Revisional studies on the Lasiocampidae of Japan. 1 : The genus Somadasys Gaede, 1932 (Lepidoptera)

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Revisional studies on the Lasiocampidae of Japan. 1*
The genus *Somadasys* Gaede, 1932
(Lepidoptera)

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The representatives of the genus *Somadasys* Gaede, 1932 are the moths which are well marked by the large silvery spot on the fore-wing, and had been known as the Far Eastern representatives of the European genus *Eriogaster* Germar, 1811 until the genus was established. Those of Japan had been, owing to the wide interspecific variation in the wing coloration and maculation, described as several different species by Butler (1885), Bartel (1899) and Matsumura (1927), but they were subsequently treated as the variations within a single species by certain authors. Bartel's species *Eriogaster argentomaculata* was synonymized with Butler's species *Chrostogastria brevivenis* by Matsumura (1925), and also Matsumura's four species, i. e., *E. daisensis*, *E. kibunensis*, *E. yatsugadakensis* and *E. takamukui* were, as Gaede (1932, 1934) expected, regarded by Inoue (1956a, b) as the individual and seasonal variations of Butler's species.

In the present paper, the recognitions of both the genus and the species involved are revised from the view-points of the morphological analysis of the interspecific variations.

Before going further the author wishes to express his hearty thanks to the late Professor T. Esaki, Professors K. Yasumatsu, T. Shirozu and Y. Hirashima, of Kyushu University, for their constant guidance in the course of his study, and to Professors T. Uchida and C. Watanabe of the Hokkaido University for permitting him to examine the late Dr. Matsumura's type specimens.

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A. Mutsuura of the University of Osaka Prefecture, Dr. H. Kuroko of Kyushu University, Mr. M. Miyatake of Ehime University, Mr. H. Ono of the Obihiro Veterinary University and Mr. T. Saigusa of Kyushu University.

METHODS OF MEASUREMENTS AND TERMS USED

1) Wing characters. The size of the discoidal spot and the lengths of the forewing and veins were measured under a binocular microscope using 7.5 diameters of magnification. The size of the discoidal spot is indicated by the ratio of the longer diameter of the discoidal spot (Fig. 2, A, cd) to the length of the vein Cu_{1b} (Fig. 2, A, Cu_{1b}) (cd/1 Cu_{1b}-ratio). The relation in length between the stalks of M_1+R_4 and M_1+R_4 is represented by the $\frac{M_1+R_4}{M_1+R_5}$-ratio. The length of the forewing (L.F.W.) is indicated by the distance from the base of the subcosta to the apex of the forewing.

In order to facilitate the description of the wing maculation, the three transverse lines on the forewing are designated as the antemedial, postmedial and submarginal lines. The surface of the forewing is divided by the postmedial line into two regions, which are named as the anterior and posterior halves of the forewing respectively.

2) Genitalic characters. After boiling in 12 per cent potassium hydroxide solution for 10 minutes at 100°C, the male genitalia was dissected into details, which were, except for the phallus, mounted on a slide with gum chloral. The phallus was mounted in a glass tube of glycerin alcohol. The details mounted were projected on a screen by the projection microscope and measured by an ordinary scale in millimeter at magnification of 139 diameters.

The shape of the superior process of the valva is indicated by the two ratios; the ratio of the breadth at the shoulder of the base (Fig. 4, A, qr) to the breadth at 1/4 from the trip (Fig. 4, A, m′n) (qr/m′n-ratio) indicates the acuity of the terminal portion, and the ratio of the distance between the tip and the base (Fig. 4, A, pq) to the breadth of the tubular portion (pq/B-ratio) indicates the relative length of the process to the breadth of the tubular portion. The breadth of the tubular portion (B) is represented by the average of the two breadths (Fig. 4, A, m′n and j′k) at 1/4 and at 1/2 from the tip $\left(B=\frac{m'n+j'k}{2}\right)$.

The number of the terminal spines of the phallus is counted under a binocular microscope under the magnifying power of 48 diameters.

GENUS *SOMADASYS* GAEDE, 1932

Somadasys Gaede, 1932, Seitz Macrolep. World 2, Suppl.: 112; Collier, 1936, Junk Lep. Cat. 73: 190; Inoue, 1956, Boll. Lab. Zool. Gen. e Agr. 33: 666; Inoue, 1956, Check List Lep. Jap. 4; 384; Okagaki, 1958, Icon. Het. Jap. Color. Nat. 2: 19; Yamamoto, 1959, Icon. Ins. Jap. Color. Nat. 1: 170; Kawada & Kato, 1959, Nat. Colour. Comm. Ins. Jap.: 51.

Chrostogastria Butler, 1885, Cist. Ent. 3: 119 (nec Hübner, 1823); Leech, 1889, Proc. Zool. Soc. London 1888: 627 (nec Hübner, 1823).

Odonestis Kirby, 1892, Syn. Cat. Lep. Het. 1: 811 (part., nec Germar, 1811); Leech, 1899, Trans. Ent. Soc. London 1899: 115 (part., nec Germar, 1811); Matsumura, 1905, Cat. Ins. Jap. 1: 45 (part., nec Germar, 1881); Matsumura, 1925, Journ. Coll. Agr. Hokkaido Imp. Univ. 15 (3): 112 (nec Germar, 1811).

Eriogaster Bartel, 1899, Entom. Nachrich. 25 (23): 353 (nec Germar, 1811); Matsumura, 1905, Cat. Ins. Jap. 1: 44 (nec Germar, 1811); Strand, 1915, Suppl. Ent. 4: 10 (nec Germar, 1811); Nagano, 1917, Bull. Nawa Ent. Lab. 2: 6 (nec Germar, 1811); Matsumura, 1921, 1000 Ins. Jap. Add. 4: 906, 908 (nec Germar, 1811); Matsumura, 1927, Journ. Coll. Agr. Hokkaido Imp. Univ. 19 (1): 22 (nec Germar, 1811); Matsumura, 1931, 6000 Ill. Ins. Jap.: 684 (nec Germar, 1811); Matsumura, 1932, Ins. Mats. 7 (1/2): 42 (nec Germar, 1811); Gaede, 1932, Seitz Macrolep. World 2, Suppl.: 112 (part., nec Germar, 1811).

Type-species: *Eriogaster daisensis* Matsumura, 1927 [=*Somadasys brevivenis brevivenis* (Butler, 1885)], fixed by Collier (1936).

Range: Saghalien, Japan (Hokkaido, Honshu, Shikoku, Kyushu), Formosa, South West China.

Generic characters. Head: Vertex simple; frontoclypeal area with conical projection at centre; compound eyes sparsely haired; palpi short, with third segment especially shrinked; maxillae with elongate galea; antennae bipectinate in both sexes. Wing venation (Fig. 2, A): Forewing with R_1 almost touching to Sc, R_2+R_3 forked with long stalk, R_4 arising from middle of stalk of R_5+M_1, M_2 and M_3 arising together from lower angle of discoidal cell; hindwing with $Sc+R_1$ anastomosed with Rs, one accessory costal veinlet arising from near base of $Sc+R_1$, M_2+M_3 forked with short stalk. Male genitalia (Fig. 3, A, B, C): Tegumen band-like, with lower edges tightly ankylosed with upper edges of vinculum; vinculum expanded posteriorly, forming an enormous ventral plate; valvae entirely separated into two processes, viz., superior process and inferior one; phallus much large-sized, connecting with articulation between inferior processes of both valvae with bold stalk derived from exterior sheath (cuticula exterior), with cornutus absent. Female genitalia (Fig. 7): Genital plates well developed with difinitive lamella antevaginalis and lamella postvaginalis; ductus bursae of slender tube; bursa copulatrix well developed with single signum.

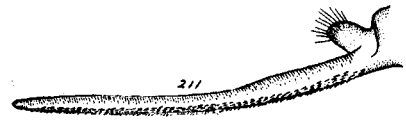

Fig. 1. Galea of *Somadasys brevivenis brevivenis* (Butler).

The species referred in the present study had been known as the Far Eastern representatives of the European genus *Eriogaster* Germar, 1811 (type-species: *Bombyx lanestris* Linné, 1758) since Bartel (1899) described his invalid species under the genus *Eriogaster*. Butler (1885)

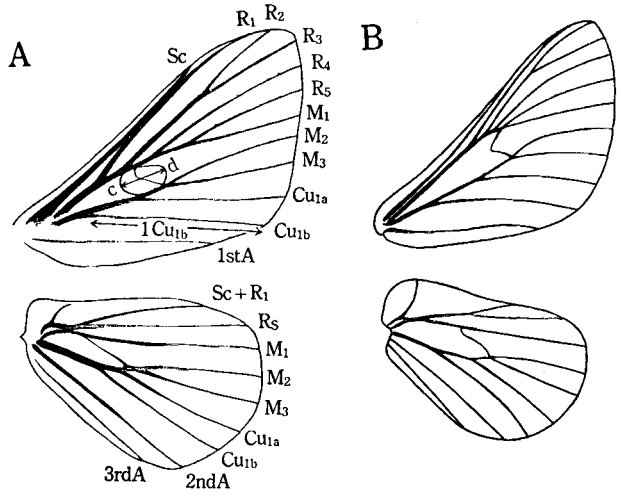

Fig. 2. Wings of *Somadasys brevivenis brevivenis* (Butler) (A) and *Eriogaster lanestris* (Linné) (B).

originally placed his *brevivenis* in the genus *Chrostogastria*, regarding it as an ally to *C. pruni* (Linné, 1758) [=*Odonestis pruni* (Linné)]. Subsequently Kirby (1892) sank the genus *Chrostogastria* Hübner, 1823 as a synonym of the genus *Odonestis* Germar, 1811 (type-species: *Bombyx pruni* Linné, 1758). When Gaede (1932) created a new genus, he excluded *E. brevivenis* (Butler, 1885) from his new genus. Because he was unable to refer it, but he stated, in his supplementary notes (1934) to his former paper (1932), that *S. yatsugadakensis* Matsumura was probably identical with Butler's *brevivenis*.

