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A New Blind Trechid found in a Lava Cave of Japan[1)]

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In the last decade, more than fifty forms of trechids have been reported from about one hundred caves and three mines of Japan. These caves and mines are, however, confined to those which develop in the formations of the Palaeozoic limestone. Now, the writer wishes to describe a new species found in a lava cave, a habitat hitherto unknown so far as troglobiontic trechids are concerned.

This interesting trechid was first obtained by Mr. Koichi SEKIGUCHI in March of 1942 (*cf.* SEKIGUCHI, 1943, p. 46; KUMANO, 1943, p. 54). In a private correspondence, Mr. SEKIGUCHI told the writer that his unique specimen was submitted to the late Mr. Hitoshi ARAKI and was lost during the World War II. The beetle was rediscovered in October of 1954 by Prof. Riozo YOSII and Mr. Gentaro IMADATÉ, who placed their specimens at the writer's disposal for study. The writer himself had an opportunity to visit the cave in the following year and was able to take a series of specimens of the same species. It was not difficult to find out that the trechid was a member of *Pseudotrechiama* and belonged to the group of *Trechiama habei*. It was, however, not easy to explain how such a troglobiontic beetle had become an inhabitant of a lava cave that had a history of but ten thousand years. Unfortunately, the matter is not clear even at the present, but the publication of the new species is in need from the taxonomic point of view. Following the description, the writer will give some consideration on the subject in question.

Before going further, the writer wishes to express his hearty thanks to Prof. Kenji NAKAMURA for his encouragement; to Prof. Riozo YOSII and Mr. Gentaro IMADATÉ for their kindness in supplying him with the valuable specimens; to Mr. Koichi SEKIGUCHI for his useful information; and to Mr. Atsushi SAITÔ for his kind aid at the field survey.

Trechiama (Pseudotrechiama) lavicola S. UÉNO, sp. nov.

Length: 4.6–5.4 mm (from front margin of clypeus to anal end).

1) Contribution No. 39 from the Spelaeological Society of Japan.

Depigmented; body surface glabrous. Colour reddish brown, translucent and very shiny; palpi, apical segments of antennae, apical sternites and legs pale reddish brown or yellowish brown.

Head subquadrate and rather narrow, with the neck relatively wide; vertex,

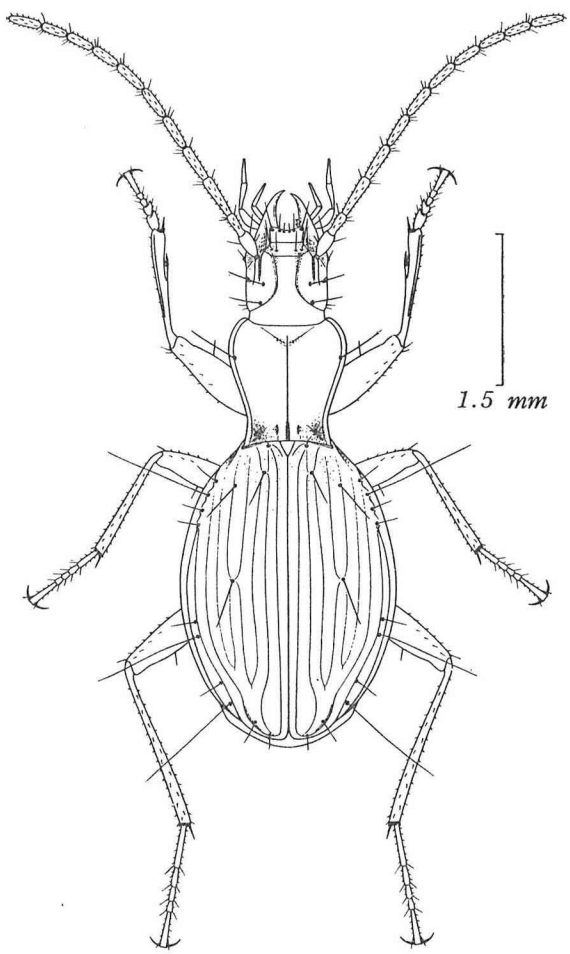

Fig. 1. *Trechiama* (*Pseudotrechiama*) *lavicola* sp. nov., ♂, of Komakado-kaza-ana Cave.

