Bull. Natn. Sci. Mus., Ser. A (Zool.), **5** (2), June 22, 1979

New Cave-dwelling Trechine Beetles from the Eastern Part of the Kii Peninsula, Central Japan

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The Kii Peninsula, lying on the Pacific side of western Honshu, is an area of considerable biogeographic importance. Certain botanists consider its flora to bear a direct relationship with that of the Island of Shikoku and attribute the affinity to paleogeographic causes. Similar relationship has also been recognized by zoologists on certain groups of salamanders and insects, though good examples showing such a distributional pattern are not very common. In certain groups, on the contrary, a boundary of distribution is marked by the Kii Channel that separates the Kii Peninsula from the Island of Shikoku. Thus, opinions are divided as to the biogeographic situation of the peninsula according to the groups of animals and plants studied.

Biospeologically, this peninsula has generally been considered to have a close faunal relationship with the other areas on the Pacific (southern) side of central and western Japan. However, a chthoniid pseudoscorpion of northern origin was reported by MORIKAWA (1956, pp. 275–276) from a limestone cave at the centre of the peninsula, suggesting that other cave animals of a similar origin can be expected to be found alongside of the southern element. Unfortunately, limestone caves are not widespread in the Kii Peninsula; they are concentrated in the Isé-Shima area at the eastern part and the Ohminé-Ohdaigahara area at the central part, leaving a wide blank in the southwestern half. Until recently, therefore, biospeological activities were limited to these small areas.

Even now, the cave fauna of the Kii Peninsula cannot be said to have been satisfactorily clarified, since no subterranean animals have been known from the intervening area between the southern half of the peninsula and the Suzuka area. Be that as it may, our knowledge has been considerably enriched by recent investigations of certain limestone caves and mine adits. Only six years ago, all we were aware of the cave trechines in that part of Japan was the occurrence of *Kusumia* in the Ohminé-Ohdaigahara area and that of *Trechiama* in the Isé-Shima area. What we know at present is that the genus *Kurasawatrechus* extends its distribution southwards into the eastern part of the Kii Peninsula, that a new species of *Trechiama* occurs in a cave to the west of the Isé-Shima area, and that the distributional range of *Kusumia* probably covers the whole southwestern part of the peninsula. As regards *Kusumia*, the new materials now at hands are still inadequate for an accurate study. In this

paper, therefore, I have confined myself to the descriptions of the new trechine beetles discovered in the eastern part of the peninsula.

In the autumn of 1973, Mr. Mitsuru HIRAKE explored three limestone caves in Ohmiya-chô of Mié Prefecture, which had theretofore been unknown to Japanese speleologists. In one of them, he obtained a pair of specimens of an anophthalmic trechine beetle and submitted them to me for taxonomic study. They proved to be a new species of *Kurasawatrechus*, which was the first cave trechine of northern origin ever found in the Kii Peninsula. In view of the zoogeographic importance of this discovery, I paid a visit to the caves early in the winter of the same year, obtained several additional specimens of the *Kurasawatrechus*, and found that the species coexisted with a new *Trechiama* in one of the caves investigated.

While preparing descriptions of these new species during that winter, I received from Mr. Hiroshi IWASAKI a specimen of another *Kurasawatrechus* taken by him in a limestone cave of the Isé-Shima area. It seemed very close to the species discovered by HIRAKE, and some additional specimens from the same population were needed to determine its true taxonomic status. Unfortunately, this has not yet been realized in spite of enthusiastic investigations made by my fellow entomologists. On the other hand, their efforts have resulted in the discovery of one more locality of *Kurasawatrechus* in the Isé-Shima area, from where only two females have hitherto been obtained. Thus, the present situation is that we have collected sufficient materials of the two new species from Ohmiya-chô, but that we have been unable to obtain adequate samples of the exceedingly rare forms occurring in the Isé-Shima area. Considering the importance of introducing the new species, particularly the new *Kurasawatrechus*, into science, I have decided to publish what has been clarified up to the present.

The abbreviations used herein are the same as those explained elsewhere in my previous papers.

I wish herewith to express my deep appreciation to the following persons, whose kind aid made the completion of this paper possible: Messrs. Akiyoshi AMAGASU, Mitsuru HIRAKE, Hajimu ICHIHASHI, Hiroshi IWASAKI, and Mrs. Kyôko KATO.

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

[Japanese name: Koya-mekura-chibigomimushi]

(Figs. 1–4)

Length: 4.65–5.65 mm (from apical margin of clypeus to apices of elytra).