Gaede (1932) separated his new genus from the genus *Eriogaster*, based upon the fact that the Matsumura's four species were distinguishable from the European species of the genus *Eriogaster* in the wing venation. The results of the present investigation give more positive evidences separating the two genera from each other. The morphological differences between the two genera are as follows:

Genus *Somadasys*	Genus *Eriogaster*
Antennae bipectinate in both sexes.	Antennae bipectinate in male but macroscopically filiform with very minute bipectination in female.
Maxillae with elongate galea.	Maxillae degenerated into lobe-like pads.
Wing venation: Forewing with R_5+M_1 forked with long stalk, from middle of which R_4 emitted; hindwing with $Sc+R_1$ anastomosed with Rs at near	Wing venation: Forewing with R_5 not stalked with M_1, both veins emitting together from upper angle of discoidal cell, R_4 arising from just

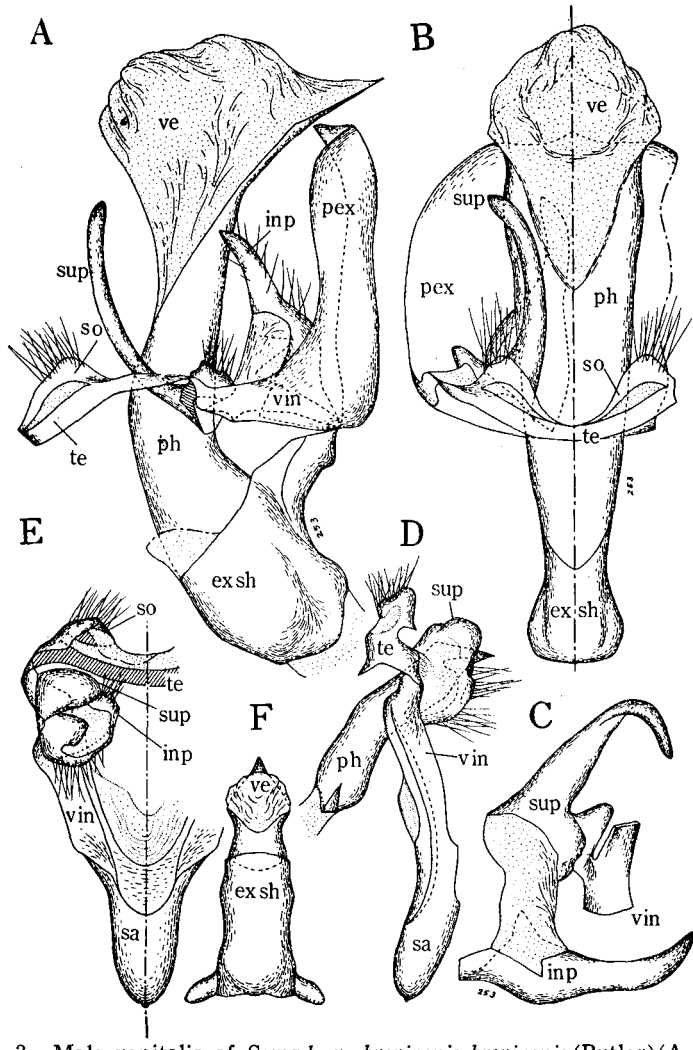

Fig. 3. Male genitalia of *Somadasys brevivenis brevivenis* (Butler) (A, B, C) and *Eriogaster lanestris* (Linné) (D, E, F). A and D: Male genitalia proper, lateral aspect. B: Male genitalia proper, dorsal aspect. C: Valva, internal aspect. E: Male genitalia proper, posterior aspect. F: Phallus, dorsal aspect. exsh: exterior sheath of phallus, inp: inferior process of valva, pex: posterior expansion of vinculum, ph: phallus, sa: saccus, so: socius, sup: superior process of valva, te: tegumen, ve: vesica, vin: vinculum.

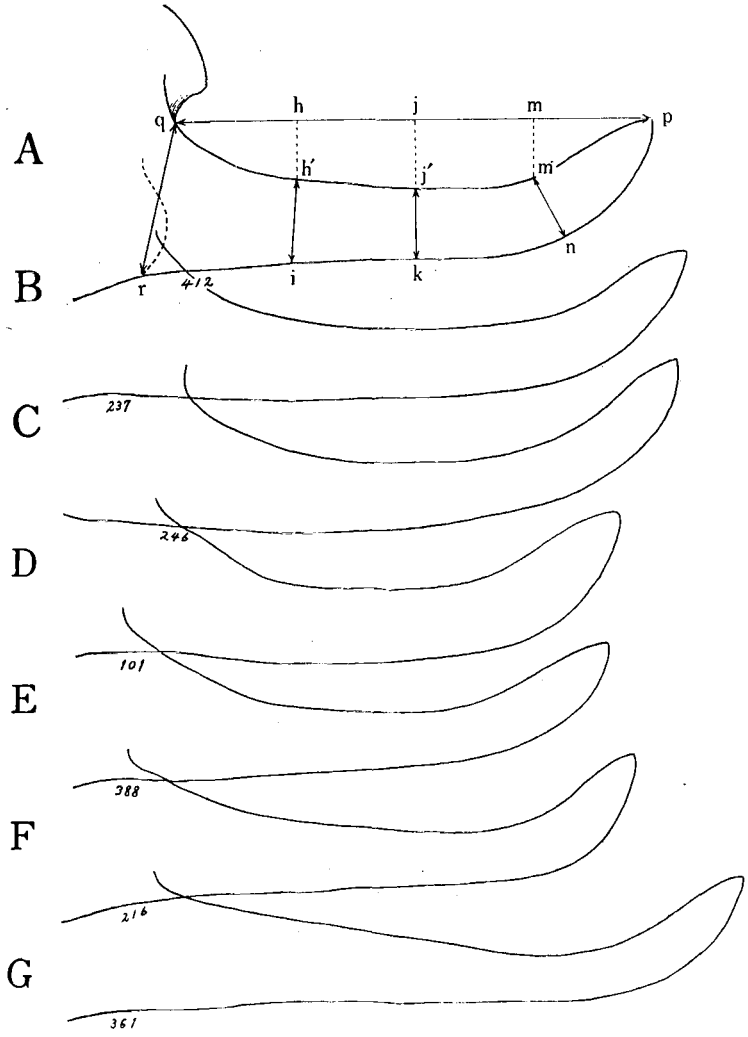

Fig. 4. Variation of the superior process of the valva. A—F: *Somadasys brevivenis brevivenis* (Butler). A. Nukabira, Tokachi Pref., pq/B=6.84, qr/m'n=2.32; B. Kanayama, Nagano Pref., pq/B=8.00, qr/m'n=2.71; C. Nashimoto, South Izu, Shizuoka Pref., pq/B=8.32, qr/m'n=2.50; D. Omogo Val., Ehime Pref., pq/B=6.39, qr/m'n=2.13; E. Mt. Takanawa, Ehime Pref. pq/B=8.27, qr/m'n=2.83; F. Mt. Hikosan, Fukuoka Pref., pq/B=8.53, qr/m'n=2.78. G: *Somadasys brevivenis catacoides* (Strand), Baibara, Formosa, pq/B=11.00, qr/m'n=2.60.

base of latter vein, M_2+M_3 forked with short stalk.	before origin of R_5 and M_1; hindwing with $Sc+R_1$ united with Rs in basal half, M_2 not stalked with M_3.
Foreleg with tibial epiphisis.	Foreleg without tibial epiphisis.
Abdomen without any caudal ornamentation in both sexes.	Abdomen with caudal portion densely clothed with long hairs in male, with seventh segment densely covered with wooly hairs in female.
Male genitalia: Vinculum with an enormous ventral plate instead of saccus.	Male genitalia: Vinculum with an ordinary saccus.
Female genitalia: Genital plates and bursa copulatrix well developed.	Female genitalia: Genital plates and bursa copulatrix degenerated in structure and size.

As tabulated above, the genus *Somadasys* does not show any close relationship to the genus *Eriogaster*, notwithstanding the fact that the certain European species of *Eriogaster*, i.e., *Eriogaster catax* (Linné, 1758), show superficial resemblance to the species of *Somadasys*.

Notwithstanding the eight specific names have been proposed by the various authors for the representatives of the genus, they should be regarded as a single species.

Somadasys brevivenis brevivenis (Butler, 1885)

Chrostogastria brevivenis Butler, 1885, Cist. Ent. 3: 119; Leech, 1889, Proc. Zool. Soc. London 1888: 627.