front and supraorbital areas convex; frontal furrows entire, deep, not strongly curved and not angulate at middle; microsculpture imperfectly reticulated and moderately impressed; eyes not faceted, the trace of them often covered with a coat of chitin; genae slightly convex, widest at the level of the trace of eyes

and with a few minute hairs at the posterior parts; mandibles slender and sharply hooked at apices; mentum tooth porrect and more or less emarginate at apex; palpi slender; antennae long, reaching the middle of elytra, with segment 2 about five-ninths as long as segment 3, which is longer than segment 4.

Pronotum elongate-cordate and convex, 1.44–1.50 times wider than head (mean 1.48), a little wider than long (range 1.01–1.07, mean 1.04), widest at about four-fifths from base; the ratio of the greatest width to the width of apex 1.41–1.49 (mean 1.45); lateral sides bordered and reflexed, with marginal gutters relatively wide throughout, moderately rounded in front and widely sinuate at one-fifth to one-sixth from base; postangular setae absent; apex widely and rather deeply emarginate; base widely emarginate, usually a little wider than apex but rarely as wide as the latter (range 1.00–1.05, mean 1.04); front angles large, porrect and rounded at apices; hind angles acute, projecting both outwards and backwards; median line deep especially on the disk, not reaching apex but widening near base; apical transverse impression shallow, with vague irregular wrinkles; basal transverse impression wide though interrupted at middle, with a large longitudinal fovea on each side of median line; basal foveae not so deep but fairly large; postangular carina absent; surface smooth, partly with vague transverse striations; microsculpture composed of fine transverse lines.

Elytra oval, well convex though evidently depressed on basal area, with a transverse furrow on basal peduncle; 1.73–1.85 times wider than pronotum (mean 1.79), 1.39–1.43 times longer than wide (mean 1.41), widest at about middle; shoulders effaced; prehumeral borders very oblique, becoming very slight inwards and obliterated outside the basal carina of interval 6; lateral sides widely explanate and reflexed, with wide marginal gutters, rather strongly rounded at middle and slightly emarginate before apices, each one of which is either subangulate or rounded; striae superficial and only indistinctly crenulate, inner striae somewhat deepening near base, striae 5–8 very shallow and obliterated near base; scutellar striole short but distinct; apical striole relatively short, moderately curved and joining stria 7; intervals smooth and flat, though intervals 1–4 more or less convex near base; apical carina obtuse; stria 3 with a single dorsal pore at about one-ninth from base (rarely closer to the base), this pore sometimes lacking in the seta; stria 5 normally with two setiferous dorsal pores situated at one-eighth to one-sixth from base (usually at basal one-seventh) and basal two-fifths to the middle (usually at about middle); a third pore rarely present on stria 5 on one elytron, and in one of the paratypes stria 5 has three setiferous dorsal pores on both the elytra; preapical pore normally absent (in two of the paratypes, a preapical pore present on left elytron at the meeting point of striae 2 and 3); microsculpture composed of fine transverse lines.

Ventral surface glabrous; sternites 3–5, each with one or two setae on each side of median line; anal sternite with one seta in ♂, two in ♀ on each side. Legs long and slender; protibia externally grooved and glabrous on the

anterior face even at the apical portion; in ♂, two proximal segments of each protarsus evidently dilated, inwardly produced at apices and provided beneath with sexual adhesive appendages.

