

# *Etizenia*

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*Occasional Publication of the Biological Laboratory  
Fukui University, Japan*

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No. 8.

VARIATION IN CHARACTERS OF *BEMBECINUS HUNGARICUS*  
FRIVALDZKY OCCURRING IN EAST ASIA, WITH TAXONOMIC  
NOTES ON HITHERTO KNOWN SPECIES  
(HYMENOPTERA, SPHECIDAE)

BY K. TSUNEKI

MARCH 15, 1965

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Synopsis

Upon the basis of colorific and morphological variation observed on *Bembecinus hungaricus* Friv. occurring in East Asia an attempt was made to divide the specimens into four geographic races, the races of Japan (*B. h. japonicus* Sonan), the Island of Amami (*B. h. amamiensis* subsp. nov.), Manchuria (*B. h. verhoeffi* Tsuneki) and Korea. The race of the last listed area, however, has a close connection with the specimens from Formosa and Asia Minor, so that the subspecific determination was postponed. Detailed study of variation made out that some of the characters hitherto used to separate species are quite doubtful in the taxonomic value. The following synonymy was recorded: — (1) Synonyms of *Bembecinus tridens* F.: *Stizus bimaculatus* Mats. et Uch., 1926; *St. nigriclypeus* Sonan, 1928; *St. satsumanus* Sonan, 1934 (probably a subspecies). (2) Synonyms of *Bembecinus hungaricus* Friv.: *Stizus formosanus*, Sonan 1928; *St. posterus* Sonan, 1928; *St. okinawanus* Sonan, 1928 (?); *St. kotoshonus* Sonan, 1928; (and *St. japonicus* Sonan, 1934; *St. japonicus* Yasumatsu, 1934; *St. hirsutus* Sonan, 1934 — the synonymy previously reported).

Introduction

Since I took notice, through the kind suggestion of Dr. W. J. Pulawski, Wroclaw, of the fact that a species of *Bembecinus* widely distributed over the Japanese Archipelago and long known as *B. japonicus* (Sonan) was nothing else than an eastern representative of *B. hungaricus* Friv., a species commonly occurs in Europe, it has been my doubt whether several other allied species also known from our region are really valid species or not. Recently having had a chance to make a taxonomic study on the Nyssonine wasps of Japan and Korea I have attempted a detailed investigation concerning the variation of the morphological as well as colorific characters of the species in question to see if such can give a key to solve the problem.

The material used in this study is not always sufficient in number (198 specimens), but seems sufficient in the variety of localities, including Hokkaido, the northernmost Prefecture of Honshu, several Prefectures of Central Japan, the southernmost Promontories of Shikoku and Kyushu, the Island of Yaku (lying about 55 km off the southern coast of Kyushu and is believed to form the southern boundary of the Palaearctic region in Japan), the Island of Amami (one of the Ryukyus and is believed to represent the northern boundary of the Oriental region in East Asia), Korea and Manchuria. The specimens from the Island of Yaku belong to the private collection of Mr. T. Tano, Fukui, and a specimen from Manchuria is the property of Mr. P. M. F. Verhoeff, Den Dolder, others all belong to my own collection.

To both the colleagues above mentioned I express here my deepest thanks.

\* Contribution No. 84, from the Biological Laboratory, Fukui University, Fukui, Japan.

Table 1. Variation of yellow (except labrum and clypeus) maculae on various body

Locality	Sex	Black on labrum			Black on clypeus			Supra-clypeal area				Pronotum		Humeral angle		LPC of mesonotum			Wing tegula						
								Cent. M.		Lat. M.															
		L	S	No	L	S	No	L	S	No	L	S	No	B	Sp. No	L	S	No	L	S	No	L	S	No	
Hokkaido	♀	2	-	-	-	2	-	-	2	-	-	-	-	-	2	-	-	2	-	-	2	-	-	2	
N. Honshu	♂	-	3	-	-	-	3	1	2	-	-	-	3	-	-	3	-	1	2	-	-	3	-	1	2
C. Honshu	♀	29	6	-	-	17	18	7	24	4	-	6	29	-	2	33	-	11	24	1	13	21	-	11	24
" "	♂	5	36	-	-	1	40	30	7	4	1	22	18	1	9	31	-	27	14	2	19	20	-	26	15
S. Shikoku	♀	5	1	-	-	1	5	4	2	-	-	3	3	-	2	4	-	6	-	-	3	3	-	4	2
" "	♂	1	8	-	-	2	7	6	2	1	-	3	6	1	2	6	-	7	2	-	5	4	-	7	2
S. Kyushu	♀	2	3	1	-	1	5	1	4	1	-	2	4	-	-	6	-	2	4	-	2	4	-	5	1
" "	♂	1	7	-	-	-	8	6	1	1	-	4	4	-	3	5	-	3	5	-	5	3	-	6	2
Is. Yaku	♀	22	5	-	3	12	12	5	11	11	-	1	26	-	2	25	-	17	10	-	7	20	-	11	16
" "	♂	-	12	-	-	-	12	6	3	3	-	1	11	1	1	10	-	7	5	-	4	8	-	7	5
Is. Amami	♀	-	19	3	-	13	9	-	12	10	-	1	21	13	6	3	22	-	-	16	6	-	-	13	9
" "	♂	-	3	16	-	1	18	18	-	1	-	12	7	17	1	1	19	-	-	16	3	-	-	16	3
Korea	♀	-	2	1	-	-	3	3	-	-	3	-	-	3	-	-	3	-	-	3	-	-	3	-	-
" "	♂	-	1	3	-	-	4	4	-	-	4	-	-	4	-	-	4	-	-	1	2	1	1	1	2
Manchuria	♀	-	1	-	-	-	1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-

Abbreviation : Cent. M... Central macula, Lat. M... Lateral macula, LPC... Latero-posterior presence, Ab... absence, IB... (medianly) interrupted band, Pet.,....

#### VARIATION IN CHARACTERS

First of all it must be mentioned that all the specimens examined in this investigation are, according to the authentic method of classification, considered to belong to one and the same species — *Bembecinus hungaricus* Frivaldzky — a reconfirmation of the conclusion previously arrived at by my provisional study. It becomes, therefore, the main point of investigation here to find out what variations are geographic and what are non-geographic.

It has been known with the European specimens of this species that variation is mainly confined to the colorific characters and little is observed with reference to their morphology. This is generally confirmed on the specimens of our region in my provisional surveying examination. On this account, in the present study stress was placed mainly on the variation of colour patterns. The form of the 2nd cubital cell of the fore wing, the semimembraneous protuberance near the sides of the posterior margin of the propodeum and the apical sternal spines in the male, together with the pilosity beneath the hind femora formed the exceptions.

Selected parts of the body and legs concerning the yellow markings are as follows:

Labrum, clypeus, supra-clypeal area (supra-clypeal area + subantennal area of Richards, 1956), pronotum, humeral angle, wing tegula, latero-posterior corner of mesonotum, scutellum, postscutellum, latero-posterior corner of propodeum, tergites 1-5 and hind tibia. Of these the first two were examined as to the black macula, since their ground colour was yellow.

##### A. Variation in maculation

Maculae on the inner orbits of the eyes and yellowish coloration beneath the antennae are more or less varied. But these were omitted to investigate. The maculation of the legs are complicated and the developmental degree on the three pair was representatively recorded by that of the hind tibia. The maculation on abdominal tergite 1 and the pilosity

parts of *Bembecinus hungaricus* Friv. occurring in East Asia.