Odonestis brevivenis Kirby, 1892, Syn. Cat. Lep. Het. 1: 811; Leech, 1899, Trans. Ent. Soc. London 1899: 115; Matsumura, 1905, Cat. Ins. Jap. 1: 45; Matsumura, 1925, Journ. Coll. Agr. Hokkaido Imp. Univ. 15 (3): 112.

Eriogaster brevivenis Matsumura, 1931, 6000 Ill. Ins. Jap.: 683, fig. 358 ♂; Matsumura, 1932, Ins. Mats. 7 (1/2): 42; Marumo, 1932 & 1941, Icon. Ins. Jap. 1st & 2nd eds.: 1322, fig. 2613 ♂; Marumo, 1950, 1951, 1952a & 1952b, Icon. Ins. Jap. 1st, 2nd, 3rd & 4th rev. eds.: 582, fig. 1609 ♂; Nomura, 1937, Sci. Bull. Fac. Agr. Kyushu Imp. Univ. 7 (4): 449; Hirayama, 1937, Genshoku 1000 shu Zoku-Kontyuzufu: 76, pl. 37, fig. 6 ♂; Ishihara, Miyatake, Hisamatsu, Edashige & Sasaki, 1953, Trans. Ent. Soc. Shikoku 3, Suppl.: 33.

Somadasys brevivenis Collier, 1936, Junk Lep. Cat. 73: 190; Kuroko, 1957, Enum. Ins. Mon. Hikosan 1: 52; Okagaki, 1958, Icon. Het. Jap. Color. Nat. 2: 19, pl. 71, fig. 1646 ♂; Asahina, 1959, Misc. Rep. Res. Inst. Natur. Resources 50: 41; Yamamoto, 1959, Icon. Ins. Jap. Color. Nat. 1: 170, pl. 117 a b ♂♂.

Somadasys brevivensis Kawada & Kato, 1959, Nat. Colour. Comm. Ins. Jap.: 51, pl. 35, fig. 542 ♂ (misspelling).

Somadasys brevivenis Butler, fv. *brevivenis* Inoue, 1956, Boll. Lab. Zool. Gen. e Agr. 33: 666; Inoue, 1956, Check List Lep. Jap. 4: 384.

Eriogaster argentomaculata Bartel, 1899, Entom. Nachrich. 25 (23): 353; Matsumura, 1905, Cat. Ins. Jap. 1: 44; Matsumura, 1921, 1000 Ins. Jap. Add. 4: 906, pl. 65, fig. 14 ♂; Nagano, 1917, Bull. Nawa Ent. Lab. 2: 6, pl. 1, fig. 4 ♂, pl. 4, figs. 9–14.

Eriogaster argenteomaculata Esaki, 1930, Mushi 3 (2): 82; Gaede, 1934, Seitz Macrolep. World 2, Suppl.: 284; Umeno, 1935, Bull. Umeno Ent. Lab. 2: 10.

Eriogaster daisensis Matsumura, 1927, Journ. Coll. Agr. Hokkaido Imp. Univ. 19 (1): 22, pl. 2, fig. 17 ♂; Matsumura, 1931, 6000 Ill. Ins. Jap.: 684, fig. 360 ♂; Matsu-

mura, 1932, Ins. Mats. 7 (1/2): 42.
Somadasys daisensis Gaede, 1932, Seitz Macrolep. World 2, Suppl.: 112; Collier, 1936, Junk Lep. Cat. 73: 191.
Somadasys brevivenis Butler, fae. *daisensis* Inoue, 1956, Boll. Lab. Zool. Gen. e Agr. 33: 666; Inoue, 1956, Check List Lep. 4: 384.
Eriogaster kibunensis Matsumura, 1927, Journ. Coll. Agr. Hokkaido Imp. Univ. 19 (1): 22, pl. 2, fig. 21 ♂; Matsumura, 1931, 6000 Ill. Ins. Jap.: 684, fig. 361 ♂; Matsumura, 1932, Ins. Mats. 7 (1/2): 42.
Eriogaster yatsugadakensis Matsumura, 1927, Journ. Coll. Agr. Hokkaido Imp. Univ. 19 (1): 23, pl. 2, fig. 18 ♂; Matsumura, 1931, 6000 Ill. Ins. Jap.: 684, fig. 363 ♂; Matsumura, 1932, Ins. Mats. 7 (1/2): 43; Kato, 1937, Three Colour. Ill. Ins. Jap. 7: pl. 37, fig. 3 ♂.
Somadasys yatsugadakensis Gaede, 1932, Seitz Macrolep. World 2, Suppl.: 112, pl. 9, fig. e.
Eriogaster takamukui Matsumura, 1927, Journ. Coll. Agr. Hokkaido Imp. Univ. 19 (1): 24, pl. 2, fig. 22 ♂; Matsumura, 1931, 6000 Ill. Ins. Jap.: 684, fig. 362 ♂; Matsumura, 1932, Ins. Mats 7 (1/2): 43.
Somadasys takamukui Gaede, 1932, Seitz Macrolep. World 2, Suppl.: 112; Collier, 1936, Junk Lep. Cat. 73: 191.

Morphological variation in the male

1) Honshu group

Materials examined: (OA) Ôhata, Aomori Pref., 25 ♂♂, 2-17. viii. 1957, T. Saigusa leg.; (NF) Nakano-mura, Fukushima Pref., 1 ♂, vi-vii. 1951, M. Kumakura leg.: (MS) Mt. Mitsumine (1,332 m), Saitama Pref., 4 ♂♂, 31. v. 1957, 1 ♂, 4. vii. 1957, K. Ishizuka leg.; (TT) Mt. Takaosan (600 m), Tokyo Pref., 1 ♂, 12. vi. 1949, H. Inoue leg., 1 ♂, 7. viii. 1950, T. Haruta leg., 1 ♂, 9. vi. 1951, without collector, 1 ♂, 14. vi. 1952, K. Ishizuka leg., 1 ♂, 25. vi. 1954, H. Inoue leg., 1 ♂, 22. v. 1958, K. Ishizuka leg., 2 ♂♂, 25. v. 1959, 1 ♂, 17. vi. 1959, H. Inoue leg.; (KN) Kamikochi (1,500 m), Nagano Pref., 1 ♂, 15. vii. 1936, T. Shirôzu leg., (NN) Nakabusa-onsen (1,500 m), Nagano Pref., 2 ♂♂, 24. vii. 1951, H. Inoue leg.; (KY) Kanayama (1,400 m), Yamanashi Pref., 3 ♂♂, 27-28. vii. 1957, T. Saigusa leg.; (TY) Teradaira (400 m), Yamanashi Pref., 1 ♂, vii. 1956, M. Murata leg.; (SY) Lake Syôji (903 m), Yamanashi Pref., 1 ♂, 25. vii. 1955, T. Saigusa leg.; (AY) Akagawara (1,500 m), Mt. Senjyo (3,033 m), Yamanashi Pref., 1 ♂, 5. viii. 1958, H. Yamamoto leg.; (NH) Nashimoto, South Izu, Shizuoka Pref., 2 ♂♂, 10-11. viii. 1959, H. Inoue leg.; (MH) Misakubo-machi, Shizuoka Pref., 2 ♂♂, 21. vii. 1950, K. Kojima leg.; (DW) Doro, Wakayama Pref., 1 ♂, 31. vii. 1951, I. Hiura leg.; (I0) Mt. Iwawakisan (838 m), Osaka Pref., 1 ♂, 23. vi. 1950, A. Mutsuura leg.

The capital letters parenthesized show the abbreviations of localities of the samples in Tables 1, 2 and 3.

Wing coloration. Amongst fifty-five specimens from the various localities of Honshu, the wing coloration is highly variable. Then, it is roughly classified into two types, viz., yellowish type and brownish one. Moreover, they may be subdivided into the following subtypes respectively.

Yellowish type
- Subtype Y_1 . . . Forewing with the posterior half frosted with the greyish scales.
- Subtype Y_2 . . . Forewing uniformly buffy ochre, lacking the greyish scales on the posterior half.

Brownish type
- Subtype B_1 . . . Forewing strongly tinged with reddish brown, retaining the yellowish or ochreous ground on the anterior half.
- Subtype B_2 . . . Forewing uniformly lateritious on the whole surface.
- Subtype B_3 . . . Forewing uniformly deep brown on the whole surface.

The frequency of the wing coloration types in the samples from the various localities of Honshu is shown in Table 1.

Wing maculation. The transverse lines are variable in curvature: The transverse antemedial line strongly geniculate at the middle of the discoidal cell, where it hardly detached with, in some extent, but widely separated from, in the greater number, the anterior edge of the discoidal spot; the transverse postmedial

Table 1. Frequency of the wing coloration types in the samples from the various localities of Honshu.

Sample	Number of spec.	Date	Wing coloration type				
			Y_1	Y_2	B_1	B_2	B_3
OA	25	Aug.	3	4	18		
NF	1	June-Jul.			1		
MS	5	May	3				1
		Jul.			1		
TT	9	May	1		1		1
		June	1	2	1	1	
		Aug				1	
KN	1	Jul.	1				
NN	2	Jul.	2				
KY	3	Jul.	3				
TY	1	Jul.			1		
SY	1	Jul.			1		
AY	1	Aug.			1		
NH	2	Aug.				2	
MH	2	Aug.				2	
DW	1	Jul.				1	
IO	1	June			1		
Total	55		14	6	26	7	2

line straight or slightly curved; the transverse submarginal line approximately parallel with the outer margin. The discoidal spot is, although varying in shape and size, concave on the upper edge in the majority of the specimens from Honshu. The variation in the size of the discoidal spot is presented by the frequency of cd/lCu$_{1b}$-ratio in Table 2.

