventrally, uncal projection strongly developed, very long and projecting upward, with its apex slightly bicuspid. Valva broad and almost quadrate in lateral aspect with its

ventral margin obtusely angulate at the middle; P_1 much reduced and barely recognizable; P_2 absent; P_3 almost triangular, sharply pointed at apex, and somewhat serrate on dorsal margin; P_4 represented by two processes, which are almost same in length and shape, and their apices curved ventrally; P_5 much flattened and its posteroventral corner sharply pointed. Phallus very long, slender and strongly arched dorsally, subzonal portion 1/4× as long as phallus. Juxta membranous, heart-shaped in posterior aspect, with a short median stalk.

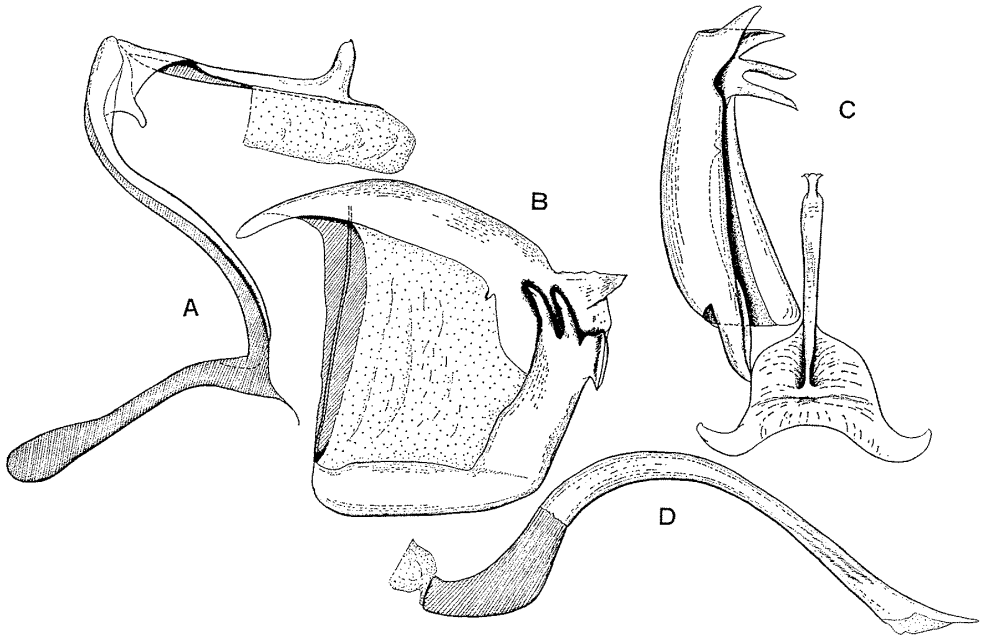


Fig. 11. Male genitalia of *Eurema hiurai* sp. nov., Mindanao. A: Lateral aspect of ring. B: Inner aspect of right-hand valva. C: Dorsal aspect of dorsum and right-hand valva. D: Lateral aspect of phallus.

Length of forewing: 20.6 mm.

♀. (Figs. 7, 8, 12) Upperside: Ground colour milky-white, sometimes with greenish yellow tinge. In forewing black distal border somewhat broad and more deeply excavated in spaces 2 and 3 than in male; black costal border somewhat narrow and diffused; black basal border absent; fringe black. In hindwing black distal border somewhat narrow and tapering near apex and tornus, with its inner edge almost uniform and somewhat diffuse; fringe black, but mixed with milky-white. The extreme bases of both wings more weakly darkened than in male.

Underside: Ground colour milky-white with greenish yellow tinge, marginal and basal parts of wings almost greenish yellow. The markings indistinct except apical patch but more prominent than in male. In forewing apical patch large, quadrate and almost entirely dark brown covering the whole of apical area and invading to space 3; cell spot very faint; discocellular marking divided into an upper and a lower spots or represented by an irregular slender ring; obscure tornal

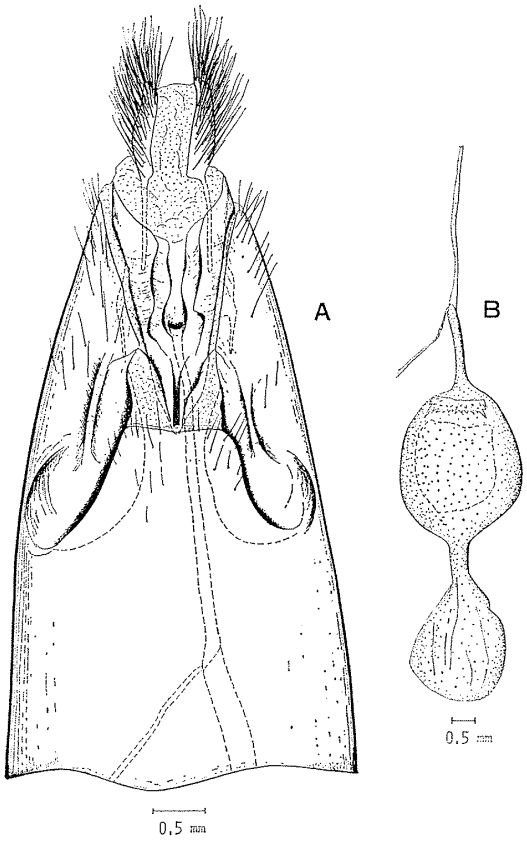


Fig. 12. Female genitalia of *Eurema hiurai* sp. nov., Mindanao. A: Ventral aspect. B: Genital ducts and bursa copulatrix.