Scutel.	Post-	LPC of	Hind	Tergite 2			Tergite 3			Tergite 4			Tergite 5			2nd cub. c.				
	scutel.	propod.	tibia	L	S	No	B	IB	Sp	No	B	IB	Sp	No	B	IB	Sp	No	Pet.	T-a
Pr. Ab.	Pr. Ab.	Pr. Ab.	L	S	No	B	IB	Sp	No	B	IB	Sp	No	B	IB	Sp	No	Pet.	T-a	Q-a
- 2	- 2	- 2	- - 2			2	-	-	-	- - - 2	2	-	-	-	- - - 2			-	2	-
- 3	- 3	- 3	- - 3			3	-	-	-	- - - 3	-	3	-	-	- 1 1 1			-	2	1
2 33	- 35	- 35	- 1 34			34	1	-	-	- 1 1 33	28	7	-	-	- - - 35	23	9	3		
2 39	1 40	- 41	5 14 22			38	3	-	-	- - 3 38	22	19	-	-	4 5 18 14	4	32	5		
1 5	1 5	- 6	- - 6			6	-	-	-	- - 1 5	5	1	-	-	- - - 6	2	4	-		
- 9	- 9	- 9	- 2 7			7	2	-	-	- - 1 8	3	5	1	-	- 1 - 8	1	7	1		
- 6	- 6	- 6	- - 6			6	-	-	-	- - - 6	4	2	-	-	- - - 6	3	3	-		
1 7	- 8	- 8	1 5 2			6	2	-	-	- - - 8	4	4	-	-	2 - 3 3	1	7	-		
2 25	- 27	- 27	- 1 26			22	5	-	-	- 3 2 22	12	15	-	-	- - 2 25	15	12	-		
- 12	- 12	- 12	- 5 7			9	3	-	-	- - - 12	5	7	-	-	- - 5 7	9	3	-		
2 20	1 21	5 22	22 - -			-	7	15	-	- - 22 -	4	18	-	-	- - 1 21	11	9	2		
- 19	- 19	6 13	19 - -			-	10	9	-	- 1 17 1	-	18	1	-	- 1 16 2	2	14	3		
3 -	- 3	3 -	3 - -			3	-	-	-	1 2 - -	3	-	-	-	- - 3 -	3	-	-		
- 4	- 4	1 3	4 - -			1	-	3	-	- 1 - 3	1	3	-	-	1 3 - -	1	2	1		
1 -	1 -	- 1	1 - -			1	-	-	-	1 - - -	1	-	-	-	- - 1 -	-	1	-		

terior corner. cub. c... cubital cell. L... large macula. S... small macula. B... band. Sp... spot. petiole. T-a... triangular. Q-a... quadrangular.

of the hind femur beneath were comparatively constant and their records were removed from the table. The results arranged with regard to each district were given in Table 1. From the table it can easily be perceived that maculae on some parts of the body, especially on the head, show a marked difference in development between the two sexes.

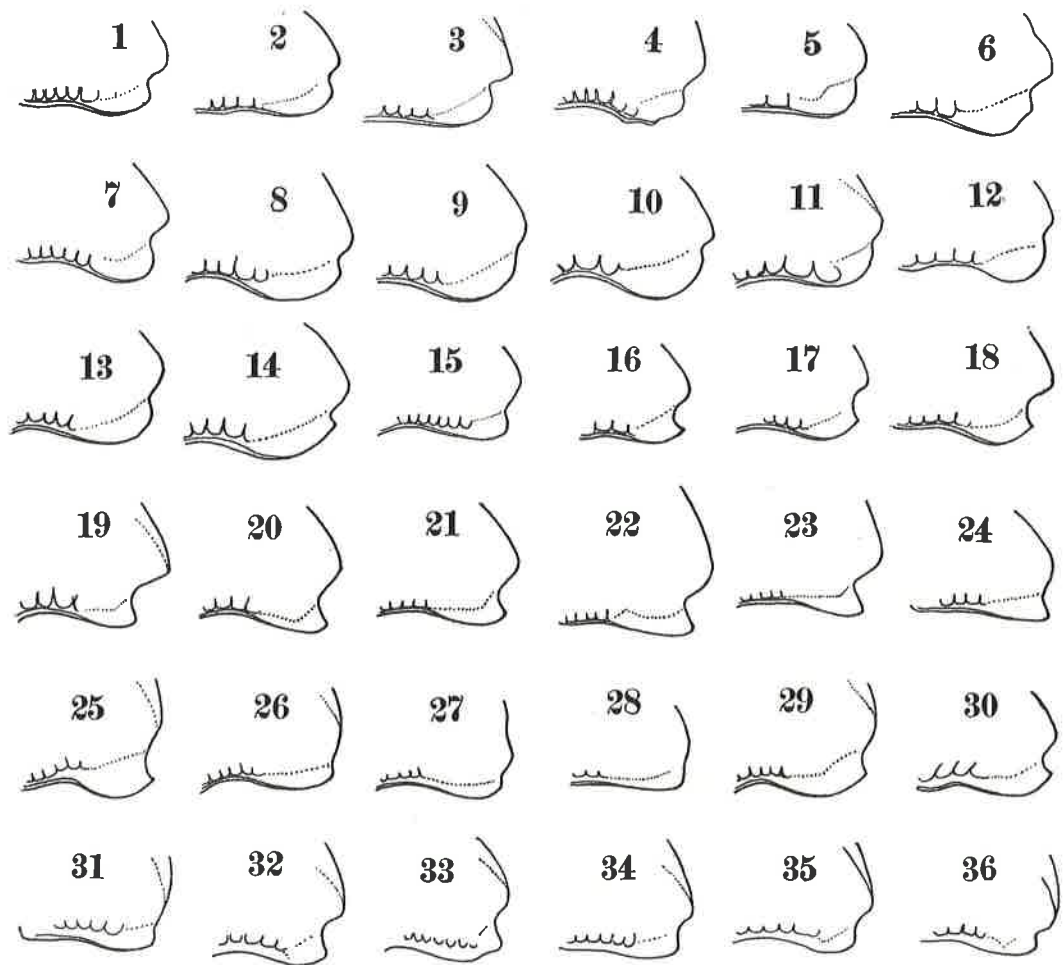
(1) **Labrum.** In all the examples examined the ground colour is yellow, with usually a black macula at the base in the middle. When it is well developed yellow comes to remain on the periferal region only (Fig. 40). Generally the macula is larger in the female than in the male. The tendency is well observed on all the specimens examined. On the other hand, difference in the development of the black macula is distinct between the specimens from Palaearctic Japan (from Hokkaido to the Island of Yaku), and those from Amami, an island of the Ryukyus, and Korea. Generally the Japanese specimens have the maculation less developed than in those from the two other regions. There is no noticeable geographic variation, however, among the specimens from various districts of Japan, although there are marked differences in the climatic conditions among them.

(2) **Clypeus.** Ground colour is also yellow and sometimes stained medially with black (Figs. 38-40). Sexual difference of the same tendency as stated regarding the labrum is also striking (Table 1), but the geographic variation could not be observed even on the specimens from the Ryukyus. While in the specimens from the Asiatic continent such a tendency seems to be present, though the material is not ample enough to lead to the definite conclusion.