$\frac{M_1+R_4}{M_1+R_5}$-ratio. The variation of this ratio is shown in Table 2, in which the frequency of the values evidently suggests that the ratio is subject to wide individual variation.

Length of forewing. The variation is presented by frequency in Table 2.

Table 2. Frequencies of the values of cd/lCu$_{1b}$-ratio, $\frac{M_1+R_4}{M_1+R_5}$-ratio and length of forewing in the samples from the various localities of Honshu.

Sample	Number of spec.	Date	cd/lCu$_{1b}$						$\frac{M_1+R_4}{M_1+R_5}$										L.F.W.(mm×7.5)						
			0.166–0.195	0.196–0.225	0.226–0.255	0.256–0.285	0.286–0.315	0.316–0.345	0.46–0.55	0.56–0.65	0.66–0.75	0.76–0.85	0.86–0.95	0.96–1.05	1.06–1.15	1.16–1.25	1.26–1.35	1.36<	103–107	108–112	113–117	118–122	123–127	128–132	133–137
OA	25	Aug.		2	7	11	4	1	1	2	5	5	6		3	2	1			2	3	9	7	4	
NF	1	June–Jul.				1			1																1
MS	5	May	1	1		2				2			2								1	1	2		
		Jul.		1									1										1		
TT	9	May		2	1									2				1 (1.78)			1	1		1	
		June		1	1	2	1		1		1	1	1					1 (1.50)				2		3	
		Aug.		1							1									1					
KN	1	Jul.					1							1											1
NN	2	Jul.			1	1				1		1											1		1
KY	3	Jul.			2	1			1				1			1							1		2
TY	1	Jul.					1							1								1			
SY	1	Jul.		1							1										1				
AY	1	Aug.					1						1										1		
NH	2	Aug.	1	1								1						1 (1.56)	1	1					
MH	2	Aug.	2								1	1									1	1			
DW	1	Jul.			1						1													1	
IO	1	June		1								1										1			
Total	55		4	11	13	18	8	1	4	5	10	10	12	4	3	3	1	3	1	4	7	16	13	9	5

Genitalia. Besides the characters given in the preceding page as the generic feature, the valval processes and the phallus will show a morphological significance on the specific level: The superior process (Fig. 4, B, C) elongate, tubular, narrowing towards the tip, with the base broad-shouldered; the inferior process approximately trigonate, with the terminal portion sharply pointed, subequal in length to the superior process; phallus, in dorsal aspect, club-shaped with the short median prong at the apex, in lateral aspect, bended ventrally, with the basal portion bulbed, with or without some minute spines on the ventro-median line of the terminal portion. The variations of the values of pq/B-ratio and qr/m'n-ratio are presented by frequency in Table 3. The number of the terminal spines of the phallus are individually fluctuant, giving no significance to geogra-

Table 3. Frequencies of the values of pq/B-ratio and qr/m'n-ratio in the samples from the various localities of Honshu.

Sample	Number of spec.	Date	pq/B									qr/m'n				
			6.76–7.25	7.26–7.75	7.76–8.25	8.26–8.75	8.76–9.25	9.26–9.75	9.76–10.25	10.26–10.75	10.76–11.25	1.86–2.15	2.16–2.45	2.46–2.75	2.76–3.05	3.06–3.35
OA	25	Aug.	3	4	11	5	1	1				3	6	8	7	1
NF	1	June–Jul.			1									1		
MS	5	May	1	2			1						1	2	1	
		Jul.		1									1			
TT	9	May		2	1								2	1		
		June	1	1		1	1				1	1	2	1		1
		Aug.				1								1		
KN	1	Jul.		1											1	
NN	2	Jul.	1		1									1	1	
KY	3	Jul.		1	2								1	2		
TY	1	Jul.	1									1				
SY	1	Jul.						1								1
AY	1	Aug.						1						1		
NH	2	Aug.				1		1					1	1		
MH	2	Aug.						1		1				1		1
DW	1	Jul.		1								1				
IO	1	June						1								1
Total	55		7	13	16	8	3	6	0	1	1	6	14	20	10	5

phical and seasonal variation; usually one to three spines present, and entirely obliterated in some specimens.

Seasonal analysis of variation. In the specimens from the lower altitudes or the submountainous regions of Honshu, there are two seasonal series of specimens; the specimens of the first series were taken from the beginning of May to the beginning of August, and those of the later part of August. In the present paper they are discriminated as the specimens of the earlier series and those of the later one.

In a series of specimens taken at the nearly same time from a given locality, the wing coloration varies from Y_1 to B_3. Thus, the variation in the wing coloration is not seasonal.

In the size of the discoidal spot and in the length of the forewing, the specimens taken in the later part of August are somewhat different from those taken from May to the beginning of August; in the specimens of the later series, the discoidal spot shows smaller value in the cd/lCu_{1b}-ratio, and the forewing is shorter in length. In both the two valval ratios, the two seasonal series of specimens are not significantly different from each other.

Geographical analysis of variation. Amongst the local samples from the various localities of Honshu, the variations of the wing and genitalic characters do not exhibit any distinct geographical difference, but some of them probably suggest a tendency to geographical variation, which is better expressed in the frequency of the wing coloration types. Of the specimens from the alpine districts of the central Honshu, those from the North Alps, Nagano Prefecture and from the Chichibu Mountains, Yamanashi Prefecture are exclusively of subtype Y_1 in the wing coloration. In the wing coloration they closely resemble the specimens from Hokkaido, but are scarcely distinguishable from the latter specimens in having the less greyish scales and the smaller discoidal spot on the forewing. The specimens from the southern alpine districts, such as Mt. Senjyo of the South Alps and Lake Shôji of the southern foot of Mt. Fuji etc., are of brownish type in the wing coloration, exhibiting a different tendency from the specimens from the central to north alpine district. In the specimens from the submountainous districts of Honshu the brownish type is obviously predominant. The tendency towards brown becomes more pronounced in the southern area of Honshu, where the four specimens from the two localities of Shizuoka Prefecture are uniformly reddish brown in the ground color.

Apart from the geographical tendency in the wing coloration, in any one of the characters considered here there is no significant difference at least among the following four local samples from the central to northern regions of Honshu:

	N	cd/1Cu$_{1b}$	$\frac{M_1+R_4}{M_1+R_5}$	L.F.W. (mm)	pq/B	qr/m'n
OA	25	0.2663±0.0306	0.870±0.205	16.18±0.78	7.937±0.558	2.591±0.286
MS	5	0.2298±0.0359	0.774±0.174	16.45±0.58	7.780±0.748	2.508±0.164
TT	8	0.2468±0.0666	1.038±0.408	16.67±0.92	8.234±1.744	2.454±0.350
AC	6	0.2663±0.0233	0.842±0.257	17.49±0.58	7.755±0.347	2.663±0.259

TT: excluding one specimen taken in the later part of August.

AC: representing the complex sample constituted of one specimen from Kamikochi (KN), two from Nakabusa-onsen (NN) and three from Kanayama (KY).

These series of means and standard deviations clearly show that the morphological variations in the four samples widely overlap to one another. From this it is conceivable that the local populations of the central to northern regions of Honshu may represent a geographical group of morphological similarity. Then, the means and standard deviations of the wing and genitalic indices in the group will, as shown in Table 12, be calculated from the aggregation of the four local samples, regarding them as a geographical group.

In addition to the samples discussed above, some scattered specimens were available from the southern alpine districts and from the western and southern regions of Honshu, but they are utterly inadequate in the size of the sample to refer to the geographical tendencies in their populations. In the specimens from the two lower altitudes of Shizuoka Prefecture, the pq/B-ratio shows an extreme increase of value, but it is uncertain whether that is geographical, seasonal or individual.

2) Hokkaido group

Materials examined: (SK) Shibecha, Kushiro Pref., 1♂, 13. vi. 1952, 9♂♂, 6. vi. 1956, 7♂♂, 25. vi.–2. vii. 1957, K. Ijima leg.; (NT) Nukabira, Tokachi Pref., 1♂, 29. vi. 1960, 25♂♂, 9–30. vi. 1960, H. Ono leg.; (NI) Niikappu, Hidaka Pref., 1♂, 7. viii. 1954, T. Kumata leg.

The capital letters parenthesized show the abbreviations of localities of the samples in Tables 4 and 5.

Wing coloration. Between the two samples from Nukabira and Shibecha, the wing coloration is fairly different from each other: In the specimens from Nukabira, the ground color extremely darkened, somewhat tinged with purplish tone, with the forewing densely frosted with the greyish scales on the posterior half, remaining the yellowish area on the lower half of the anterior portion; in the specimens from Shibecha, the ground color paler, buffy ochreous, with the forewing densely frosted with the greyish scales on the posterior half as in the specimens from Nukabira. In the one specimen from Niikappu the wing coloration is brownish, resembling the specimens of subtype B_1 in the Honshu group.

