

## The Anophthalmic Trechine Beetles from Takamatsu, Southwest Japan<sup>1)</sup>

By

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### Introduction

We are once again indebted to Mr. Masaaki SATOU, who already made important contributions to clarifying the trechine fauna of northeastern Shikoku (cf. UÉNO, 1975, 1976, 1980 b, 1981 b), for the discovery of a new locality of three anophthalmic species. Most unexpectedly, it was found at the heart of Takamatsu, the second largest city in the Island of Shikoku, Southwest Japan.

The city is famous for the beautiful garden called Ritsurin-kôén, which is built at the eastern skirts of the small hill called Shiun-zan. Its northwestern continuation is called Iwaseo-yama, and together they form a kind of island 4 km long and 1.5 km wide isolated on the alluvial plain. It rises only to 240 m above sea-level even at the highest point; its western side is cut down by the Gôtô-gawa River, which enters into the Inland Sea of Seto-naikai only 1 km to the north. Lying in the large city, the hills have been tampered with to a considerable extent, and have never been carefully investigated before so far as the fauna is concerned.

Though generally simple in topography, Iwaseo-yama is deeply cut at its northern side by the valley called Suribachi-dani, and though the valley is crossed by a paved road at several points, the bottom of its branch gully has been preserved in a fairly good natural condition. A narrow stream, usually drying up except for rainy seasons, runs through a mixed temperate forest on the andesite bed of the gully, forming small cascades here and there. Its banks are either rocky or clayey, or formed by colluvia.

On April 22, 1982, Mr. SATOU happened to go down into the gully and was surprised to encounter two different species of anophthalmic trechine beetles there. Encouraged by this discovery, he revisited the gully three days later, and was really astounded to find that besides the two species, a third anophthalmic trechine of peculiar facies did occur in the same habitat. He at once submitted his findings to me for examination.

After a careful study, it became evident that the two species first discovered were identical with *Trechiana satoui* S. UÉNO and *Stygiotrechus satoui satoui* S. UÉNO, both theretofore known only from the Sanuki Hills about 25 km to the south of Iwaseo-

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yama beyond the Sanuki Plain. Their discoveries on a small isolated hill were by themselves of considerable interest from the zoogeographic view-point, but still more interesting was the third species which proved to be a new member of the genus *Trechiana*. As will be described on later pages, this new *Trechiana* is much isolated within the genus, and though certain resemblance is recognized between this species and *T. sonei* S. UÉNO, its true affinity cannot be determined with confidence at the present moment. It is difficult to explain why and how such a remarkable species can survive on the isolated hill in coexistence with more widely spread ones. I will come to this subject again after the enumeration of the three species.

Though coexisting in the same gully, *Trechiana* and *Stygiotrechus* exhibit a slight difference in their micro-habitats. Guided by Mr. SATOU, I paid a brief visit to the gully on November 4, 1982, and carefully examined their mode of life. The two species of *Trechiana* dwelt exactly in the same habitat, usually in the upper hypogean zone under colluvia but sometimes under stones lying on the wet banks of the stream. They were always active when dug out; the new species in particular moved about very quickly. However, the latter is much rarer and more light-coloured than *T. satoui*, which seems to suggest the possibility that it is originally an inhabitant of deeper places. I myself was unable to obtain any specimen of *Stygiotrechus*, but according to Mr. SATOU, all his specimens were found clinging to the under surfaces of large stones embedded in the clay at the sides of the gully. This minute, short-legged species must, therefore, be endogean in nature, in contrast with the upper hypogean, long-legged *Trechiana*.

In the present paper, I am going to describe the new *Trechiana* in the first place and then to record the other two species. After the enumeration, a brief discussion will be made on the distribution of these anophthalmic trechines. The abbreviations used herein are the same as those explained in other papers of mine.

Before going further, I wish to express my hearty thanks to Mr. Masaaki SATOU, whose enthusiastic investigations led to the striking discovery reported in the present paper. I am also indebted to Mr. Masahiro IWASAKI, who kindly aided my visit to Iwaseo-yama late in the autumn of the last year.