(3) **Supra-clypeal area.** From here on, the ground colour is always black and the macula is represented by the yellow band or spot. Supra-clypeal area used here includes both the supra-clypeal area and the subantennal area of Richards' term (1956). The central (strictly medio-apical) macula is usually triangular and the lateral maculae when present are the inward extension of the lower ends of the stripes along the inner orbits of the eyes (Figs. 38 and 42). The maculae are usually developed in various degrees (Figs. 37-41) and

in the extreme cases the area turns to be all yellow or all black. Sexual difference in the developmental degrees is also observed — in this case the maculae are larger in the male —, especially regarding the central one. There is no distinct local changes among the Japanese specimens, including those from the Island of Amami. As for the Continental specimens, however, the geographic difference is most remarkable. In all of them the maculation is highest developed and the area comes to be wholly yellow (Fig. 37).

(4) **Pronotum.** The material can be divided into three groups in the maculation of



Figs. 1-36. Variation in the form of the propodeal protuberance (the lower), the upper being the latero-posterior corner of propodeum (in the lateral view). 1-18, Japanese group. 18-24, Amami group. 25-30, Korean group. 31, a Manchurian specimen. 32-36 Spanish specimens. (See Table 2).

this area: The group of Japan, that of Amami and that of the Continent. In the first group the area is without maculae, as a rule; sometimes, however, with two small spots, and very rarely with a narrow band. In the second a yellow band is the rule, but usually not broad and sometimes widely interrupted in the middle and very rarely without the maculae. In the last group the band is broad and mostly with the sinuated anterior margin.

(5) **Humeral angle.** In the examples from Palaearctic Japan this area is either all

black or with a small spot, while in those from Oriental Japan and Asiatic Continent nearly whole of the swelling is adorned with yellow.

(6) **Maculae on the latero-posterior corners of the mesonotum.** The relationship similar to the above is also observed in this character (Table 1 and Figs. 43-45), though sometimes less distinct.

(7) **Maculae on the latero-posterior corners of the propodeum** (Figs. 43-45). Similar to the above (Table 1).

(8) **The macula on the hind tibia.** The relationship is similar to the above. When the maculation is well developed yellow extends over whole the length of the tibia. In general, the maculae on the fore and middle legs are developed in proportion to the size of the macula of this area. However, even when the hind tibia is wholly black a more or less extent of other legs is scattered with yellow markings.

(9) (10) **Scutellum and postscutellum.** Maculae on both the area occur rather rarely and it seems that there is no geographical difference among the specimens (Table 1).

Table 2. Variation in the form of the semimembraneous protuberance near the sides of the posterior margin of the propodeum.

Locality	Sex	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Hokkaido	♀	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
N. Honshu	♂	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
C. Honshu	♀	6	9	1	1	3	1	1	4	2	1	2	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
	♂	3	5	3	.	3	.	2	3	9	.	2	7	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
S. shikoku	♀	2	.	.	.	.	.	1	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
	♂	.	.	1	.	1	.	1	2	.	.	1	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
S. Kyushu	♀	.	1	.	.	1	.	1	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
	♂	.	1	.	.	1	.	1	1	1	1	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Is. yaku	♀	8	5	1	.	1	.	2	3	2	.	1	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	
	♂	2	1	.	.	1	1	1	.	1	.	.	.	.	.	1	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	
Is. Amami	♀	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	4	8	4	2	3	3	.	.	.	.	.	.	.	
	♂	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	5	2	5	.	.	.	.	.	.	.	.	
Korea	♀	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.
	♂	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	.	.	.
Manchuria	♀	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1

(11) **Tergite 1.** This segment always carries two large oval maculae, with a slight variation in relative size. No case, however, has been found in which the maculae are fused into a transverse band, or are reduced into two small lateral spots, or completely disappear. In a female specimen captured in Harbin, however, the maculae are so large and so markedly extend inwards that they become quite approximated to each other (Fig. 46). Generally, in the Korean specimens the maculae are larger than in the Japanese ones.

(12) **Tergite 2.** In the specimens examined the laterally enlarged band is the rule. Sometimes the band is narrowly interrupted in the middle (Figs. 48 and 49). But in the greater part of the specimens captured on the Island of Amami and in some of the Korean examples the central narrowed portion becomes broadly disappeared and the band turns into two oval lateral markings (Figs. 47 and 54). At the same time, various grades of transitional states from a band to two lateral spots are observed upon some of the Amami specimens (Fig. 48) and a few of the Yaku specimens (Fig. 49). It seems of interest, however, that among the specimens from Amami none bears the complete band on this segment.

(13) **Tergite 3.** The specimens from Palaeartic Japan are usually inornate on this

segment. only very rarely specimens occur that have two small lateral spots. Of the 149 specimens examined the very exceptional four show a broken band on this tergite (Fig. 50), three of which belong to the specimens from Yaku. In the specimens from Amami lateral maculation is the rule (Fig. 47). On one of them, however, the maculae narrowly extend towards the middle to turn into a medianly interrupted band. Only in one of them the tergite is wholly black, with no trace of maculation just as in the Japanese specimens. Out of 8 specimens from the Continent 5 have the band, either complete or narrowly interrupted in the middle, in the remaining 3 the segment is immaculate.

(14) **Tergite 4.** In general, to have a band is the rule, always broadened at the sides, but fairly frequently it is narrowly interrupted in the middle. In the specimens from Amami this state is most frequently met with. Very exceptionally, one from S. Shikoku (Ashizuri) and one from Amami each half is reduced to a lateral spot. No sexual difference as to the occurrence of both the types of maculation, as is the case in tergites 1-3.

(15) **Tergite 5.** The greater part of the specimens were without a macula. This is especially conspicuous in the female specimens. That the Continental specimens are always maculated on this tergite seems worth noting.

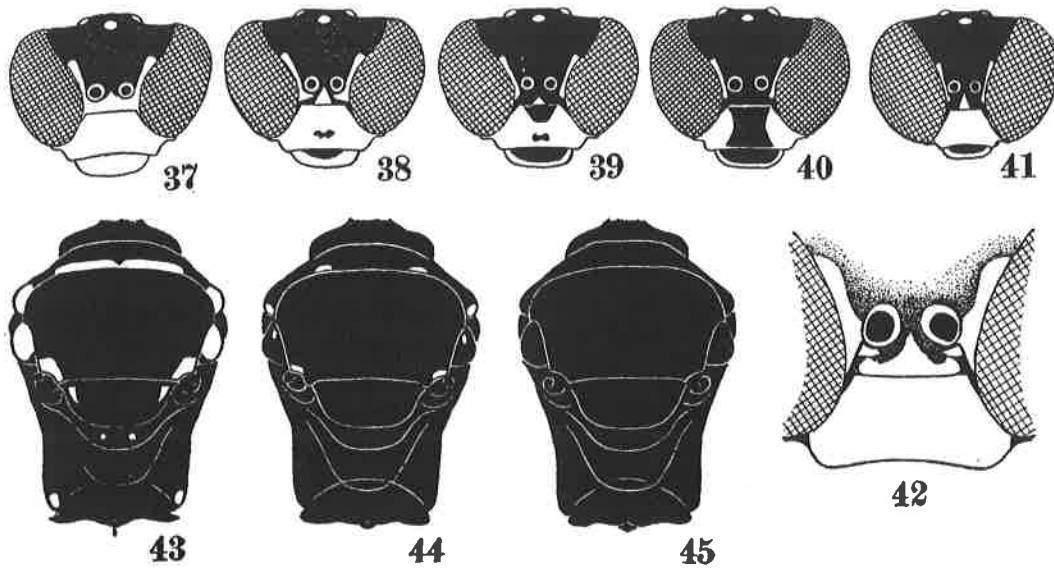
Besides the portions above mentioned, (1) the antennal scapes in front and the flagella beneath are also yellow or yellowish brown, the developmental degrees of the maculae being also roughly proportional to those of the hind tibial macula; (2) as a rule, sternites 2-3 (♀) or 2-4 (♂) bear a yellow spot on each side respectively, sometimes sternite 4 in the male lacking the maculae, or, to the contrary, even sternite 5 carrying the maculae (this is especially the case in the specimens from Amami-Ohshima). In the Korean specimens the maculation on the ventral side of the abdomen is markedly varied in the male. In one of them sternites 2-6, in two of them sternites 2-4, and in the remaining one sternites 2-3 (3 very faintly) only are maculated on each side.