Wing maculation. Notwithstanding the distinct difference in the wing coloration, the maculation on the forewing is identical with each of the two samples from Nukabira and Shibecha. Moreover, in each sample the wing maculation shows a less individual variation: The transverse antemedial line strongly geniculate at the middle of the discoidal cell, where it is widely separated

from the anterior edge of the discoidal spot; the transverse postmedial line weekly arched, bending at near the base of the vein M_2; the transverse submarginal line almost parallel with the outer margin; the discoidal spot nicely oval, large-sized. The individual variation in the size of the discoidal spot is presented by the frequency of cd/1Cu_{1b}-ratio in Table 4.

$\frac{M_1+R_4}{M_1+R_5}$ *-ratio.* Also in the specimens from Hokkaido, this ratio is subject to wide individual variation. The frequency of the ratio is given in Table 4.

Length of forewing. The variation is presented by frequency in Table 4.

Genitalia. The superior process of valva (Fig. 4, A) takes the form of a sward, with the tubular portion broader in general than that in the specimens from the other districts. The variations of the two valval ratios are presented by frequency in Table 5.

Table 4. Frequencies of the values of cd/1Cu_{1b}-ratio, $\frac{M_1+R_4}{M_1+R_5}$-ratio and length of forewing in the samples from three localities of Hokkaido.

Sample	Number of spec.	Date	cd/1Cu_{1b}							$\frac{M_1+R_4}{M_1+R_5}$								L.F.W. (mm×7.5)				
			0.226–0.255	0.256–0.285	0.286–0.315	0.316–0.345	0.346–0.375	0.376–0.405	0.406–0.435	0.46–0.55	0.56–0.65	0.66–0.75	0.76–0.85	0.86–0.95	0.96–1.05	1.06–1.15	1.16<	118–122	123–127	128–132	133–137	138–142
SK	17	June–Jul.	3	3	9	1			1	1	2	4	6	2	1		1(1.50)	3	7	6		1
NT	26	June	1	8	14	2	1			3	3	10	4	3	2	1		3	8	9	6	
NI	1	Aug.			1									1					1			
Total	44		4	11	24	3	1	0	1	4	5	14	10	6	3	1	1	6	16	15	6	1

Table 5. Frequencies of the values of pq/B-ratio and qr/m′n-ratio in the samples from three localities of Hokkaido.

Sample	Number of spec.	Date	pq/B					qr/m′n				
			5.76–6.25	6.26–6.75	6.76–7.25	7.26–7.75	7.76–8.25	1.86–2.15	2.16–2.45	2.46–2.75	2.76–3.05	3.06–3.35
SK	17	June–Jul.	4	4	5	1	3	10	4	1	1	1
NT	26	June	1	12	9	3	1	10	11	5		
HI	1	Aug.		1					1			
Total	44		5	17	14	4	4	20	16	6	1	1

Analysis of variation. Excepting a single specimen from Niikappu, all the specimens from Hokkaido were taken from the middle of June to the beginning of July, and also those from Sapporo which are preserved in Hokkaido University had been taken in June. This fact probably suggests that the moth appears once a season in Hokkaido. The seasonal analysis of variation is, therefore, left out of consideration.

Except for the difference in the wing coloration, the two local samples from Shibecha and Nukabira are, however, similar to each other in the structural characters. The means and standard deviations of the wing and genitalic indices in the two samples are as follows:

	N	cd/lCu_{1b}	$\frac{M_1+R_4}{M_1+R_6}$	L.F.W.(mm)	pq/B	qr/m'n
SK	17	0.2989±0.0146	0.805±0.214	16.86±0.49	6.836±0.672	2.239±0.350
NT	26	0.2935±0.0223	0.747±0.144	17.17±0.45	6.832±0.411	2.254±0.187

These series of means and standard deviations apparently indicate that the two samples closely overlap to each other in the morphological variations. The two samples may, therefore, represent a geographical group of morphological similarity. The means and standard deviations of the wing and genitalic indices in this group will be given in Table 12 as those of the Hokkaido group.

Nevertheless, an attention may be called to the distinct difference in the wing coloration between the two samples. The ground color of fuscous brown is, however, quite peculiar to the specimens from Nukabira, but the ground color of buffy ochre is found not only in the specimens from Shibecha but also in certain number of those from Honshu and Shikoku. Thus, the general ground color of wings in the Hokkaido population should be buffy ochreous. This may be supported by another fact that the wing coloration is buffy ochreous also in the specimens from Sapporo and even in a single specimen from Saghalien which are preserved in the Matsumura's collection of Hokkaido University.

3) Shikoku group

Materials examined: (TE) Mt. Takanawa (986 m), Ehime Pref., 7♂♂, 21. vii. 1954, M. Okada leg.; (IE) Mt. Ishizuchi (1,921 m), Omogo Val. (700 m), Ehime Pref., 2♂♂, 3. v. 1956, 1♂, 3. v. 1958, Y. Miyatake leg., 4♂♂, 26. vi. 1951, 1♂, 27. viii. 1955, M. Miyatake leg.; Jojusha (1,420 m), Ehime Pref., 1♂, 27. vi. 1951, M. Miyatake leg., 2♂♂, 12. vi. 1961, M. Okada leg.; Mt. Tebako (1,807 m), Kochi Pref., 4♂♂, 10. vi. 1959, M. Miyatake leg.; (SK) Mt. Tsurugiyama (1,955 m), Kochi Pref., 3♂♂, 3. v. 1951, 2♂♂, 5. v. 1951, A. Mutsuura leg.; (KK) Kuroson, Kochi Pref., 1♂, 13. viii. 1955, T. Ishihara, S. Hisamatsu, Wake & M. Okada leg.

The capital letters in the parentheses show the abbreviations of localities of the samples in Tables 6, 7 and 8.

Wing coloration. The wing coloration in the specimens from Shikoku is highly variable and classified into two main types and five subtypes as in the

Table 6. Frequency of the wing coloration types in the samples from five localities of Shikoku.

Sample	Number of spec.	Date	Wing coloration type				
			Y_1	Y_2	B_1	B_2	B_3
TE	7	Jul.	2		5		
IE	14	May			3		
		June	2		6		1
		Jul.	1				
		Aug.		1			
TK	3	June			2		1
SK	5	May	2			1	2
KK	1	Aug.					1
Total	30		7	1	16	1	5

Table 7. Frequencies of the values of cd/lCu_{1b}-ratio, $\frac{M_1+R_4}{M_1+R_5}$-ratio and length of forewing in the samples from five localities of Shikoku.

Sample	Number of spec.	Date	cd/lCu_{1b}						$\frac{M_1+R_4}{M_1+R_5}$												L.F.W. (mm×7.5)				
			0.106–0.135	0.136–0.165	0.166–0.195	0.196–0.225	0.226–0.255	0.256–0.285	0.56–0.65	0.66 0.75	0.76–0.85	0.86–0.95	0.96–1.05	1.06–1.15	1.16–1.25	1.26–1.35	1.36–1.45	1.46–1.55	1.56–1.65	1.66<	108–112	113–117	118–122	123–127	128–132
TE	7	Jul.			3	3	1				1		1	1	3			1				2	1	4	
IE	14	May			1	2						1			1			1							3
		June		1	2	4	2				1	2	1	2	2		1						4	4	1
		Jul.		1													1						1		
		Aug.	1						1												1				
TK	3	June				3				1	1				1							1	1	1	
SK	5	May			2	2		1		1			1	2			1						2	2	1
KK	1	Aug.		1																1(3.00)					1
Total	30		1	3	8	14	3	1	1	2	3	3	3	5	7	0	3	2	0	1	1	3	9	11	6

specimens from Honshu. The frequency of the wing coloration types in the samples from Shikoku is shown in Table 6.

Wing maculation. The three transverse lines and the shape of the discoidal spot of the forewing are as in the specimens from Honshu.

The variation in the size of the discoidal spot is presented by the frequency of cd/lCu$_{1b}$-ratio in Table 7.

$\frac{M_1+R_4}{M_1+R_5}$ *-ratio.* The variation of the ratio is shown in Table 7. The ratio is, although individually fluctuate, over 1.00 in the majority of specimens available. The extreme increasing of the ratio in the specimen from Kuroson should be accepted as an individual aberration.

Length of forewing. The variation is presented by frequency in Table 7.

Table 8. Frequencies of the values of pq/B-ratio and qr/m'n-ratio in the samples from five localities of Shikoku.

Sample	Number of spec.	Date	pq/B								qr/m'n				
			5.26–5.75	5.76–6.25	6.26–6.75	6.76–7.25	7.26–7.75	7.76–8.25	8.26–8.75	8.76–9.25	1.56–1.85	1.86–2.15	2.16–2.45	2.46–2.75	2.76–3.05
TE	7	Jul.			1	1	1	2	2				4	2	1
IE	14	May				1	2					1	2		
		June	1		1	1	1	2	1	2	1	1	3	2	2
		Jul.						1						1	
		Aug.						1						1	
TK	3	June					2			1			2	1	
SK	5	May			2	1		1	1		1	2		1	1
KK	1	Aug.					1					1			
Total	30		1	0	4	4	7	7	4	3	2	5	11	8	4

Genitalia. The shape of the tubular portion of the superior process of the valva is subject to wide variation i.e. in some specimens being sward-like as in those from Hokkaido (Fig. 4, D), and in others sharply pointed towards the tip (Fig. 4, E). The variations of the pq/B-ratio and qr/m'n-ratio are shown by frequency in Table 8.