Male genital organ not very large though well chitinized. Aedeagus robust, wide at middle and suddenly attenuated towards apex, which is blunt in profile and is rather widely rounded in dorsal view; viewed laterally, dorsal side semicircularly rounded; basal part large, with large basal orifice, the lateral sides of which are deeply emarginate; no sagittal aileron; ventral side nearly straight at middle and gently concave before apex. Inner sac armed with a well developed copulatory piece and two groups of large teeth; copulatory piece very large,

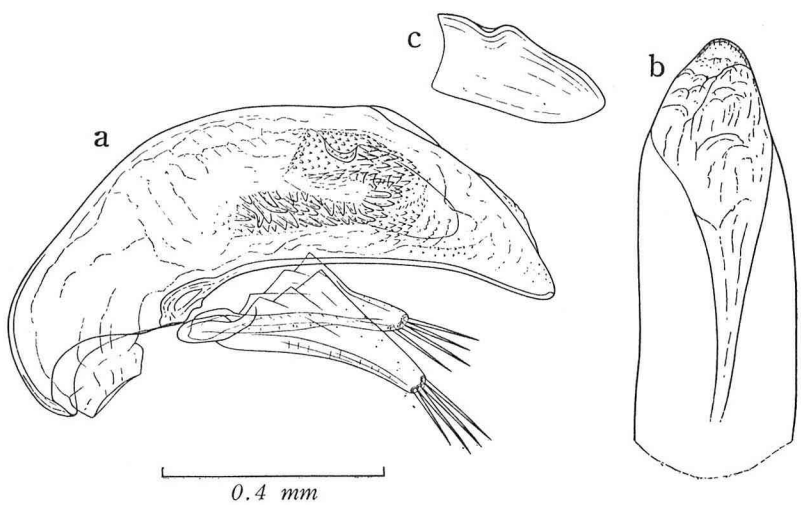

Fig. 2. Male genital organ of *Trechiama* (*Pseudotrechiama*) *lavicola* sp. nov., of Komakado-kaza-ana Cave; left lateral view (a), dorsal view of the apical part of aedeagus (b), and separated copulatory piece, left lateral view (c).

spatulate and situated at the right side inside the sac, with the dorsal margin distinctly notched near the base; two groups of large teeth are situated one above another at the left side of copulatory piece, the ventral group being larger and longer than the dorsal group, which is subdivided into two smaller ones. Styles fairly wide, left style obviously longer than the right, each provided with four setae at apex.

Type-specimens: Holotype: ♂, allotype: ♀ (10-IX-1955, collected by S. UÉNO). Paratypes: 2 ♀♀ (14-X-1954, by R. YOSII); 3 ♂♂, 4 ♀♀ (20-X-1954, by G. IMADATÉ); 6 ♂♂, 1 ♀ (10-IX-1955, by S. UÉNO).

All the type-specimens are preserved in the writer's collection.

Type-locality: A lava cave called "Komakado-kaza-ana"[2], at Komakado, in Fujioka of Gotenba City, Shizuoka Prefecture, on the Pacific coast of central Honshu.

This is a remarkable new species evidently isolated from the other described members of the group of *Trechiama habei*. It is unique in the structure of the humeral areas of elytra and in the direction of the apical striole, and reminds us of some species of *Ishikawatrechus* in these respects. It may, however, be related to *T. tamaensis* on account of the absence of the preapical pore and of the presence of a dorsal pore on the third elytral stria. Such an affinity would be confirmed if a comparative study had been made on the male genitalia of the two species. Unfortunately, it has been impossible up to now to make the comparison because of the extreme rarity of the male individuals of the latter species.

On the other hand, *T. lavicola* seems to be in the midst of regressive evolution. This may be known from the occurrence of some individuals that are aberrant in their chaetotaxy. Normally, there is no preapical pore on the elytra of the present species, but the pore is present on one elytron in two of the specimens examined. In many trechid groups, this pore has an alleged taxonomic significance and its loss has been recorded quite exceptionally. It must be noted here that the elytral pores have a decisive evolutionary trend in the Japanese trechids, which is in the direction of reduction. Therefore, the presence of a preapical pore on one elytron of some individuals may not be considered as a mere aberrancy, but be regarded as a reappearance of a character that was possessed by the ancestor. Contrary to this, the loss of a seta on the dorsal pore on the third elytral stria, a phenomenon that occurs in *T. lavicola* according to individuals, may represent an advanced status and seems to suggest the complete loss of this dorsal pore in some distant future. A similar feature is also seen in *Yuadorgus uozumii* (*cf.* UÉNO, 1955, p. 41).