Finally it must particularly be mentioned that hue of the colouration is always orange yellow in the Japanese and the Korean specimens, only in a considerable number of the specimens from Amami-Ohshima the maculae on the abdomen show a slightly greenish hue. While in the Manchurian specimen the maculae of the abdomen are markedly pale and greenish, the same tendency, though somewhat slight, being observed on the maculae of the head.

#### B. Variation in structure

The structure of the antennae of both sexes and the genital organ of the male may be said constant, though the cloudiness of the paramere of the latter organ is more or less varied with the individual. While in some characters variation is considerably marked. In connection with this, particular attention should be paid to the fact that some of such variable characters have been used, since Handlirsch, as a key to separate the species.

(1) **The form of the 2nd cubital cell of the fore wing.** It was made clear by the statistic study that this character is considerably variable among the specimens collected in the same district. In the specimens from Central Japan (chiefly collected in Fukui Pref.) 27 have the cell shortly petiolated above, 41 triangular cell without the petiole and remaining 8 quadrangular cell, that is to say, the transverse cubital nervures are more or less distantly apart from each other at their connecting points on the radial nervure. Viewed on all the specimens used in this study, 75 have the petiolated-, 107 triangular and 16 quadrangular cell. In the case of the quadrangular cell, generally the upper abscissa is comparatively shorter than in the typical case in *Bembecinus tridens*; sometimes, however, it is almost as



Figs. 37-45. Variation of maculation on the head (37-42) and thorax (43-45). (See Table 1).  
41, ♂; others. ♀.

long as that in this species. The fact was already pointed out by Beaumont (1954), but the occurrence of such seems far surpassing his estimation. The fact will give an important suggestion towards the traditional method of classification in this genus.

(2) **Semimembraneous protuberance near the sides of the posterior margin of the propodeum.** It is strikingly variable in form not only within the same species, but also among the individuals of the same district. As for the specimens here dealt with the various forms of the protuberance, together with the latero-posterior angle of the segment, seen in the lateral view, were given in Figures 1-31 (Figs. 32-36 were drawn with specimens from Spain) and their frequency in Table 2. The presence of marked variation in this character was also already pointed out by Beaumont (1954). But the result obtained here seems to show that the range of variation, e. g. Nos. 1-17 appearing upon the specimens from Fukui Pref., far rises above his estimation. However, it must particularly be mentioned that although the variation within the same district is very marked, yet there is certainly a distinct tendency of geographic variation beyond such a local fluctuation. This is obviously observed upon the specimens of Amami and of the Continent as contrasted to those of Palaearctic Japan. In the first two the protuberance (the lower protuberance in the figures) is angulated at the ventro-posterior corner in the lateral view. Seen from above, the upper protuberance in the figure forms the latero-posterior corner of the propodeum and the protuberance in question comes to locate inwards (Figs. 43-45) and to take quite another form. In this case such types as Nos. 16-23 turn into a curved acute tooth with the apex pointed. Nos. 25, 29, 30 are similar in form, but slightly broader. Nos. 27, 28 and 31 appear triangular. While rest of the figures except 32-36 take the form of broad rounded, or subrectangular outgrowth, varied in width.

Types 19-24 are occupied solely by the examples from Amami, types 15-18 are the exceptional or rather transitional states found among the specimens from other regions of Japan, while types 24-31 are represented by the specimens from the Continent. Types 32-36 were observed on the Spanish specimens at hand.



(3) **Caudal spines of the male.** The 8th sternite of the abdomen in the male is provided with three spines at the apex, one in the middle and two symmetrically at the lateral corners, the latter being shorter than the former and slightly curved inwards and slightly divergent towards the apex. That the form and their relative length are variable was as already pointed out by Beaumont (1954). The result of my examination of the East Asiatic specimens are as given in Table 3. According to this, the end of the median spine is most

Table 3. Variation in the state of the apical portion of the caudal spines of the male

Locality	State 1	State 2	State 3	State 4
N. Honshu	2	-	1	-
G. Honshu	34	1	6	-
S. Shikoku	5	2	2	-
S. Kyushu	3	2	2	-
Is. Yaku	5	-	7	-
Is. Amami	1	-	1	17
Korea	4	-	-	-

Remarks. End of medial spine:

State 1 ... Slightly enlarged, apex rounded.

State 2 ... Fairly markedly enlarged, apex rounded.

State 3 ... Not enlarged, parallel, apex rounded.

State 4 ... Attenuate towards end, apex pointed.

towards the end and pointed at the apex. The but with the apices rounded.

The relative length between the medial and lateral spines, measured from the bottom of the sinus between them to each apex, and averaged from five specimens is 32.8 : 19.8 (=1.66 : 1) in the Honshu specimens, and 28.8 : 17.4 (=1.65 : 1) in the Amami specimens, that is to say, there is no substantial difference between the two groups. The apparent difference in the absolute length of the spines between them is only due to that the specimens measured of Amami casually consisted of comparatively small specimens.

(4) **Proportions of four parts of the head.** In order to compare the detailed relative development of certain parts of the head in the specimens captured in various districts given in Table 1 measurement was carried out using, whenever possible, six specimens of both males and females of each district. They consisted of the largest two, the smallest two and the medium-sized two of all the specimens of the district. The parts selected were as follows:

Interocular distance at the sides of the apical margin of the clypeus (C); The minimum interocular distance near the base of the clypeus (the place is slightly different with the sex) (F); The maximum interocular distance at the vertex (V), and the length of the clypeus in the middle (L).

The convergency of the inner orbits of the eyes towards the clypeus is roughly represented by  $F/V$ , and their divergency from there towards the bases of the mandibles by  $C/F$  and the relative length of the clypeus by  $L/F$ . The values of the first two proportions are applicable to the comparison within the same sex, since the relative length of the front and clypeus is different in both sexes.

As generally perceived from the mere observation the clypeus is relatively longer in the male than in the female. This is clearly shown by the measurement, the result of which

usually somewhat enlarged and rounded in the Japanese and Korean specimens, except those from Amami-Oshima. Sometimes, however, it is not enlarged, parallel and merely rounded at the apex. Rarely there are specimens that have the spine markedly enlarged at the end. The lateral spines are usually not enlarged, with their apices rounded. The thickness of the spines are fairly markedly variable; therefore, some appear stumpy and some slender.