Seasonal analysis of variation. As in the samples from Honshu, the two seasonal series of specimens are recognized in the samples from five localities of Shikoku. The vast majority of the specimens available for this analysis was taken from May to July, and two of those were taken in the later part of August. The latter two

specimens, which were taken from Mt. Ishizuchi and Kuroson respectively, are well marked by the smaller discoidal spot, but they do not exhibit any significance to mark them off from the former specimens in the wing coloration; the one from Mt. Ishizuchi is of subtype Y_2, and the other from Kuroson of subtype B_3. Further, in the other wing characters the two seasonal series of specimens are not significantly different from each other.

Geographical analysis of variation. Amongst the four local samples from Shikoku, the local difference is not significant in any one of the wing and genitalic indices. The means and standard deviations of the wing and genitalic indices in each sample are as follows:

	N	cd/lCu$_{1b}$	$\frac{M_1+R_4}{M_1+R_5}$	L.F.W.(mm)	pq/B	qr/m'n
TE	7	0.1977±0.0288	1.147±0.224	16.25±0.37	7.650±0.659	2.459±0.188
IE	13	0.2030±0.0276	1.115±0.215	16.51±0.56	7.568±1.003	2.436±0.332
TK	3	0.197 ~0.211	0.69 ~1.18	15.60~16.80	7.39 ~ 9.19	2.17 ~2.69
SK	5	0.2104±0.0304	1.038±0.247	16.53±0.42	7.282±0.931	2.290±0.472

These series of means and standard deviations show that the variations of the wing and genitalic indices exhibit a common ranges throughout the four local samples. The means and standard deviations of the wing and genitalic indices in the Shikoku group are, thus, given in Table 12, regarding the four local samples as a geographical group of morphological similarity.

4) Kyushu group

Materials examined: (HF) Mt. Hikosan (1,200 m), Fukuoka Pref., The Hikosan Biological Laboratory, Kyushu University (700 m), 1♂, 20. vii. 1951, T. Takara leg., 4♂♂, 18-23. viii. 1954, S. Nakao, H. Yamamoto & C. Okuma leg., 4♂♂, 17. vii. 1956, H. Kuroko leg., 7♂♂, 21-25. viii. 1956, H. Kuroko leg., 2♂♂, 15. vii. 1958, K. Morimoto leg., 1♂, 13. vii. 1958, K. Yano leg., 2♂♂, 22. vii. 1960, H. Yamamoto leg.; (SO) Mt. Sobosan (1,758 m), Oita Pref., Kôbaru (400 m), 2♂♂, 12. viii. 1959, H. Yamamoto leg.

The capital letters parenthesized show the abbreviations of localities of the samples in Tables 9, 10 and 11.

Wing coloration. Throughout the specimens from Kyushu the ground color is more deeply tinged with reddish tone than in the specimens from the other districts. Even in the specimens of yellowish type the ground color is rather orange yellow. The tendency to reddish brown in the ground color brings about an ambiguity in subdividing the brownish type into the three subtypes. The brown of the specimens from Kyushu will, therefore, be represented as a complex of B_1, B_2 and B_3. The frequency of the wing coloration types in the samples from Kyushu are shown in Table 9. As far as the author knows, there is no specimen of subtype Y_1 from Kyushu.

Wing maculation. The three transverse lines are subject to wide in-

dividual variation in curvature: The transverse antemedial line strongly geniculate at the middle of the discoidal cell, where sufficiently separated from, in the great majority of the specimens, and hardly detached with, in some specimens, the anterior edge of the discoidal spot; the transverse postmedial line almost straight or very slightly arched; the transverse submarginal line approximately parallel with the outer margin, not wavy in the greater number but irregularly sinuated in a few.

Table 9. Frequency of the wing coloration types in the samples from two localities of Kyushu.

Sample	Number of spec.	Date	Wing coloration type		
			Y_1	Y_2	B_1-B_2-B_3 complex
HF	21	Jul.		4	6
		Aug.		2	9
SO	2	Aug.		1	1
Total	23			7	16

In the majority of the specimens from Kyushu, the discoidal spot is more deeply concave on the upper edge and more dwindled than in the generalized form in the Honshu and Shikoku groups. The variation of the size of the discoidal spot is presented by the frequency of cd/$1Cu_{1b}$-ratio in Table 10.

$\frac{M_1+R_4}{M_1+R_5}$ *-ratio.* The frequency presented in Table 10 apparently indicates that the variation of the ratio is utterly individual.

Length of forewing. The variation is presented by frequency in Table 10.

Table 10. Frequencies of the values of cd/$1Cu_{1b}$-ratio, $\frac{M_1+R_4}{M_1+R_5}$-ratio and length of forewing in the samples from two localities of Kyushu.

Sample	Number of spec.	Date	cd/$1Cu_{1b}$					$\frac{M_1+R_4}{M_1+R_5}$								L.F.W. (mm×7.5)				
			0.106–0.135	0.136–0.165	0.166–0.195	0.196–0.225	0.226–0.255	0.56–0.65	0.66–0.75	0.76–0.85	0.86–0.95	0.96–1.05	1.06–1.15	1.16–1.25	1.26–1.35	108–112	113–117	118–122	123–127	128–132
HF	21	Jul.		1	5	2	2	1	2	1		3	1	1	1	1	2	1	5	1
		Aug.	2	3	6			2	3	3	3					1	3	5	2	
SO	2	Aug.			1	1			2								1		1	
Total	23		2	4	12	3	2	3	7	4	3	3	1	1	1	2	6	6	8	1

Genitalia. In the majority of specimens, the superior process of valva (Fig. 4, F) slender, narrowing towards the tip which is sharply pointed.

Consequently the two valval ratios take smaller values in the samples from Kyushu than in those from the other districts. The variations of the two ratios are presented by frequency in Table 11.

Table 11. Frequencies of the values of pq/B-ratio and qr/m'n-ratio in the samples from two localities of Kyushu.

Sample	Number of spec.	Date	pq/B						qr/m'n						
			6.76–7.25	7.26–7.75	7.76–8.25	8.26–8.75	8.76–9.25	9.26–9.75	1.86–2.15	2.16–2.45	2.46–2.75	2.76–3.05	3.06–3.35	3.36–3.65	3.66–3.95
HF	21	Jul.		4	3		3			1	6	2		1	
		Aug.	1	2	3	2	1	2		2	4	3	1		1
SO	2	Aug.					1	1	1				1		
Total	23		1	6	6	2	5	3	1	3	10	5	2	1	1

Analysis of variation. Also in the sample from Mt. Hikosan there are two seasonal series of specimens, series I and II; the members of the series I have been taken in July, and those of the series II at the end of August. Moreover, in the numerous specimens from Mt. Hikosan in the collections of the Entomological Laboratory and the Hikosan Biological Laboratory of Kyushu University, the two seasonal series of specimens are well recognized. As in the scattered specimens taken in the later part of August from the certain localities of Honshu and Shikoku, the series II shows a smaller value of cd/lCu_{1b}-ratio than that of the specimens of the series I. A comparison of the wing and genitalic indices between the two seasonal series of specimens is given below and a comparison of three of them is illustrated in Fig. 5.

	N	cd/lCu_{1b}	$\frac{M_1+R_4}{M_1+R_5}$	L.F.W.(mm)	pq/B	qr/m'n
Ser. I	10	0.1974±0.0260	0.948±0.243	16.23±0.80	8.087±0.630	2.705±0.362
Ser. II	11	0.1631±0.0239	0.779±0.096	15.77±0.66	8.315±0.821	2.776±0.474

Since only two specimens are available from other localities than Mt. Hikosan, it is impossible to make an analysis of the local variation in the Kyushu population.

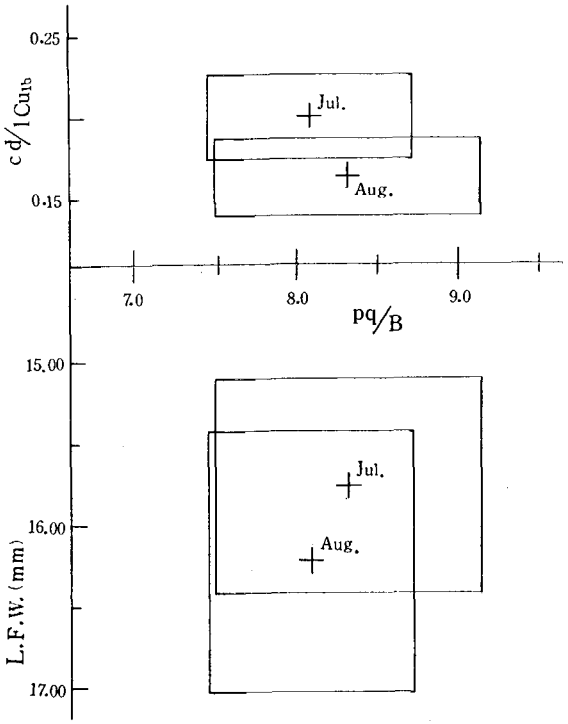

Fig. 5. Comparison of cd/lCu$_{1b}$-ratio, pq/B-ratio and length of forewing between the two seasonal series of the specimens from Mt. Hikosan, Kyushu. Each side of a quadrangle representing the width of standard deviation, and each bar of a closs representing the level at mean.