Belonging to the group of *T. habei* and externally close to *T. imadatei* (S. UÉNO et SHIBANAI) (in UÉNO, 1954, pp. 32, 35, fig. 4B) of the caves at Shimaji-yama, but the head is larger, the pronotum is less contracted anteriorly and has sharper hind angles, the elytra are a little narrower and more elongate on an average, with effaced shoulders and shallower striae, the latter of which are much less strongly punctate, and the appendages are slenderer. Strikingly different from *T. imadatei* in genitalic features, above all in the shape of aedeagal apical lobe and in the structure of inner

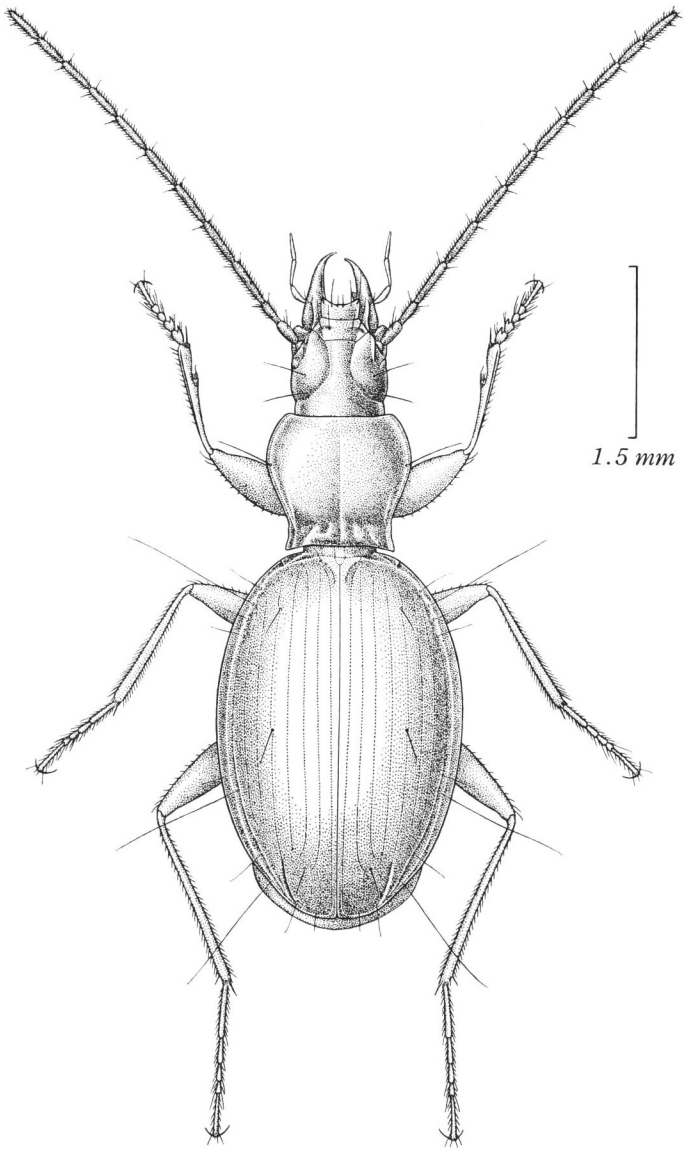


Fig. 1. *Trechiama* (*Pseudotrechiama*) *apicedentatus* S. UÉNO, sp. nov., ♂, from Koya-no-kômori-ana Cave.

armature.

Colour as in *T. imadatei* though somewhat lighter, reddish brown, translucent, shiny and faintly iridescent; palpi, scape and apical two-thirds of antennae, ventral

surface of hind body, and legs yellowish brown to light reddish brown.