*Trechiana* (s. str.) *exilis* S. UÉNO, sp. nov.

[Japanese name: Ritsurin-mekura-chibigomimushi]

(Figs. 1–3)

Length: 4.80–5.30 mm (from apical margin of clypeus to apices of elytra).

An isolated species recognized at first sight on its elongate body with peculiarly shaped prothorax and square elytral shoulders. Colour light reddish brown, shiny, faintly iridescent on elytra; palpi, antennae, ventral surface and legs yellowish brown. Inner wings absent.

Head square, about as wide as long, with frontal furrows deep throughout and rather weakly curved; frons and supraorbital areas gently convex; microsculpture

distinct, mostly consisting of fine transverse meshes and lines; genae completely glabrous, rather flat at middle but gently convex at the posterior parts; neck wide, the anterior constriction being shallow but clearly marked at the sides; labrum widely

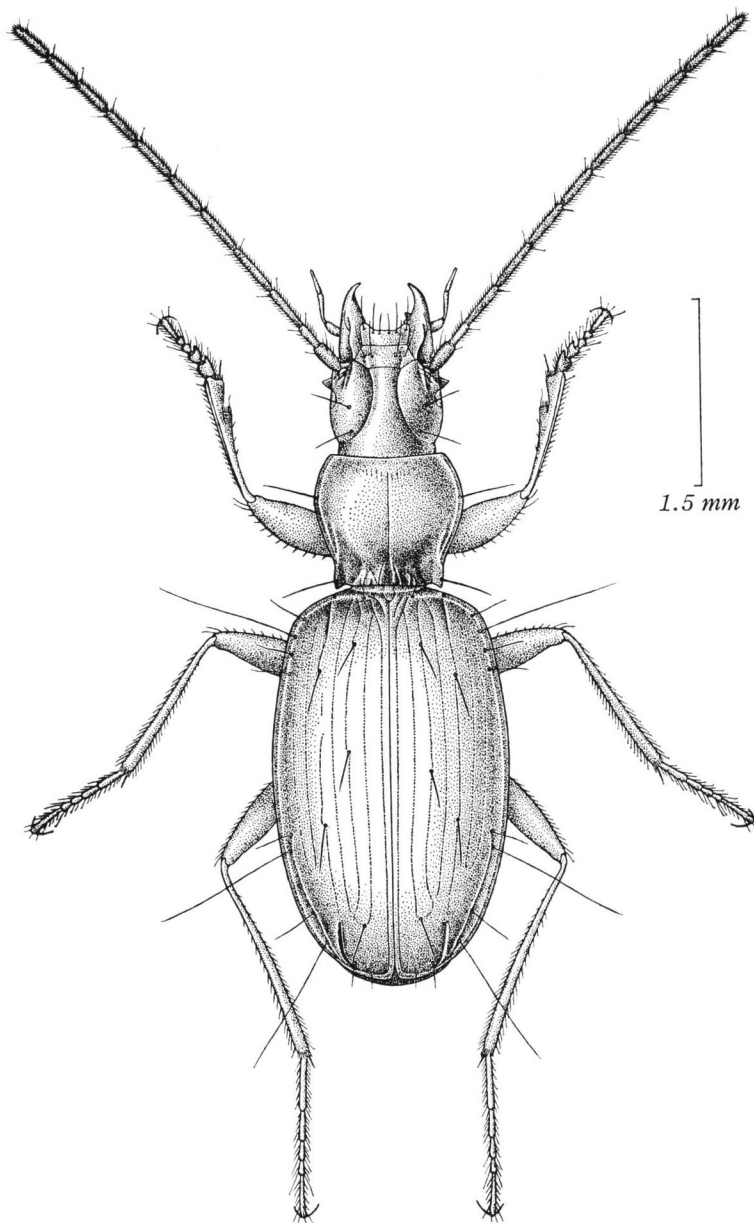


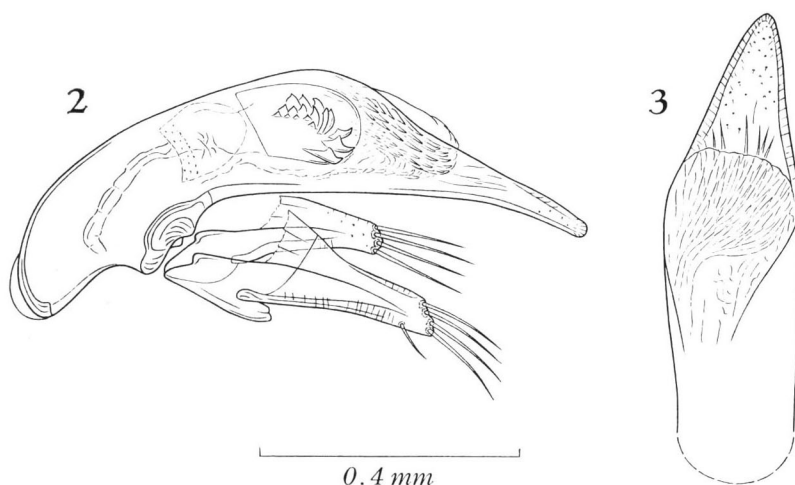
Fig. 1. *Trechiana* (s. str.) *exilis* S. UÉNO, sp. nov., ♂, from Iwaseo-yama in Takamatsu City.

emarginate at apex; mandibles fairly stout though sharply incurved at apices; mentum tooth broad and porrect, either truncated or slightly emarginate at the tip; palpi thin; antennae long and slender, reaching apical third of elytra, segment 2 about two-thirds as long as segment 3 or 4, apical segments subcylindrical, 8–10 each nearly 4 times as long as wide, terminal segment about as long as segment 7 and about 1.5 times as long as scape.

Pronotum subcordate, wider than head, a little wider than long, widest at about two-thirds from base, and equally narrowed in front and behind; PW/HW 1.30–1.35 (M 1.33), PW/PL 1.12–1.19 (M 1.16), PW/PA 1.34–1.41 (M 1.38), PW/PB 1.38–1.44 (M 1.40); surface convex and devoid of discal setae, with vague transverse striations; microsculpture fine, consisting of irregular transverse lines which are partially obliterated; sides widely arcuate in front, rather shallowly but distinctly sinuate at about one-fifth from base, and then subparallel towards hind angles; lateral setae normal, the posterior one being a little distant from hind angle; apex either almost