5) Discussion

As mentioned in the preceding paragraphs, in the lower altitudes or the submountainous regions of Honshu and in the mountains of Shikoku and Kyushu, there are two seasonal series of specimens named as the earlier series (or ser. I) and the later one (or ser. II). Between the two seasonal series of specimens, the morphological difference is recognized only in the size of the discoidal spot. In the specimens of the later series the discoidal spot is significantly smaller than that in the specimens of the earlier series. Therefore, this difference between the two is accepted as a seasonal variation and the two series of specimens may represent the different generations. Supposing that the species has two annual broods, the following absurdities may arise:

1) The moth of the first generation appears irregularly during such a long period as three months.
2) The progeny of the moth emerged in July or even at the beginning of August completes its early stages within such

a short period as thirty or fourty days.

The most probable solution to these absurdities may be that the species has two biological races; the one has two annual broods, and the other a single brood. The specimens taken in May should be the representatives of the first generation of the double-brooded race, and the specimens taken in the later part of August those of the second generation of the same, while the specimens taken from July to the beginning of August those of the single-brooded race. Then, the earlier series of specimens comprises the representatives of the first generation of the double-brooded race and those of the single-brooded race, and the later series of specimens comprises only the representatives of the second generation of the double-brooded race.

From Mt. Hikosan, Kyushu, no specimen of the first generation of the double-brooded race was available for the present study. As far as the author have been able to examine, there is only one specimen of the first generation of the double-brooded race in the collection of the Hikosan Biological Laboratory, Kyushu University. In the alpine districts of the central Honshu and in Hokkaido, the species is seemingly represented by the race of single brood.

In conclusion, concerning only the size of the discoidal spot, the distinct seasonal difference is recognized between the moth of the second generation and the moths of the first generation and of the single-brooded race. The moth of the first generation of the double-brooded race is morphologically indistinguishable from that of the single-brooded race.

If the difference in wing coloration between the two local samples within the Hokkaido populations is regarded as a peculiar local variation, the difference is not significant among the local samples within each of Hokkaido, Honshu, Shikoku and Kyushu populations. Thus the geographical variation will be treated among the four geographical groups of samples. The morphological attributions of the four groups are presented by the series of indices in Table 12, in which the varia-

Table 12. Comparison of the wing and genitalic indices among the four geographical groups, which exclude the specimens of the second generation.

Group	N	cd/lCu$_{1b}$	$\frac{M_1+R_4}{M_1+R_5}$	L.F.W.(mm)	pq/B	qr/m'n
Hokk.	43	0.2956±0.0337	0.770±0.175	17.05±0.37	6.833±0.521	2.248±0.258
Hon.	44	0.2586±0.0401	0.886±0.260	16.48±0.77	7.948±0.729	2.566±0.289
Shi.	28	0.2030±0.0258	1.085±0.227	16.41±0.52	7.585±0.882	2.415±0.318
Kyu.	10	0.1974±0.0260	0.948±0.243	16.23±0.80	8.087±0.630	2.705±0.362

tions of the three indices, cd/1Cu$_{1b}$-ratio, pq/B-ratio and qr/m'n-ratio, showing a significance to the geographical variation are illustrated in Fig. 6.

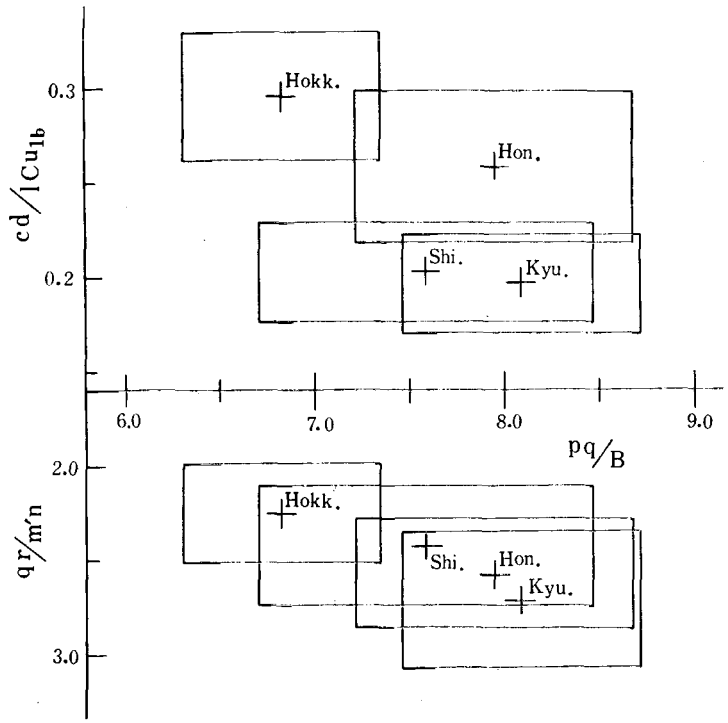

Fig. 6. Comparison of cd/1Cu$_{1b}$-ratio, pq/B-ratio and qr/m'n-ratio among the four geographical groups. Hokk.: Hokkaido group, Hon.: Honshu group, Shi.: Shikoku group, Kyu.: Kyushu group. Each side of a quadrangle representing the width of standard deviation, and each bar of a closs representing the level at mean.

In Fig. 6, the Shikoku and Kyushu groups are widely overlapped to each other, and the Honshu group is, although differential in the cd/1Cu$_{1b}$-ratio, also allied to the preceding two in the two valval ratios, but the Hokkaido group is rather separable from others in the cd/1Cu$_{1b}$-ratio and pq/B-ratio. Besides the quantitative characters presented in Fig. 6, the Hokkaido group has some tendencies to mark it off from others in the shape of the discoidal spot and in the wing pattern. In the Hokkaido group, the discoidal spot is nicely oval and the posterior half of the forewing is densely frosted with the greyish scales, while, in the other three groups, the former is concave in general on the upper edge, and the latter lacks the greyish scales or is less frosted. Nonetheless, the differences between the Hokkaido group and

others is, however, inadequate to consider the Hokkaido group as a distinct geographical race, for the variations of the cd/$1Cu_{1b}$-ratio and the two valval ratios are evidently continuous from group to group, and for the variations of the other wing characters are rather unstable, being liable to vary individually.

It should be concluded from what has been treated above, that all the populations of Hokkaido, Honshu, Shikoku and Kyushu are represented by the single subspecies *S. brevivenis brevivenis* (Butler).

Judging from the previous authors' original descriptions, the nominate form, *Chrostogastria brevivenis* Butler, 1885 should be a male of subtype B_1, and *E. argentomaculata* Bartel, 1899 also one of the male specimens of brownish type. Both the species were based upon the specimens from the same locality, Nikko. Thus, *E. argentomaculata* Bartel is an absolute synonym of *C. brevivenis* Butler as previously treated by Matsumura (1925).

The four species described by Matsumura (1927) from Honshu and Kyushu, *E. daisensis, E. kibunensis, E. yatsugadakensis* and *E. takamukui*, are also regarded as the synonyms of Butler's species. As treated in the preceding paragraphs, the specific features of the Matsumura's four species which were denoted by the original author only exhibit seasonal or individual difference. In this respect the author shares the view with Inoue (1956a).

The smaller-sized discoidal spot in *E. daisensis* and *E. kibunensis* is evidently attributed to seasonal variation, and the irregulary rounded discoidal spot in *E. yatsugadakensis* ought to be accepted as an individual abnormality. Especially, *E. yatsugadakensis* agrees well with the ordinary form in the alpine districts of the central Honshu in the various wing characters except for the discoidal spot. *E. takamukui* which was secured at Fukuoka, Kyushu is entirely identical with the specimens of subtype Y_2 from Mt. Hikosan, and is a representative of the single-brooded race.

Description of the female

A few female specimens of this subspecies have been known. The sole description of the female was what was given by Matsumura (1927) as that of *E. daisensis*. Fortunately, the author was able to examine one female specimen captured at Mt. Takaosan, Tokyo, through the courtesy of Dr. H. Inoue.

Color and maculation. Head, antennae, palpi, tegulae and dorsal side of thorax reddish ochre. Thorax with a longitudinal dorso-median line dark brown. Abdomen fulvous, with caudal hairs more or less lightly colored. Forewing: Upperside: Ground color reddish ochre inside and somewhat brownish outside transverse postmedial line, lacking greyish scales on posterior half; transverse

antemedial line strongly geniculate at middle of discoidal cell, where it sufficiently detached from anterior edge of discoidal spot; transverse postmedial line a little sinuous on upper part, turning anteriorly near base of vein M_2; transverse submarginal line somewhat indistinct, weakly arched; discoidal spot silvery white, semilunate, cd/lCu_{1b}-ratio=0.215: Underside: Uniformly fulvous with two transverse, indistinct bands of darker color, the anterior band just median, and posterior one submarginal, faintly marked on cell IX to cell VI. Hindwing; Upperside: Uniformly fulvous, without any marking: Underside: Concolorous with upperside, with costal zone and median transverse band dark brown.