spot present or absent; vein-dots conjointed with a fine black anticiliary line; fringe black. In hindwing a series of discal markings in spaces 1 to 7 arranged in an irregular zigzag line; a black subbasal dot each in spaces 1 and 7; basal spot absent; discocellular spot of a faint irregular slender ring; small vein-dots present; fringe milky-white.

Forewing fairly convex along distal margin. Hindwing evenly rounded in basal half of costal margin; distal margin evenly rounded. Wing venation and antennal characters almost as in male. Thorax and abdomen milky-white, much darkened above, clothed with milky-white hairs on thorax and base of abdomen, a black longitudinal line appearing along lateral margins of abdominal terga.

Female genitalia: Seventh abdominal sternum trapezoidal with straight hind margin; lamella antevaginalis represented by a narrow groove; ostium bursae exposed and opening at the middle portion of genital plate; ductus bursae long and slender, 2.5× as long as neck of bursa, weakly sclerotized for about one-fifth from the anterior end; lamella postvaginalis represented by a rather broad and deep longitudinal groove narrowed in the middle portion; irregular dike-like swellings of lateral margins of 8th tergum developed; apophysis anterioris straight, slightly

hamulate upwards at the tip and longer than apophysis posterioris, with a small protuberance at dorsoproximal portion; apophysis posterioris straight and almost as long as papilla analis.

Length of forewing: 22.7–25.0 mm.

Type-locality. Palan-Capatagan (1,000–1,100 m alt.), Mt. Apo, Mindanao, Philippines.

Geographical distribution. This new species is known only from the mountain forest of Mt. Apo.

Holotype: ♂, Palan-Capatagan (1,000–1,100 m alt.), 26. xi. 1969, Isamu HIURA leg. (Holotype is deposited in the collection of the Osaka Museum of Natural History).

Paratypes: 1 ♂, Capatagan (1,100 m alt.), 1. xii. 1969, native collector leg. 1 ♀, Sisinon-Palan (800–1,000 m alt.), 1 ♀, Palan-Capatagan (1,000–1,100 m alt.), 26. xi. 1969, Isamu HIURA leg. 1 ♀, Upper Sibulan-Todaya (450 m alt.), 7–14. xii. 1969, CUTIERREZ and REYNOSO leg. (Some paratypes will be deposited in the National Museum of the Philippines).

Remarks. The new species seems to be most closely related to *E. lacteola* from Malaya and Borneo in every respect. In this connection the former was treated as a subspecies of the latter by HIURA and ALAGAR (1974). However, the following differences seem to be specific judging from the general criteria of morphological differences between sympatric species of the genus *Eurema* as stated above.

Differences in general appearances: 1) Ground colour in male lemon yellow and somewhat darker than in the same sex of *lacteola.* 2) Inner margin of black distal border in hindwing upperside almost uniform, while in *lacteola* zigzag-shaped. 3) Apical patch of forewing underside developed in female quite as in *E. sari* (HORSFIELD, 1829), while in *lacteola* entirely absent. 4) A series of discal spots and vein-dots in hindwing underside almost disappearing especially in male, while in *lacteola* fairly distinct.

Differences in male genitalia: 1) Valva almost quadrate in lateral aspect, while in *lacteola* somewhat oblong and narrowed towards the apex. 2) P_1 of valva much reduced and barely recognizable, while in *lacteola* distinctly projected and normal for the *hecabe* group. 3) P_3 of valva almost triangular, sharply pointed at apex, and somewhat serrate on dorsal margin, while in *lacteola* bluntly pointed at apex and uniform on dorsal margin.

Difference in female genitalia: Dike-like swellings of lateral margins of 8th tergum with an irregular longitudinal ridge, while in *lacteola* uniform and without the ridge.

At first glance, the females of the new species very closely resemble *sari* in bearing the large blackish brown apical patch on the forewing underside. However, we came to the conclusion that the female specimens described above belong to *hiurai* in the following reasons: 1) The wing markings are very similar to those of

male of *hiurai* other than in bearing the apical patch of forewing underside. 2) The ground colour is milky white as in the female of *lacteola* which is very closely related to *hiurai*. 3) The black distal border in hindwing upperside is narrower than in *sari* and not diffuse towards tornus. 4) Only the small black vein-dots are defined in hindwing underside, while in *sari* black dots appear at marginal middle point of each space in addition to the vein-dots. 5) The apical patch in forewing underside is blackish brown, while in *sari* bright chocholate brown. 6) The female genital structure more closely resembles that of *lacteola* than of *sari*. 7) The male specimen of *sari* is entirely unknown from Mindanao. 8) The female in question were obtained together with the male of *hiurai* in same season and same collecting site. The specific name is dedicated to Mr. Isamu HIURA, one of the collectors of the new species.