In the specimens from the Island of Amami, all but a single exception bear slender spines that are always attenuate

slender spines, exceptional one has also slender spines,

Table 4. Measurements of four parts of the head and their proportions.

	G	F	V	L	F/V (Range)	C/F (Range)	L/F (Range)
Hokkaido ♀ (2)	42.0	27.0	55.0	18.0	0.49 (0.49-0.49)	1.56 (1.54-1.57)	0.67 (0.65-0.68)
C. Honshu ♀ (6)	35.8	23.2	49.3	16.3	0.47 (0.46-0.49)	1.54 (1.50-1.59)	0.70 (0.65-0.77)
S. Shikoku ♀ (6)	40.2	25.9	54.2	17.8	0.48 (0.47-0.48)	1.55 (1.51-1.58)	0.69 (0.46-0.72)
S. Kyushu ♀ (6)	37.2	24.2	51.3	16.8	0.47 (0.46-0.48)	1.54 (1.48-1.58)	0.69 (0.67-0.74)
Is. Yaku ♀ (6)	36.5	23.5	50.0	16.5	0.47 (0.47-0.47)	1.55 (1.50-1.60)	0.70 (0.68-0.73)
Is. Amami ♀ (6)	34.6	22.8	52.7	17.1	0.43 (0.42-0.45)	1.52 (1.47-1.56)	0.75 (0.72-0.78)
Korea ♀ (3)	34.3	22.5	48.7	17.3	0.46 (0.44-0.50)	1.52 (1.51-1.55)	0.77 (0.76-0.78)
Manchuria ♀ (1)	29.0	20.0	44.0	14.5	0.45	1.45	0.73
Spain ♀ (3)	35.0	23.3	50.3	15.7	0.46 (0.45-0.48)	1.50 (1.46-1.55)	0.64 (0.65-0.70)
N, Honshu ♂ (3)	28.3	19.3	45.0	16.3	0.43 (0.41-0.46)	1.47 (1.45-1.50)	0.84 (0.80-0.88)
C. Honshu ♂ (6)	28.5	18.3	46.2	16.5	0.40 (0.38-0.42)	1.56 (1.50-1.63)	0.90 (0.85-0.95)
S. Shikoku ♂ (6)	28.5	18.7	46.7	17.2	0.40 (0.37-0.42)	1.52 (1.48-1.59)	0.92 (0.86-0.95)
S. Kyushu ♂ (6)	26.7	17.1	43.7	15.8	0.39 (0.38-0.40)	1.56 (1.50-1.59)	0.92 (0.88-0.97)
Is. Yaku ♂ (6)	26.8	17.3	44.7	16.1	0.39 (0.36-0.43)	1.56 (1.50-1.65)	0.93 (0.85-1.00)
Is. Amami ♂ (6)	25.7	16.4	46.1	17.1	0.36 (0.33-0.38)	1.57 (1.49-1.60)	1.04 (1.00-1.12)
Korea ♂ (4)	29.3	18.5	50.0	19.5	0.37 (0.37-0.37)	1.58 (1.54-1.63)	1.06 (1.03-1.08)
Spain ♂ (2)	28.0	18.0	46.5	15.5	0.39 (0.39-0.39)	1.53 (1.51-1.55)	0.86 (0.81-0.89)

Remarks. Whenever possible six specimens were used, always including the largest two, the smallest two and the middle-sized two. C ... Interocular distance at apical margin of clypeus. F ... Interocular distance at lower face (minimum interocular distance). V ... Interocular distance at vertex (maximum interocular distance). L ... Length of clypeus in the middle.

was given in Table 4. It becomes also obvious that the minimum interocular distance is comparatively smaller in the male (the eyes are comparatively larger as much accordingly). It seems interesting to be made clear that the value of C/F is similar in both sexes, because apparently the value seems smaller in the male. The latter fact is due to the difference of the relative length of the clypeus (see Figs. 40 and 41).

On this occasion it may be added that as one of the sexual characters the pilosity of the head is generally longer and on the clypeus much closer in the male than in the female, so that the surface and the apical margin of the area tend to become invisible. The character is important to suppose the status of *Stizus hirsutus* Sonan, 1928.

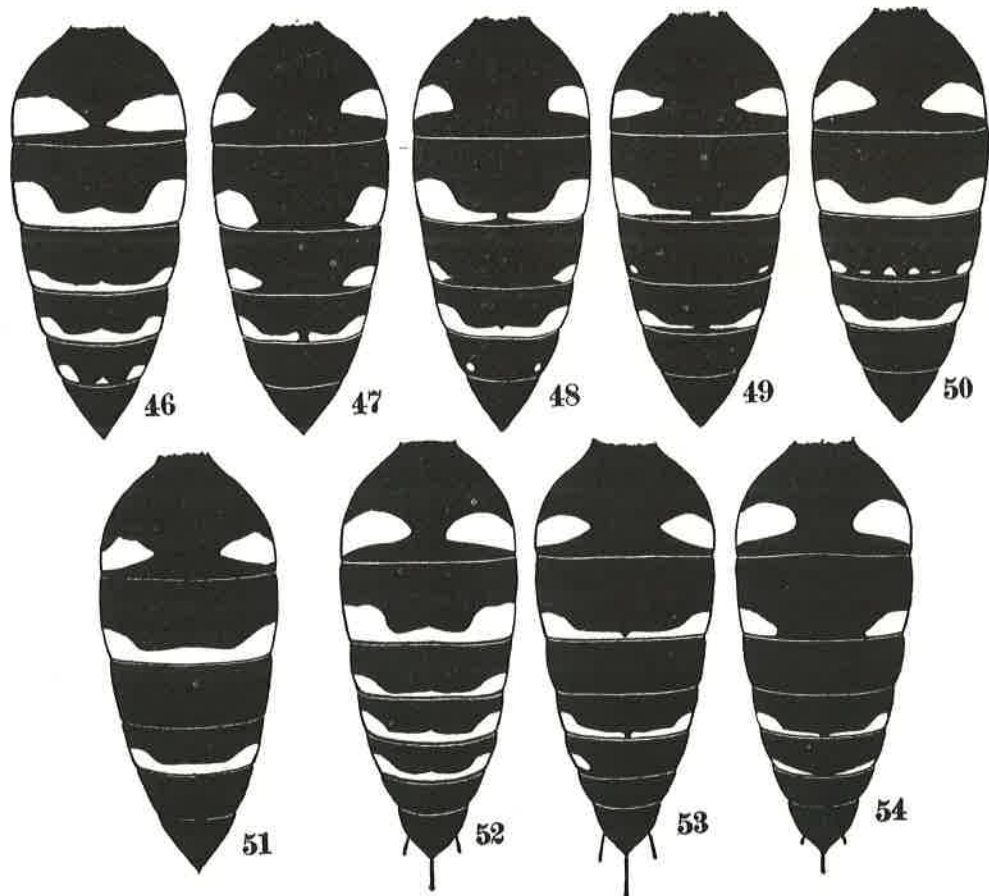
As for punctuation, it is also variable to a considerable extent, especially that of abdominal sternites. On the area the punctures are comparatively well observed, hence attractive to the investigator. But they are quite varied in size as well as in density among the specimens captured in the same location. Punctuation on other parts of the body is also more or less varied and to use the character in classification much prudence is required.