Komakado-kaza-ana Cave lies in the village of Komakado at the southeastern foot of Mt. Fuji. It develops almost horizontally in one of the oldest lava streams spouted from Fuji Volcano, and harbours a fauna richest among the lava caves around Mt. Fuji. The gallery is wide and wet, abounding in organic matters. Many diplopods, arachnids and springtails are found among vegetable debris, and the other rarer animals (pseudoscorpion, pselaphid, etc.) also dwell in the same habitat. The present trechid is found everywhere in the dark zone under stones or rotten boards, and runs away promptly when it is uncovered. It is not easy to capture the beetle, for there are too many loop-holes on the floor due to the porous nature of the lava.

Some comment should be required on the colonization of those troglobionts in such recent cavities as lava caves. So far as known to the writer, no

2) Sometimes called "Komakado-fûketsu".

troglobiontic trechid has hitherto been reported from lava caves, and the present report may give some clue to the analysis of the Japanese cave fauna. Three explanations may be possible to show the process of colonization in such lava caves. The first is that the troglobionts have evolved in lava caves since the cavities were formed. This interpretation is simplest and is easy to understand, but is quite insufficient to explain why the epigean ancestors had penetrated into the underground. Moreover, it is not known whether such troglobionts have been yielded within several thousand years or not. These are the fatal defects of the interpretation.

The second explanation is that the epigean ancestors, which to a varying degree had undergone morphological modifications adaptive to subterranean life, had gradually invaded the areas devastated by the flows of lava with the recovery of vegetation, and then settled in caves under the influence of warm climate during the Atlantic Age (about six thousand years ago). Those which could not penetrate into the underground may have been unable to withstand the climatic changes and have vanished from the surface of the earth. Some animals which are not morphologically different from true cave-dwellers are known from many places in western Honshu, especially on the coast of the Japan Sea. They usually inhabit the depths of soil in thick forests but are often found in places exposed to the sun. These evidences will help the comprehension of the process how the preadapted ancestral forms had spread over an area where the life had once been mopped up by the lava.

Third to come under consideration is that the ancestors of such troglobionts had already been adjusted to endogean habitats and escaped in the depths of soil from the volcanic disaster. Although this explanation seems to be almost incredible, some endogean animals are effectively protected against the influence of eruption by the heatproof power of the soil. An example of such a case was reported by YASUMATSU (1948, p. 189).

At present, the writer is rather inclined to accept the second interpretation. Geological data show that the lava stream in which Komakado-kaza-ana Cave lies was spouted from Mt. Fuji about ten thousand years ago. This means that the cave was formed during a period when the climate was cooler than that of the present. Such a climate seems to have been advantageous to the dispersal of ancestral trechids which were preadapted to subterranean life. It may be presumed from the pattern of distribution that the ancient dispersal of the group of *Trechiama habei* may have been performed during the late Pliocene or the early Pleistocene. If this be true, the present trechid may have had a history of blind life much longer than that of the lava cave itself. And thus, the first interpretation may be eliminated from consideration, though subsequent adaptations in the cave environment must have occurred to the beetle. On the other hand, there still remain some possibilities of the occurrence of the process given in the third interpretation. The cave fauna is, however, too rich and too diverse in Komakado-kaza-ana Cave to have been derived from

the survivors of volcanic catastrophes.