The Systematic Positions and Biogeography of *timorensis* and *hiurai*

Eurema timorensis is classified into the *tilaha* complex together with *lombokiana* by the specialized female genital structure characterized by the compressed dike-like swellings along the lateral margins of 8th tergum, although we have seen no female specimens of the last-named. On the other hand *hiurai* is grouped in the *lacteola* complex by the some apomorphic characters, the much lengthened uncus, milky-white ground colour in female, etc. The *tilaha* complex is the sister-group of the *lacteola* complex, and these two undoubtedly form a distinct monophyletic group, the *tilaha-lacteola* complex, based on infferred synapomorphy of the development of male harpal process (P_5). Thus these two new species are both included in the

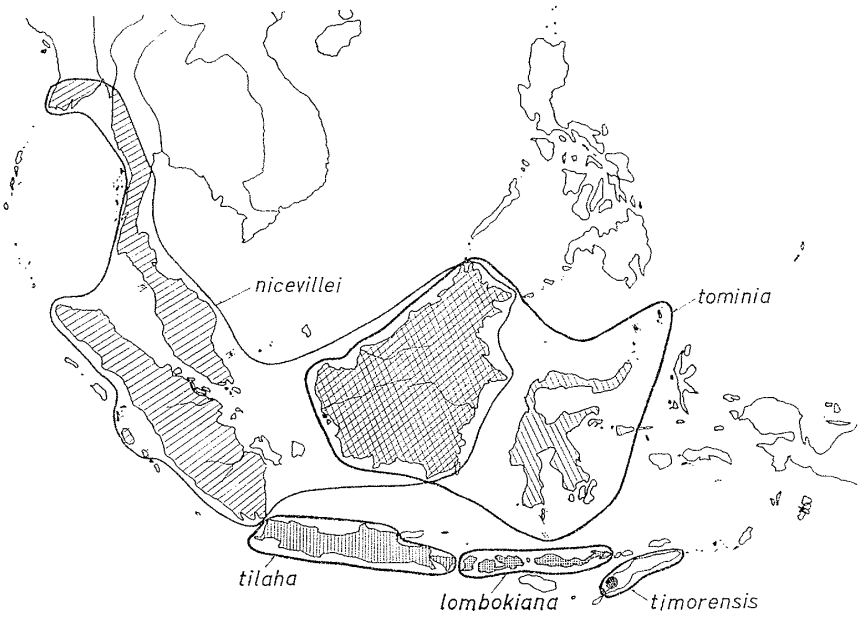


Fig. 13. Distribution of the *tilaha* complex.

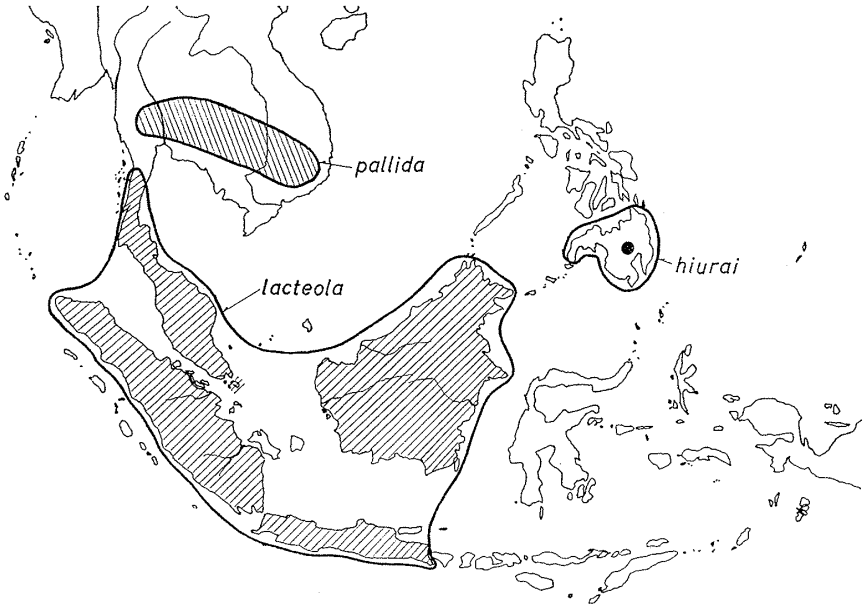


Fig. 14. Distribution of the *lacteola* complex.

tilaha-lacteola complex which is a subgroup of the *sari* group.

The species of the *tilaha* and *lacteola* complex are almost allopatric in distribution within each complex as shown in Figs. 13 & 14. Each distributional pattern of these species seems to represent mostly a generalized distributional track. Furthermore, most species are rare and local in distibution, and cofined to the tropical rain forest. Judging from the above-mentioned circumstances, we consider that allopatric speciation has primarily occured in each complex. In the near future we will discuss in detail the cladistic analysis and historical biogeography of the *tilaha-lacteola* complex in the revisional research of the Old World *Eurema*.

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