straight or slightly emarginate, about as wide as base, PB/PA 0.96–1.02 (M 0.98), with front angles blunt and hardly porrect; base straight at middle but distinctly emarginate on each side close to hind angle, the latter small but more or less sharp, always projecting backwards but never outwards; median line sharply impressed, widening near base; apical transverse impression mal-defined, though the apical area is longitudinally wrinkled; basal transverse impression fairly deep, laterally merging into subtriangular basal foveae, which are deep at each centre; postangular carinae sharp and fairly long; basal area longitudinally rugose.

Elytra elongated ovate, widest at about middle, and more regularly narrowed towards apices than towards bases; EW/PW 1.57–1.62 (M 1.60), EL/EW 1.56–1.63 (M 1.60); surface convex, though more or less depressed longitudinally in the sutural area; microsculpture formed by fine transverse lines but largely obsolete; shoulders salient, with prehumeral borders straight, complete to the base of stria 5 and only a little oblique; sides narrowly reflexed, almost straight behind shoulders, feebly arcuate at middle, and then moderately rounded to apices without distinct preapical emargination, usually forming a small re-entrant angle at suture; striae superficial, lightly punctate, becoming much shallower at the side though even striae 7 and 8 are traceable, stria 5 deepening near base, stria 8 deeply impressed behind the middle set of marginal umbilicate pores; scutellar striole short but distinct; apical striole short, deep, hardly curved anteriorly, and almost joining stria 5; intervals flat even near suture; apical carina obtuse; stria 3 with two setiferous dorsal pores situated at  $1/8-1/6$  and  $3/7-1/2$  from base respectively, stria 5 also with two setiferous dorsal pores at  $1/5-1/4$  and  $5/9-5/8$  from base respectively, the anterior pore being at a level evidently posterior to that on stria 3; preapical pore situated at the apical anastomosis of striae 2 and 3 on the level of the terminus of apical striole, closer to the striole than to suture, and much more distant from apex than from suture.