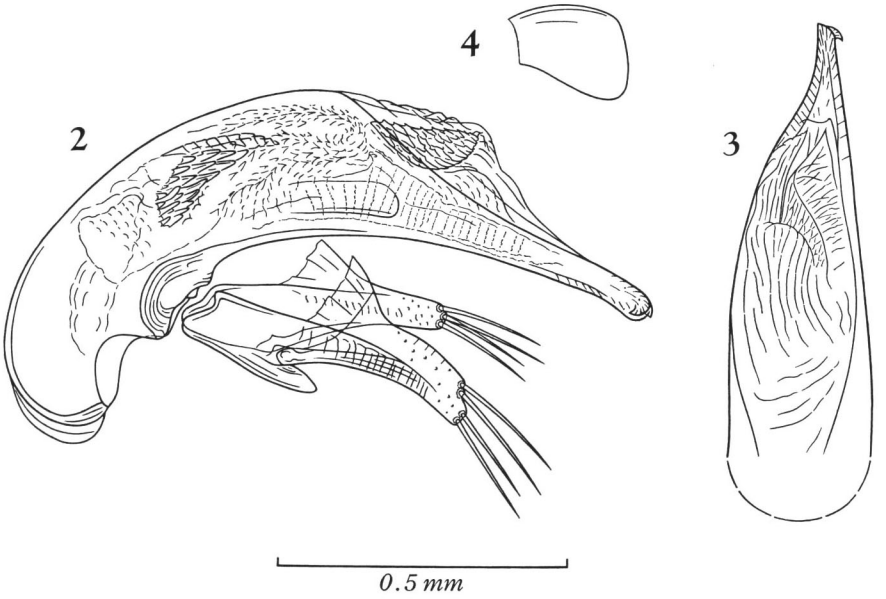
Head subquadrate and depressed above, with deep entire frontal furrows which are not angulate at middle and moderately divergent in front; supraorbital areas and frons gently convex; microsculpture distinct, mostly consisting of fine transverse meshes; eyes degenerated though the trace of them exists behind the insertion of each antenna; genae feebly convex and perfectly glabrous; neck wide, with the anterior constriction shallow though obvious; labrum transverse, moderately emarginate at apex though its median portion is almost straight; mandibles fairly slender, sharply hooked at apices; mentum free, with the tooth either truncated or slightly cleft at the tip; submentum sexsetose; palpi slender, with the penultimate segments gradually dilated towards apices; antennae long and slender, reaching apical two-fifths to one-third of elytra (the length of antennae is somewhat variable according to individuals); scape short and thick, longer than segment 2 but only three-fifths as long as terminal segment, segment 2 only a half as long as segment 3 or 4 which is a little longer than the terminal; apical antennal segments cylindrical, segments 8–9 each about 3.5 times as long as wide.

Pronotum cordate, much wider than head, a little wider than long, widest at about two-thirds from base and equally contracted in front and behind; PW/HW 1.40–1.49 (M 1.46), PW/PL 1.06–1.14 (M 1.12), PW/PA 1.42–1.53 (M 1.48), PW/PB 1.30–1.41 (M 1.36); surface moderately convex and perfectly glabrous, with vague transverse striations; microsculpture composed of fine transverse lines, though largely obliterated; sides evenly bordered and reflexed throughout, rather strongly rounded in front, deeply sinuate at about two-ninths from base, and then divergent towards hind angles, which are acute and protrude postero-laterad; postangular setae absent; apex either straight or slightly emarginate, only a little narrower than base, PB/PA 1.02–1.14 (M 1.08), with front angles blunt though a little produced; base widely emarginate though almost straight at the median part; median line deeply impressed, more or less widening basad; apical transverse impression vague, basal one deep, bearing a foveole on each side of median line and laterally merging into basal foveae, which are deep but not large; postangular carinae obtuse; basal area uneven and notched along basal margin.

Elytra oval, widest at about four-ninths from base, and moderately convex though depressed on the disc; EW/PW 1.61–1.72 (M 1.68), EL/EW 1.46–1.53 (M 1.50); shoulders effaced, prehumeral borders very oblique and almost straight; sides widely reflexed at middle, moderately arcuate before middle, less so behind, and slightly emarginate before apices, which are almost conjointly rounded though having a small re-entrant angle at suture; striae superficial though entire, only very weakly punctate, moderately impressed on the disc but becoming shallower at the side, stria 8 deeply impressed behind the middle set of marginal umbilicate pores; scutellar striole short but distinct; apical striole deep and feebly curved, usually joining stria 5; intervals slightly convex near suture but flat at the side; apical carina obtuse though distinct; no dorsal pore on stria 3; preapical pore always present on the apical anastomosis

of striae 2 and 3, and evidently more distant from apex than from suture; stria 5 with two setiferous dorsal pores at 1/8–1/6 from base and about middle (or slightly before middle); marginal umbilicate pores aggregated; microsculpture composed of fine transverse lines though largely degenerated.

Ventral surface glabrous and smooth; sexual setae on anal sternite normal. Legs slender; protibiae straight, grooved on the external face and glabrous on the anterior face; tarsi thin, segment 4 with a long ventral apophysis in pro- and mesotarsi; in ♂, two proximal segments of each protarsus dilated and stoutly produced inwards at apices.