At the northern foot of Mt. Fuji, there are many other caves developed in the recent lava streams, of which the most recent one is said to have been spouted about one thousand years ago. No troglobiontic trechid has been found heretofore in those recent caves. TORII (1960) has recently published a paper dealing with the problem of colonization in such recent caves. However, ecological aspects of cave animals and the epigean relatives are wholly neglected by him. He has failed in consulting recent literature, in which many new knowledges have been accumulated, and has believed that blind depigmented animals are yielded only in cave environment. Moreover, there are too many errors in his discussion. Even the material that back his paper up is many years out of date and unreliable. These have led him to a conclusion that would not be acceptable to the modern zoogeographers. At present, the writer is not in the situation to pass a sweeping criticism on the paper in question. It seems, however, to the writer that, to those who are willing to analyse the colonization in the lava caves around Mt. Fuji, the first step of the study is to make a careful comparison of the cave faunas based on thorough investigations. Unfortunately, our present-day knowledge is too inadequate to accomplish such a work. It should be necessary to make full investigations in the old caves at the western foot, where there may be found rich cave faunas.

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For the convenience of future studies, the writer prefers to take this opportunity of summarizing the species and the subspecies of the group of *Trechiama habei* in a key and of giving some supplementary accounts of *Trechiama tamaensis*, recently described by Messrs. Akira YOSHIDA and Sizumu NOMURA.

Key to the species and the subspecies

1 (4) Elytral stria 3 without dorsal pore; preapical pore present; apical striole joining stria 5; prehumeral borders entire to the base of stria 5.

2 (3) Pronotal postangular setae present; aedeagus robust, with large basal part and without sagittal aileron; inner sac armed with a very large copulatory piece and two groups of large teeth; (Ja-ana Cave near Lake Hamana-ko) ..... *T. habei* (S. UÉNO).

3 (2) Pronotal postangular setae absent; aedeagus elongate, with smaller basal part and well developed sagittal aileron; inner sac armed with a small copulatory piece and without group of teeth .... *T. imadatei* (S. UÉNO et SHIBANAI).

3a (3b) Pronotum wider, with lateral sides strongly rounded in front; pronotal base distinctly wider than apex; prehumeral borders less oblique;

(limestone caves at Shimajiyama on the Shima Peninsula)..... ..... *T. imadatei imadatei* s. str.

3b (3a) Pronotum narrower, with lateral sides less rounded in front; pronotal base only slightly wider than apex; prehumeral borders very oblique; (Shûrei-no-mizu-ana Cave on the Shima Peninsula) .... *T. imadatei iwatai* (S. UÉNO).

4 (1) Elytral stria 3 with a dorsal pore near base; preapical pore normally absent.

5 (6) Pronotum obviously wider than long; pronotal pastangular setae present; apical striole joining stria 5; shoulders distinct, prehumeral borders entire to the base of stria 5; (Yôzawa-dô Cave on the Kwantô mountain range) ..... *T. tamaensis* A. YOSHIDA et S. NOMURA.

6 (5) Pronotum only a little wider than long; pronotal postangular setae absent; apical striole joining stria 7; shoulders effaced, prehumeral borders incomplete; (Komakado-kaza-ana Cave at the foot of Mt. Fuji) ..... *T. lavicola* sp. nov.

Trechiama (Pseudotrechiama) tamaensis A. YOSHIDA et S. NOMURA.

Yozawadous tamaensis A. YOSHIDA et S. NOMURA, 1952 (in litt.), The Chûhô, Tokyo, **6**, p. 4.

Trechiama (Pseudotrechiama) tamaensis A. YOSHIDA et S. NOMURA, 1960, Jap. J. Zool., **12**, p. 493, fig. 1; type-locality: Yôzawa-dô Cave in Tokyo Pref.

This interesting species is markedly different from the others in the shape of pronotum, which is much more transverse and has shorter basal part. It resembles *T. habei* in the structure of the humeral part of elytra, but may be closer to *T. lavicola* in view of the presence of a setiferous dorsal pore on the third elytral stria and of the absence of a preapical pore. It is very unfortunate to the writer to be unable to examine the aedeagus of this species, which may be useful in analysing the phylogenetic relationship of the species-group. As a full description of *T. tamaensis* was given by the original authors, the writer will refrain here from repeating it. Some accounts of the individual variation will be supplemented as seen below.

Length: 4.8–5.7 mm (from front margin of clypeus to anal end).