Ventral surface smooth; anal sternite provided with a pair of sexual setae in ♂, with two pair of the setae in ♀. Legs long and slender; protibiae straight, gently dilated



Figs. 2-3. Male genitalia of *Trechiana* (s. str.) *exilis* S. UÉNO, sp. nov., from Iwaseo-yama in Takamatsu City; left lateral view (2), and apical part of aedeagus, dorsal view (3).

towards apices, longitudinally grooved on the external face, and glabrous on the anterior face even at the apical part; tarsi thin, segment 4 with a long ventral apophysis in pro- and mesotarsi; in ♂, two proximal segments of each protarsus widely dilated, stoutly produced inwards at apices, and furnished beneath with adhesive appendages.

Male genital organ small though moderately sclerotized. Aedeagus only two-sevenths as long as elytra, gently depressed, thickest a little behind middle, and gradually narrowed both proximally and apically, with the basal part elongate and only feebly curved; basal orifice fairly large, with the sides rather deeply emarginate; sagittal aileron present though small; apical lobe long, flattened, and slightly curved ventrad, narrowly subtriangular and blunt at the tip in dorsal view, narrowly prolonged and ending in a blunt extremity in lateral view; ventral margin almost straight at middle in profile. Inner sac armed with two teeth-patches and a poorly sclerotized copulatory piece; apical teeth-patch large and compact, consisting of numerous spine-like teeth and extending from the right side of inner sac to the area of apical orifice; proximal teeth-patch small and rather loose, lying at the left side of inner sac lateral to the concave face of copulatory piece; copulatory piece fairly large but very thin and hyaline, somewhat spatulate with rounded apical margin, and lying vertically at about middle of aedeagus. Styles relatively short and broad, left style obviously larger than the right, each ordinarily provided with four short setae at apex; in one of the paratypes, a small additional seta present on the ventral margin before the apex of left style (cf. Fig. 2).

*Type-series.* Holotype: ♂, 25-IV-1982, M. SATOU leg. Allotype: ♀, 4-XI-1982, S. UÉNO leg. Paratypes: 1 ♂, 5 ♀♀, 25-IV-1982, M. SATOU leg.; 3 ♀♀, 27-IV-1982, M. SATOU leg.; 1 ♂, 29-IV-1982, M. SATOU leg. All deposited in the collec-

tion of the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo.

*Type-locality.* Suribachi-dani on Iwaseo-yama, 60–120 m above sea-level, in Takamatsu City of Kagawa Prefecture, at the northeastern corner of the Island of Shikoku, Southwest Japan.

*Notes.* Though considerably differing from all the described forms of the genus, this new species may have some relationship with *T. sonei* S. UÉNO (1982, p. 185, figs. 1–3) known from the southeastern tip of the Island of Shikoku and, therefore, may belong to the group of *T. ohshimai* (cf. UÉNO, 1980 a). They resemble each other in the conformation of pronotal hind angles, the number and arrangement of elytral dorsal setae, and the general appearance of male genitalia. There are, however, radical differences between the two. Most conspicuous is in the facies, the unique habitus of *T. exilis* making a sharp contrast to the ordinary appearance of *T. sonei*. A marked discrepancy is also observed in the disposition of aedeagal inner armature.

At the present state of our knowledge, it is difficult to determine conclusively the true affinity of *T. exilis*. I consider it preferable to regard the new species as a peculiar offshoot of the group of *T. ohshimai* for the time being and to leave the final solution of the problem for future studies.

#### *Trechiana* (s. str.) *satoui* S. UÉNO, 1975

*Trechiana* (s. str.) *satoui* S. UÉNO, 1975, Bull. natn. Sci. Mus., Tokyo, (A), 1, p. 204, figs. 1–3; type-locality: Mt. Daisen-zan.