Structure. Antennae with pectines shorter than in male; in longest pecten, $\frac{\text{length of pecten}}{\text{diameter of shaft}}$ = 3.3 (4.4 in male). Wing venation similar to that of male, $\frac{M_1+R_4}{M_1+R_5}$ =ratio=0.917 in this specimen. Genitalia (Fig. 7): Genital plates well developed, highly complex in structure, entirely telescoped by membraneous pouch derived from intersegmental membrane between seventh and eighth segments; lamella antevaginalis tongue-shaped; lamella postvaginalis flattened, with cup-shaped invagination of ostium; bursa copulatrix large-sized, bluntly produced at shoulders, with band-like, scobinate, single signum, to anterior edge of which the ductus seminalis connected; papillae anales with rod moderate in length, forming an arrow-head on basal portion.

Size: Length of forewing, 21.33 mm; body length, about 17 mm.

Data: 1♀, Mt. Takaosan, Tokyo Pref., 30. Aug. 1959, H. Inoue leg.

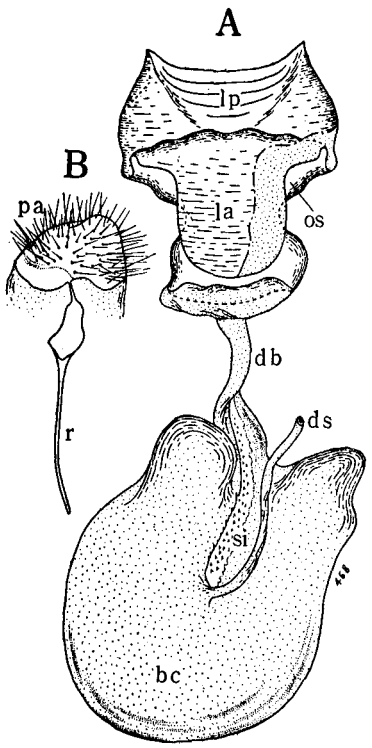

Fig. 7. Female genitalia of *Somadasys brevivenis brevivenis* (Butler). A: Female genitalia proper, ventral aspect. B: Ovipositor, lateral aspect. bc: bursa copulatrix, db: ductus bursae, ds: ductus seminalis, la: lamella antevaginalis, lp: lamella postvaginalis, os: ostium, pa: papila analis, r: rod.

Distribution

This subspecies is widely distributed throughout Japan as far north as South Saghalien. The northernmost record which was made by Matsumura (1925) was based upon a single male specimen from Ichinosawa, South Saghalien. The author's examination of that specimen reveals that it has a close resemblance to the specimens from Hokkaido, especially to those from Shibecha and Sapporo, and hardly separable from them. The

southernmost record made by Nomura (1937) was based upon a paired specimens from Kosugidani, Is. Yakushima. Although the author was unable to exaimine them, it is probable that they belong to the present subspecies of *brevivenis*-complex.

In Hokkaido, the insect inhabits from the low altitudes under an elevation of 100 m to the piedmonts of the mountains. In Honshu, Shikoku and Kyushu, the insect is, as a general rule, distributed from subalpine to alpine districts. In the central Honshu, the insect is distributed in the lower mountains of an elevation of 600 m—1,000 m and in the piedmonts of the higher mountains above an elevation of 2,000 m, but, in Shimokita Peninsula, the northern extremity of Honshu, it inhabits in the lowland of an elevation of about 200 m. In Shikoku and Kyushu, the distribution of the insect is presumably confined in the mountainous districts where the main peaks have an elevation of approximately 1,000 m or over. Especially in Kyushu, as far as the author knows, there is no example from the lower mountainous districts where the main peaks have an elevation of 500 m—600 m or less.

The distributional records of this subspecies which have been published are arranged below:

Saghalien: Ichinosawa, 1♂, Matsumura (1925).

Hokkaido: Hakodate, Oshima Pref., 3♂♂, Leech (1889), 2 exs., Leech (1899), Nagano (1917).

Honshu: Yunomata, Shimokita Peninsula, Aomori Pref., 6♂♂, Asahina (1959); Nikko, Tochigi Pref. (type locality), Butler (1885), Leech (1889), Leech (1899), 2♂♂ (include the type of *E. argentomaculata*), Bartel (1899), Nagano (1917); Mt. Yatsugadake, Nagano Pref., 1♂ (type of *E. yatsugadakensis*), Matsumura (1927); Osaragi Pass, Tokyo Pref., 1♂, Hirayama (1937); Kibune, Kyoto Pref., 1♂ (type of *E. kibunensis*), Matsumura (1927); Mt. Daisen, Tottori Pref., 1♂ 1♀ (type of *E. daisensis*), Matsumura (1927).

Shikoku: Omogo Val., Ehime Pref., Ishihara et al. (1953).

Kyushu: Fukuoka (Yanagawa?)*, 1♂ (type of *E. takamukui*), Matsumura (1927); Mt. Hikosan, Fukuoka Pref., Kuroko (1957); Mt. Sobosan, Oita Pref., 1♂, Esaki (1930), Umeno (1935); Kosugidani, Is. Yakushima, 1♂ 1♀, Nomura (1937).

Range: Saghalien, Hokkaido, Honshu, Shikoku, Kyushu.

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* Matsumura (1927) denoted the locality of *E. takamukui* as merely "Fukuoka", but he stated, in his subsequent papers (1931, 1932), that the insect occurred in Yanagawa of Fukuoka Prefecture. It seems rather doubtful that the insect inhabits in such low and paddy field as Yanagawa.

Somadasys brevivenis catacoides (Strand, 1915)

Eriogaster catacoides Strand, 1915, Suppl. Ent., 4: 10; Matsumura, 1931, 6000 Ill. Ins. Jap.: 684, fig. 359♂; Matsumura, 1932, Ins. Mats. 7 (1/2): 42; Gaede, 1932, Seitz Macrolep. World 2, Suppl.: 112; Collier, 1936, Junk Lep. Cat. 73: 170.
Somadasys catacoides Yamamoto, 1959, Icon. Ins. Jap. Color. Nat. 1: 170.
Eriogaster formosana Matsumura, 1921, 1000 Ins. Jap. Add. 4: 908, pl. 65, fig. 15♂.

Materials examined: 1♂, Formosa, 21. iv. 1917, T. Shiraki leg. (type of *E. formosana* Matsumura); 2♂♂, Baibara, Formosa, 23. ix. 1925, K. Kikuchi leg., with the genitalic slide no. 361; 1♂, Musha, Formosa, 18. v. -15. vi. 1919, T. Okuni, J. Sonan, K. Miy and M. Yosh leg.

These specimens and the genitalic slide are in Matsumura's collection of Hokkaido University.

Although *E. catacoides* Strand has been known as a distinct species, it seems probable that it is a geographical race of *S. brevivenis* (Butler). Although showing a gap to those of the Japanese one, the morphological traits of the Formosan race should be accepted as an extreme presentation of the continuous geographical variation in the Japanese representative.

Judging from the original descriptions, it is evident that *E. formosana* Matsumura, 1921 is, as treated in Matsumura's later paper (1931), an absolute synonym of *E. catacoides* Strand.

The detailed description of this subspecies is given below, and the wing and genitalic indices were made from one of the two male specimens from Baibara and its genitalic slide (no. 361).

Color and maculation. Head, thorax and abdomen reddish brown; antennae with pectinations light brown; thorax with a longitudinal dorso-median band dark brown. Forewing: Upperside: Ground color reddish brown, with anterior portion yellowish, submarginal zone roughly frosted with scattered scales of purpulish grey; transverse antemedial line strongly arched or geniculate at middle of discoidal cell, where it widely separated from anterior edge of discoidal spot; transverse postmedial line shallowly incised on vein M_1; transverse submarginal line approximately parallel with outer margin, and shallowly incised on vein M_1 as well as postmedial line; discoidal spot silvery white, crescent posteriorly, small-sized, with cd/lCu_{1b}-ratio=0.157: Underside uniformly fulvous. Hindwing uniformly brown on both sides.

Structure. Wing shape: Apex of forewing sharply pointed. Wing venation identical with that of nominate subspecies, with $\frac{M_1+R_4}{M_1+R_5}$-ratio = 0.975. Genitalia almost identical with those of nominate subspecies in main structures, but superior process of valva (Fig. 4, G) more elongated, sharply pointing towards tip, with pq/B-ratio=11.00 and qr/m'n-ratio=2.60.

Size: Length of forewing, 17.00 mm; body length, approximately 18.5 mm.

The female specimen is unknown.

The subspecies resembles closely the second generation of the southern populations in the nominate subspecies, but the former may

be significantly distinguished from the latter in the following respects:

1) Apex of forewing more sharply pointed in subsp. *catacoides*.

2) Superior process of valva more elongated in subsp. *catacoides*; pq/B-ratio=11.00 in subsp. *catacoides*, while it is 8.315 at mean and 9.75 at maximum in the sample of the second generation from Mt. Hikosan, Kyushu.

Great interest should be aroused in one male specimen from Tatsienlu, Sikang, South West China which was illustrated and described by Gaede (1932) as *E. kibunensis* Matsumura. Judging from his figure and description, the specimen resembles rather the Formosan specimens than those of the nominate subspecies.

Range: Formosa, South West China?

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