Pronotum 1.37–1.48 times wider than head (mean 1.43), 1.16–1.26 times wider than long (mean 1.22), widest at about two-thirds from base; the ratio of the greatest width to the width of apex 1.42–1.53 (mean 1.46), that to the width of base 1.35–1.43 (mean 1.40); base usually a little wider than apex but rarely as wide as the latter (range 1.00–1.09, mean 1.05). Elytra 1.63–1.74 times wider than pronotum (mean 1.67), 1.41–1.52 times longer than wide (mean 1.47); apical striole usually joining stria 5, but rarely (on one elytron) interrupted at the extremity and extending laterally beyond stria 5; stria 3 with a single dorsal pore situated at one-tenth to one-eighth from base, stria 5 always with two dorsal pores situated at one-fourth to two-sevenths and three-fifths to

two-thirds from base respectively; preapical pore always absent.

Specimens examined: 2 ♀♀ (holotype and paratype) (7-V-1959, collected by S. UÉNO and R. ISHIKAWA); 8 ♀♀ (5-XI-1959, by S. UÉNO); 1 ♀ (19-V-1960, by S. UÉNO).

All the specimens examined are preserved in the writer's collection.

Locality: A limestone cave called "Yôzawa-dô", at Kamiyôzawa of Komiya, in Itsukaichi-chô, Tokyo Prefecture, on the Pacific coast of central Honshu.

Yôzawa-dô Cave is situated at about 1 km north of the village of Kamiyôzawa and on the southern slope of Mt. Hinodé-yama. Three entrances are open on an outcrop of limestone in a forest of cryptomeria. Though small, it is eutrophic and wet throughout, and harbours a fauna richest among the caves on the Kwantô mountain range. Cave animals taken in this grotto involve five species of beetles, i.e. two trechids, two pselaphids and a catopid, each one of which is confined within a limited place. *T. tamaensis* inhabits a small basin near the innermost and is found under heaps of fist-sized stones.

Formerly, this trechid was considered to be extremely rare, for it had not been re-obtained for a long time despite of repeated investigations after a pair of the elytra had been discovered by Mr. Sizumu NOMURA. The specimens in a perfect condition were first brought to light by the present writer in 1959. In the autumn of the same year, he succeeded in obtaining a series of new specimens, which overthrew the supposition once prevalent.

It is very strange and worthy of special mention that in this species the females are extremely in excess of the males, i.e. all the eleven specimens hitherto known are females. Such a predominancy of females is a common phenomenon among the troglobiontic trechids of Japan. There is, however, no other example comparable to the case of *T. tamaensis*.

References

KUMANO, M., 1943. The animals of the lava caves around Mt. Fuji. Hakubutsugaku Zasshi, Tokyo, **39**: 51–56. (In Japanese.)

SEKIGUCHI, K., 1943. The animal life on Mt. Fuji and the vicinities (XXVI). A short observation of myriapods, arachnids and some other insects of lava caves. Ibid., 44–46. (In Japanese.)

TORII, H., 1960. A contribution of the distribution of some troglobionts of Japanese caves. (I). Jap. J. Zool., **12**: 555–584.

UÉNO, S., 1954. Studies on the Japanese Trechinae (II) (Coleoptera, Harpalidae). Mem. Coll. Sci. Univ. Kyoto, (B), **21**: 29–37.

——— 1955. Ditto (V). Ibid., **22**: 35–50.

——— 1957. Ditto (VI). Ibid., **24**: 179–218.

YASUMATSU, K., 1948. The distribution of Japanese ants. Kyôdo-Shizenkagaku no Kenkyû (Natural Environment and Life), Part 1, Montane districts, pp. 185–213. Tokyo, Kyoritsu Shuppan. (In Japanese.)

YOSHIDA, A., & S. NOMURA, 1952. A list of the Arthropoda in the limestone caves in Kantô-Mountainland, with the descriptions of a new genus and three species. The Chûhô, Tokyo, **6**: 1–8.

——— & ——— 1960. Description of a new carabid-beetle from a limestone cave of Japan. Jap. J. Zool., **12**: 493–496.