*Specimens examined.* 3 ♂♂, 2 ♀♀, 22–IV–1982, M. SATOU leg.; 4 ♂♂, 4 ♀♀, 25–IV–1982, M. SATOU leg.; 1 ♂, 2 ♀♀, 2–V–1982, M. SATOU leg.; 1 ♀, 3–XI–1982, M. SATOU leg.; 6 ♂♂, 6 ♀♀, 4–XI–1982, S. UÉNO, M. SATOU & M. IWASAKI leg. All deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

*Locality of the specimens examined.* Suribachi-dani on Iwaseo-yama, 60–120 m above sea-level, in Takamatsu City of Kagawa Prefecture, Southwest Japan.

*Notes.* In the Iwaseo-yama specimens, the apical lobe of aedeagus is usually thinner and more distinctly curved ventrad than in the type-series, but the difference is not decisive because of individual variation. The smallest of the 29 specimens examined measures only 4.90 mm from the apical margin of clypeus to the apices of elytra, hence smaller than any known specimens from the type population.

#### *Stygiotrechus satoui satoui* S. UÉNO, 1976

*Stygiotrechus satoui* S. UÉNO, 1976, Bull. natn. Sci. Mus., Tokyo, (A), 2, p. 278, figs. 1–4; type-locality: Ôyashiki in Shionoé-chô.

*Stygiotrechus satoui satoui*: S. UÉNO, 1980, J. speleol. Soc. Japan, 5, p. 10.

*Specimens examined.* 1 ♂, 1 ♀, 22–IV–1982, M. SATOU leg.; 1 ♂, 4 ♀♀, 25–IV–1982, M. SATOU leg.; 7 ♂♂, 4 ♀♀, 2–V–1982, M. SATOU leg. All deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

*Locality of the specimens examined.* Suribachi-dani on Iwaseo-yama, 60–120 m

above sea-level, in Takamatsu City of Kagawa Prefecture, Southwest Japan.

*Notes.* The specimens recorded above perfectly agree with the topotypical specimens of the nominate subspecies, and are readily distinguished from *S. satoui compira* S. UÉNO (1980 b, pp. 6, 10, figs. 5–6), which has hitherto been known only from Mt. Zôzu-san.

### Discussion

The discovery of the anophthalmic trechines on Iwaseo-yama is very important for three reasons: 1) coexistence of three different species in the same gully; 2) existence of isolated populations of two species without showing any geographical differentiation; and 3) occurrence of a singular, upper hypogean species in isolation.

The first point may not appear very important from the global view-point, but in Japan, anophthalmic trechines are usually allopatric except in such areas where distributional ranges of two different groups come into contact with each other. A very rare exception is the limestone cave called Himisé-dô in the Naka-gawa drainage of eastern Shikoku, in which the three species, *Awatrechus yoshidai* S. UÉNO, *Himiseus kiuchii* (S. UÉNO) and *Ryugadous awanus* S. UÉNO, coexist in the same habitat (cf. UÉNO, 1969 a, b). It is true that three different species of trechine beetles with degenerated eyes occur in the Akiyoshi limestone area (*Trechiamia pluto pluto* S. UÉNO, *Rakanatrechus etoi etoi* S. UÉNO and *Stygiotrechus parvulus* S. UÉNO; cf. UÉNO, 1958 a, b, 1969 c) and on Mt. Takao-san (*Trechiamia tamaensis* A. YOSHIDA et S. NOMURA, *Paragonotrechus paradoxus* S. UÉNO and *Kurasawatrechus eriophorus* A. YOSHIDA et S. NOMURA; cf. UÉNO, 1981 a, c), but in these places, the habitat of at least one of the three species is segregated from those of the remainings. It is, therefore, astonishing that the three species recorded in the present paper do coexist in the small gully on Iwaseo-yama, even though *Stygiotrechus satoui satoui* lives in a habitat slightly different from those of the two *Trechiamia*.