#### FOUR GEOGRAPHIC TYPES IN VARIATION

As described in the foregoing pages, *Bembecinus hungaricus* Friv. occurring in Japan, Korea and Manchuria shows a considerable degree of variation not only in its maculation, but also in some of the structural characters. The variation is sometimes non-geographic and fluctuative, but sometimes distinctly connected with the location from which the specimen is derived, hence certainly genotypic to some extent. According to such a difference in the

main trend of variation the specimens dealt with in the present study can be divided into four geographic groups, the group of Japan proper, the group of Amami, the group of Korea and the group of Manchuria. In the first group are also included the representatives of Hokkaido, Kyushu, Shikoku and the Island of Yaku.

(1) In the specimens of the group of Japan proper the labrum is yellow, with a black macula at the base; the clypeus yellow, with or without the black macula on the median area; supraclypeal area black, adorned more or less with yellow macula or maculae; the pronotum inornate as a rule; the humeral angles, wing tegulae and the latero-posterior corners of the mesonotum are either all black or with a small yellow spot; The scutellum, postscutellum and the latero-posterior corners of the propodeum are usually without yellow maculae, only rarely the former two carry small spots; hind tibia is wholly black as a rule, very rarely with a small spot at the base; tergite 1 always provided with two large maculae; tergite 2 with a band, sometimes interrupted in the middle; tergite 3 always without maculae, very exceptionally some carry small spots; tergite 4 with a band, often interrupted in the middle; tergite 5 usually immaculated, in the male, however, frequently maculated. The bands on tergites 2 and 4 always expanded at the sides. Legs with maculae more reduced in distribution, mostly with hind tibia wholly black.



Figs. 46-54 Variation of maculation on the abdomen (46-51, ♀; 52-54, ♂). 46, Manchurian specimen; 47-48 Amami specimens; 49, Yaku specimen; 50 (exceptional), 51, 53 (common), Honshu specimens; 52, 54, Korean specimens. (See Table 1).

As for the propodeal protuberances the specimens of this group are usually provided with comparatively broad and not pointed ones. The caudal spines in the male are not attenuate, rather parallel at the apical portion, with the end slightly enlarged and with the apex rounded. Finally, in the relative development of the four parts of the head selected (Table 4) the specimens from various districts of Japan show nearly equal proportions within each sex, except the male group from N. Honshu (Towada) which were restricted in available number and of which further study is required.

(2) In the second group, the group occurring on the Island of Amami, the black maculae on labrum and clypeus are more reduced on an average than in the first group, but the maculation on supra-clypeal area is similar, pronotum usually provided with a yellow band; maculae on humeral angles, latero-posterior corners of mesonotum and hind tibiae markedly large, especially on humeral angles they occupy whole the areas; while wing tegulae, scutellum and postscutellum are similarly less maculated as in the specimens of Japan; propodeum frequently adorned with a yellow spot on each latero-posterior corner, but the immaculated is dominant. Maculation on abdominal tergites are characteristic, most usually, particularly in males, tergites 1, 2, 3, 4 (and 5 in males) with a large oval spot on each side, those on 4 usually more or less extend narrowly inwards. Such a maculation appears quite another thing as contrasted with that of the first group.

In structure, the semimembraneous propodeal protuberances are, seen from above, dentiform, curved outwards, with apex pointed, seen in profile, always with an angle on the posterior margin; the caudal spines of the 8th sternite in males slender, attenuate apically and pointed at the apex. In the proportions between four parts of the head (Table 4), the male and female specimens of this group show respectively a marked deviation from those of the corresponding sex of other groups. The convergence of inner orbits towards the middle of the face is stronger, their divergence forwards is weaker and the clypeus much longer. It is very clear from this table only that the specimens of Amami form a separate group.

(3) In the Korean group labrum and clypeus are mostly all yellow, supra-clypeal area without black interspace between maculae, hence yellow completely fills whole the area; pronotum always banded with yellow, the band is broader than in the second group; humeral angles, wing tegulae, LPC of mesonotum and of propodeum, each with a large macula as a rule, especially so the humeral angles and hind tibia (also front and mid legs accordingly). Abdominal maculae well developed, but, contrary to the Amami-group, tergites 2-4 (5 also in ♂) are provided with a band respectively; sometimes, however, in the male specimens tergite 2 carries two lateral spots only and tergite 3 completely immaculated.

The propodeal protuberances are generally intermediate in development between the first and second groups, but fairly varied individually (Figs. 25-30). The caudal spines of the male are as in the first group. proportions between the interocular distances etc. this group is somewhat close to the preceding group and, apart from the value of L/F, it resembles the Spanish population, some specimens of which were used in the present study for comparison, as is also the case in some specimens in colouration.

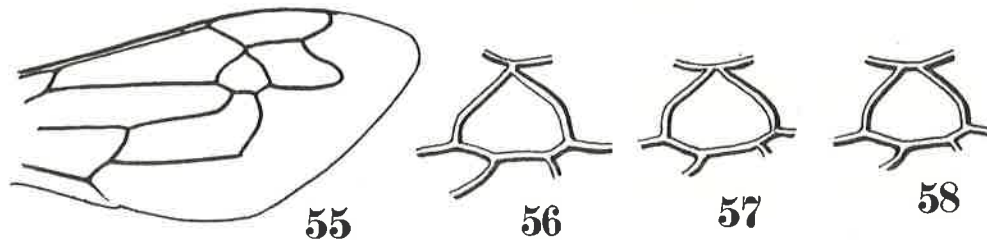
(4) The Manchurian specimen, though a single in number, is very close to some of the 3rd group in many characters, but it seems characteristic in the hue of the abdominal maculation, its particular development and the remarkably feeble protrusion of the postero-lateral angles of the propodeum (in reality they do not represent the corners and so the semimembraneous protuberances appear to be at the corners). The proportions of the four

parts of the head in the specimen seem to show a special tendency, but to speak anything about this the material is too scanty.

#### CONSIDERATION

I have so far placed a stress on the variation of some characters of the specimens, especially on such as is considered geographic. It might appear therefore that my plan is to separate species. But the specimens dealt with in this investigation have a number of other characters in common that are considered important in species classification, such as structure of the fore leg, antennae, abdominal sternite and male genitalia. I am therefore convinced that the specimens before me doubtlessly belong to one and the same species. The four groups divided on the basis of the geographic variation cannot be raised, therefore, above the subspecific level, a level of the local race. This concept seems further supported by the fact that any character that is apparently distinct to a certain subdivision is by no means completely separated from the corresponding one of other group or groups. Some states gradually approaching towards such are always found among other groups, though usually very restricted in number. Moreover, some exceptionally undeveloped state, close to that of other group is also used to be discovered among the members of their own group.

For instance, the Amami group is considered well established. In the maculation of the abdomen, in the form of the propodeal protuberances and in the structure of the male



Figs. 55-58. Variation in the form of the second cubital cell of the fore wing. 55, venation. 56, shortly petiolated. 57, triangular. 58, quadrangular.

caudal spines the group is certainly distinct and apparently separated. But an example captured on the Island of Yaku represents a state closely approaching in coloration the type of Amami (Fig. 49), while a specimen of Amami, to the contrary, shows a state close to that of Yaku (Fig. 48). Moreover in one specimen from Amami the 3rd tergite is completely immaculate and in a considerable number the 2nd is yellow banded, though usually medianly narrow and interrupted in the middle. Such a state is very close to the maculation of the Japan group. Similarly in the propodeal protuberance some of the Japanese specimens are provided with ones bearing the angulated margin (Figs. 14-18). Such a form as No. 16 is, seen from above, denticular and very close to the form usually met with among the Amami specimens. The same relationship is also observed as to the male caudal spines between the specimens from Amami and Yaku.