The second point is also very exceptional for the Japanese species of anophthalmic trechines. They are almost always much localized in Southwest Japan. There are indeed some that are rather widely spread, but such species are usually distributed on single ranges of hills or in relatively wide limestone areas. As a rule, large rivers and especially alluvial plains form effective barriers against their dispersal, and if certain species occur on both sides of such barriers, they may become differentiated into geographical races. As regards the two species, *Trechiamia satoui* and *Stygiotrechus satoui*, however, no appreciable differentiation seems to have taken place between the Ohtaki-san population and the Iwaseo-yama one, although on Mt. Zôzu-san, which is only 15 km distant from the type-locality of the former and about 29 km distant from that of the latter, *T. satoui* is replaced by *T. instabilis* S. UÉNO (1981 b, p. 12, figs. 1–3) and *S. satoui* becomes differentiated into a distinctive subspecies (UÉNO, 1980 b, p. 6).

Two explanations seem possible to account for this phenomenon. One is that

the Iwaseo-yama populations of the two species may have been derived from the mother stocks of the Sanuki Hills. As was already noted in the introduction of this paper, the western side of Iwaseo-yama is cut down by the Gôtô-gawa River, which rises in Mt. Ohtaki-san of the Sanuki Hills where live both *T. satoui* and *S. satoui satoui*. The distance between the two localities is about 30 km along the course of the river. It is quite possible that certain individuals of the trechine beetles have been carried down from time to time by floods of the river. Most of such drifters may have perished in the turbulent water, but there may have been some that were able to reach Iwaseo-yama and to establish a new colony there.

The other explanation is to regard the Iwaseo-yama population of each species as an isolated remnant of once widespread ancestral stock. As was already pointed out (cf. UÉNO, 1975, p. 210), the ancestor of *Trechiana satoui* must have come from eastern Chûgoku to northeastern Shikoku across the Inland Sea of Seto-naikai. The origin of *Stygiotrechus satoui* is not so apparent, but it must also be somewhere in the Chûgoku District. Since Iwaseo-yama lies on the way from the Chûgoku Hills to the Sanukis, it may have furnished a useful stepping stone to the ancestral trechines if they island-hopped from the north. There is, however, a positive defect in this conjecture: *T. satoui* is specifically distinctive from the Chûgoku species of the group of *T. oni* and yet does not show any differentiation between the population of Iwaseo-yama and that of the Sanukis. If its ancestor reached Iwaseo-yama first and then invaded the Sanukis, the former must be considered to have served as the place of differentiation. The hill appears too small and simple to have played the rôle, and besides, no appropriate means of southward dispersal can be found provided that it was effected in a recent period. The same can be said also for *Stygiotrechus satoui*.

Thus, the first explanation seems much more plausible than the second. The ancestors of both *T. satoui* and *S. satoui* may have invaded northeastern Shikoku from somewhere in the Chûgoku District and established their colonies on the Sanuki Hills, where they became differentiated into endemic species. Very recently, no doubt in the Postglacial Period, certain individuals of both the species may have been carried down to Iwaseo-yama by the water of inundation of the Gôtô-gawa River and have successfully colonized there.

Last to be considered is the problem posed by *Trechiana exilis*. Since no close relative of this peculiar species has been known from anywhere else, it is difficult to trace its exact derivation. It is, however, most probable that its ancestor invaded the northern tip of Shikoku from the eastern part of the Chûgoku Hills, which harboured the ancestral forms of both the group of *T. oni* and that of *T. ohshimai* (cf. fig. 4 in UÉNO, 1975, p. 211). As was repeatedly pointed out (e.g., UÉNO, 1980 a, p. 199, 1981 b, p. 13), the former species-group seems to have become differentiated from the latter, and if so, *T. exilis* may also have become differentiated from the same species-group without losing the internal series of setiferous dorsal pores on elytra.

Since *T. exilis* seems to be more highly adapted to the hypogean existence than *T. satoui*, it may have colonized on Iwaseo-yama prior to the arrival of the latter. At



that stage, *T. exilis* may have been the sole inhabitant of the hill so far as anophthalmic trechines are concerned and, therefore, survived without undergoing much modification. Much later, *T. satoui* successfully settled a new colony on the same hill and became predominant. It may have driven the original inhabitant into the deeper part of the subterranean domain, and an equilibrium may have been established between them by zonal segregation of their micro-habitats. This view seems to be supported by the fact that most known specimens of *T. exilis* were met only after heavy rains.

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