Upon examining and tabulating the variation of characters I was deeply impressed by the fact that some characters that have been traditionally used in separating species, such as the form of the second cubital cell of the fore wing, the state and the form of the posterior lateral angle and semimembraneous protuberance close to it, are much more unstable than are considered by some taxonomists. It seems dangerous, therefore, to use such characters independently and singly for classifying even the subspecies.

I do not say, however, that all such characters are completely of no use, since variation of a certain character may bear an independent entity according to the locality from which the specimens were collected, or according to the group to which the specimens belong, even when all the specimens appear to form a single group. When the deviation of, say, two of such entities is not conspicuous the ranges of their variation may be more or less overlapped. Nevertheless, they form two separable populations in reality, having respectively an independent tendency of evolution. Such a fact is made out only by the statistic study to ascertain the range of variation. Otherwise they may be divided into variable number of species or subspecies, according to the knowledge and experience of the investigator.

To turn to the four groups above mentioned of our region they are to be named as subspecies, since they each represent a geographical race. However, in Japan and Formosa several so-called species (!) of the genus *Bembecinus*, under the generic name of *Stizus* then prevailed, have been known, about a half of which were described upon the colorific characters alone. On this occasion these must be reviewed and rearranged. However, *B. hungaricus* Friv. is originally described from Europe, as its specific trivial name shows and is known to occur widely throughout Europe, North Africa and West Asia. Before touching upon the so-called species of Japan and Formosa we must examine the status of *B. hungaricus* so far known.

In 1954 de Beaumont described various forms of this species collected from the western Palaearctic region. But he did not give any of them the subspecific name, probably because the districts they occur are not always separated by the particular barrier and, moreover, a considerable degree of variation is found within the same locality. According to his information generally the yellow maculae of the specimens are progressively decreased as their localities go northwards. In southern Europe the abdomen is always adorned with 4 of 5 bands, as represented on my Spanish specimens, while in Hungaria, Czechoslovakia, Yugoslavia and western France the bands on tergites 2, 3 and 5 are reduced to small lateral spots, and sometimes tergite 3 is completely immaculate. Therefore the state of the Central European specimens somewhat resembles that of Amami and the last mentioned case that of Japan, as far as the 3rd tergite is concerned. In the specimens from Asia Minor the maculation is much more developed and the state becomes almost identical with that of the brightest form of the Korean specimens, as far as the maculation goes. To my regret, however, no detailed description was made as to their structural variation\*. Lack of such information becomes a serious obstruction in the trustful comparison between the representatives of Europe and East Asia.

Such being the case, it seems justified to attempt that the races of our region are named independently from the representatives of western Palaearctic region. But the group of Korea which has a close relative not only in Asia Minor, but also, as given below, in Formosa and which is not always well united in coloration and in some of the structure was reserved to be dealt with as a distinct race.

#### REARRANGEMENT OF HITHERTO KNOWN SPECIES OF *BEMBECINUS* FROM JAPAN AND THE ADJACENT TERRITORIES

Up to date, ten species of *Bembecinus* have been described or recorded from Japan,

\* The specimens from Spain at my hand show the following structural variation:  
Second cubital cell all shortly petiolated, propodeal protuberance as given in Figs. 32-36, the caudal spines in the male slender, parallel, not enlarged towards the end and rounded at the apex.

Formosa and Korea, under the generic name, *Stizus* Latreille. Viewed from the present-day taxonomy, however, it is to be regretted that the utilizable parts of the descriptions are almost all confined to the colorific distinctions except for some in which the characters of wing venation and pilosity are involved.

Most of the type specimens of these species are now abroad and even their present state is unknown. Therefore, the actual confirmation of their characters needed for the modern classification is very difficult, if not impossible. In the present attempt I had to restrict my study to the detailed examination of the given descriptions and to suppose the real status of the so-called species.

According to my consideration, out of the ten species in question at least three of them must be synonyms of *Bembecinus tridens* (Fabricius), a species widely distributed over the south-western Palaearctic region, and six of *B. hungaricus*. The references are as follows:

### 1. *Bembecinus tridens* (Fabricius, 1781)

*Stizus bimaculatus* Matsumura et Uchida, Ins. Mats., 1 (1), p. 43, 1926. (Syn. nov.)

*Stizus nigriclypeus* Sonan, Trans. Nat. Hist. Soc. Formosa, 18 (97), p. 265, 1928. (Syn. nov.)

*Stizus satsumanus* Sonan, Kontyu, 8 (1), p. 40, 1934. (Syn. nov.)

① *S. bimaculatus* is considered very close in maculation to *Bembecinus tridens insulanus* Beaumont, known from Corsica and Sardinia, but it is further adorned with two longitudinal yellow maculae on the propodeum (? yellow flecks on the latero-posterior corners). The status was supposed mainly from the colour of the clypeus. Collected on Ishigaki, the Ryukyus, described with a single female specimen.

② *S. nigriclypeus*. Judging from the description, 'closely resembles *S. formosanus* (= *Bembecinus hungaricus*), but has the clypeus wholly black', I referred it to *B. tridens*. The specimen (♀) must be a form having maculation less developed, with the following portions black: Labrum, clypeus, antennae beneath and greater part of legs. Abdominal maculae: Two large maculae on tergite 1, a band on 2 and 3, two spots on 4. Known from Formosa by a single female specimen.

③ *S. satsumanus*. The characters of the 2nd cubital cell of the fore wing and the black clypeus seem to indicate that the specimen must belong to *tridens*. The maculation on the abdomen is close to that of *B. hungaricus* of the Amami-group, having 4 pair of lateral marks. This form may represent a distinct subspecies, but a further study using ample material is required. Described upon a single female specimen captured in Kagoshima, S. Kyushu.

### 2. *Bembecinus hungaricus* (Frivaldzky, 1876)

The following are considered synonyms of this species, but one of them with a query.

*Stizus formosanus* Sonan, Trans. Nat. Hist. Soc. Formosa, 18 (97), p. 262, 1928. (Syn. nov.)

*Stizus posterus* Sonan, Ibid., p. 264. (Syn. nov.)

? *Stizus okinawanus* Sonan, Ibid., p. 265.

*Stizus kotoshonus* Sonan, Kontyu, 8 (1), p. 37, 1934. (Syn. nov.)

*Sitzus japonicus* Sonan, Ibid., p. 38.

*Stizus hirsutus* Sonan, Ibid., p. 39.

*Stizus japonicus* Yasumatsu, Rep. Leafhop. inj. Rice Pl. Nat. Enem., Dept. Agr. Kyushu Imp. Univ., 5, p. 25, 1934.

① *Stizus formosanus* is considered one of the bright coloured forms of *B. hungaricus*, having the supra-clypeal area wholly yellow, abdominal tergites 2 and 4 fasciated, 1, 3 and

5 laterally spotted; var. *5-maculatus* carries two spots on scutellum and propodeum, and a short band on postscutellum; var. *4-maculatus* lacking the band on postscutellum. The type is similar in maculation at least to one of the colour forms of the Korean specimens or to that of the West Asiatic region. Described with 8 ♀♀ 14 ♂♂ from Formosa.

On the other hand, Iwata (1936) recorded the nesting biology of this colour form of *B. hungaricus* under the name of *Stizus formosanus*. That the habits of this form is substantially identical with those of the Japanese form is an interesting collaboration towards the conclusion arrived at in the present study.

② *Stizus posterus*. Similar in maculation of head and thorax to *S. formosanus* var. *4-maculatus* except the clypeus which has a black spot on the apical margin. As to abdomen maculae similar to that of the commonest form of the Japanese specimens. A mere colour form of *formosanus*. Described basing on a single female specimen from Formosa.

③ *Stizus okinawanus*. The accounts helpful to know the species characteristics found in the original description: A black line of anterior margin of clypeus, a spot on each side of the 1st and 2nd tergites (rest of abdomen black), hind tibia black. Based on a single specimen from Okinawa. But the sex is uncertain, since while the description was given as dealing with ♂, but in the data the specimen is given as ♀.

This specimen may be a particular form of the Amami-group of my classification above mentioned in which maculae on tergites 3 and 4 extremely reduced. In my collection is there a specimen captured on Amami that is inornated on tergite 3. However, the clypeal coloration throws some doubt. Supposing from that the specimen may be an aberrant form of *Stizus bimaculatus* Mats. et Uch., i. e. *Bembecinus tridens*, further study with sufficient material is needed.

④ *Stizus japonicus*. Under the same specific trivial name, *japonicus*, the Japanese group of *B. hungaricus* of my classification was described by two entomologists independently in the same year (1934). But the description of Sonan got the priority and had been used until recently. The name *japonicus*, however, should be sunk to the subspecific level as was already pointed out by me.

⑤ *Stizus hirsutus*. Both in the description and the data of the specimen it was given as ♀. But it seems to me that the specimen was a male, because the description is completely consistent with the characters of the male of the Japanese group of my classification (vide p. 10). If it was truly a female, the particular state (front and clypeus densely covered with silvery hairs) may be due to the light condition under which the specimen was examined. Known by a single specimen collected from the suburbs of Osaka.

### 3. *Bembecinus anthracinus* (Handlirsch, 1892)

Besides the species above discussed *Stizus anthracinus* Handlirsch was recorded from the Ogasawaras (the Bonin Islands). This species was originally described from New Guinea basing on a single female specimen. Sonan's description was given with four male specimens and it agrees with the original description as far as the colour patterns are concerned. At present I cannot reexamine the specimens nor obtain the new specimens from the Islands. I therefore adopt this scientific name rather provisionally until the chance favours me to confirm the true status of the specimens of Chichijima.



NOMENCLATURE OF THE FOUR GEOGRAPHIC GROUPS OF  
*B. HUNGARICUS*

1. *Bembecinus hungaricus japonicus* (Sonan, 1934)

The Japanese population of *B. hungaricus* except those occurring in the Ryukyus should be called as above. This subspecies is characterized in the main by the particular maculation of the abdomen. Further, within a certain limit, the state of the propodeal protuberance, the sinus above it (in the lateral view) and the caudal spines in the male may also be considered characters. The references:

*Stizus japonicus* Sonan, Kontyu, 8 (1), p. 38, 1934.

*Stizus japonicus* Yasumatsu, Rep. Leafhop. inj. Rice Plant. Nat. Enem. Dept. Agr. Kyushu Imp. Univ., 5, p. 25, 1934.

*Stizus japonicus*: Iwata, Kontyu, 10 (5), pp. 236-241, 1936 (Biol.).

! *Bembecinus japonicus*: Yasumatsu, Icon. Ins. Jap., Ed. II, p. 1472, 1950.

*Bembecinus japonicus*: Tsuneki, Mem. Fac. Lib. Arts, Fukui Univ., II, 6 (1), p. 144, 1956. (Biol.).

*Bembecinus hungaricus japonicus*: Tsuneki, Kontyu, 28, p. 239, 1960.

2. *Bembecinus hungaricus amamiensis* subsp. nov.

For the population living on Amami a new subspecific name was proposed. The combination of the following distinctions is characteristic of the new subspecies:

Maculation chiefly on abdomen (Fig. 47), character of the propodeal protuberances (Figs. 19-24) and slender, attenuate and apically pointed caudal spines of the male. References:

*Bembeciuns hungaricus*: Tsuneki, Life Study (Fukui), VI (1), p. 7, 1962.

Holotype: ♂, Gusuku, Amami-Ohshima, 27. VI. 1961, K. Tsuneki leg.

Paratypes: 22 ♀♀ 18 ♂♂, Gusuku and Akaogi, Amami-Ohshima, 27. VI - 7. VII. 1961, K. Tsuneki leg.

3. The Korean representative

The material is too scanty in number to draw any conclusion from them. Nevertheless it was perceived that the population has not a good unity as a race, showing a considerable variation of characters among the members and on the other hand, bearing certain characters in common with those of Asia Minor and Formosa, as far as our present knowledge goes. I therefore hesitate to deal with the population as a distinct local race.

4. The Manchurian specimen

A single example as it is, it is considered a valid representative of the local race. I have given it a subspecific name already in another paper dealing with the Manchurian digder wasps.

References

Beaumont, J. de. 1954. Les *Bembecinus* de la région paléarctique. Mitt. Schweiz. Ent. Ges., 27 (3), pp. 241-276.

Handlirsch, A. 1892. Monographie der mit *Nysson* und *Bembex* verwandten Grabwespen. Sitzber. Akad. Wiss. Wien. Abt. 1, 101, pp. 25-205.

Iwata, K. 1936. Biology of *Bembix* and *Stizus*. Kontyu, 10 (5), pp. 233-250. (In Japanese)

Matsumura, S. und Uchida, T. 1926. Die Hymenopteren-Fauna von den Riukiu Inseln. Ins. Mats.,

- 1 (1), pp. 32-52.
- Sonan, J. 1928. On *Stizus* (Bembicidae) of Formosa and Okinawa. Trans. Nat. Hist. Soc. Formosa, 18 (97), pp. 262-266.
- 1934. On four new species and a known species of *Stizus* Latreille (Hymenoptera, Bembicidae). Kontyu, 8 (1), pp. 37-41.
- Tsuneki, K. 1959. Ethological studies on *Bembix niponica* Smith, with emphasis on the psychobiological analysis of behaviour inside the nest. I. Biological Part. Mem. Fac. Lib. Arts, Fukui Univ., II, 6 (4), pp. 78-172.
- 1960. Taxonomic notes on some Japanese species of Aculeate Hymenoptera, with the description of a new species of the genus *Trypoxylon*. Kontyu, 28, pp. 239-243.
- 1962. The Aculeate Hymenoptera collected on the Island of Amami Ohshima, the RiuKius. Life Study (Fukui), 6 (1), pp. 1-9 (In Japanese with English summary)
- 1965. Some fossorial wasps from Manchuria. Akitu (in press).
- 1965. A guide to the study of the Japanese Hymenoptera (22). 10. Nyssoninae of Japan and Korea. Life Study, 9 (1-2) (In Japanese with English key) (in press)
- Yasumatsu, K. 1934. *Stizus japonicus* n. sp. Report Leafhopper injur. Rice Plant. Nat. Enemy, Dept. Agr. Kyushu Imp. Univ., No. 5, pp. 25-28.
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