Figs. 2–4. Male genitalia of *Trechiama* (*Pseudotrechiama*) *apicedentatus* S. UÉNO, sp. nov., from Koya-no-kômori-ana Cave; left lateral view (2), apical part of aedeagus, dorsal view (3), and separated copulatory piece, left dorso-lateral view (4).

Male genital organ robust and heavily sclerotized. Aedeagus about one-third as long as elytra, gently arcuate, abruptly narrowing from behind middle in lateral view, gradually attenuate towards apex in dorsal view, and widely membraneous on the dorsal surface in apical half; basal part rather elongate and hardly bent, having large basal orifice, the sides of which are deeply emarginate; sagittal aileron narrow though heavily sclerotized; apical lobe prolonged, almost straight and obviously compressed, forming a small rounded sagittal lamella on the ventral side of the distal end and bearing two sharp denticles on either side of the lamella, of which the left recurved one is somewhat obliquely horizontal while the right one is almost vertical and produced ventro-apicad; viewed laterally, ventral margin widely but shallowly emarginate at

middle. Inner sac wholly covered with poorly sclerotized scales and provided with two patches of heavily sclerotized teeth and a lamellar copulatory piece; the proximal teeth-patch lies at the left side before the middle of aedeagus; the apical teeth-patch, lying at the right dorsal side just inside apical orifice, forms a very compact mat composed of sharp teeth which are partially fused with one another; copulatory piece thin, hyaline and apically dilated, lying at the right ventral side of the median part of aedeagus, its apical margin being subtruncated with rounded corners. Styles broad, left style obviously larger than the right, each bearing four setae at apex.

Type-series. Holotype: ♂, allotype: ♀, 15–XII–1973, S. UÉNO & K. KATO leg. Paratypes: 6 ♂♂, 4 ♀♀, same data as the holotype; 1 ♂, 3–XI–1974, H. IWASAKI leg.

All the specimens of the type-series are deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

Type-locality. Limestone cave called Koya-no-kômori-ana (also called Nana-ho-no-kômori-ana), at Koya of Ohmiya-chô in Mié Prefecture, at the eastern part of the Kii Peninsula, Central Japan.

Notes. Koya-no-kômori-ana Cave, the type-locality of this new species, lies in the village of Koya (or Fujikoya) a little more than 20 km to the west-southwest of Shûrei-no-mizu-ana Cave, which is the westernmost known locality of *T. imadatei*. The entrance to the cave is open just above the water of the left side of the Fuji-gawa, a tributary of the Miya-gawa River that empties into the Bay of Isé. The main passage heads west by south and ends at the depth of only 22 m. At about 7 m from the entrance, however, there is a narrow side passage leading off to the right (or towards the northwest), which continues for about 50 m and has a muddy room halfway to the innermost. All the known specimens of the present trechine were found either in this room or in its immediate vicinities, from under stones and rotten boards or crawling on the muddy floor.

I have tentatively placed this new species in the subgenus *Pseudotrechiama*, since it doubtless belongs to the same species-group as *T. habei*, which is the type-species of the subgenus. Though *Pseudotrechiama* was regarded by JEANNEL (1962, pp. 192, 195) as a genus independent of *Trechiama*, its validity becomes more and more doubtful according to the new findings by recent investigations. Of special importance in this regard are the discoveries of *T. shuten* and *T. yoshiakii* in the northern part of the Kinki District (cf. UÉNO, 1978 a), which doubtless belong to the group of *T. oni* [*Trechiama* s. str.] but have all the diagnostic features of *Pseudotrechiama*. Perhaps *Pseudotrechiama* should be regarded as a synonym of *Trechiama* (s. str.), but I prefer to refrain from proposing such an arrangement now, leaving the final solution of the problem until the classification of other species-groups of the genus is satisfactorily clarified.

Kurasawatrechus hirakei S. UÉNO, sp. nov.

[Japanese name: Hirake-mekura-chibigomimushi]

(Figs. 5–7)

Length: 2.45–3.10 mm (from apical margin of clypeus to apices of elytra).

Closely allied to *K. ichihashii* S. UÉNO (1959, p. 300, figs. 1–2) of Shinodachi-no-kaza-ana Cave, but the hind body is a little larger and more rounded, the microsculpture is more or less degenerated, especially on elytra, the frontal furrows are more or less angulate at middle, the elytral striae are crenulate and usually visible even at the side, the apical lobe of aedeagus is obviously longer and slenderer, and the copulatory

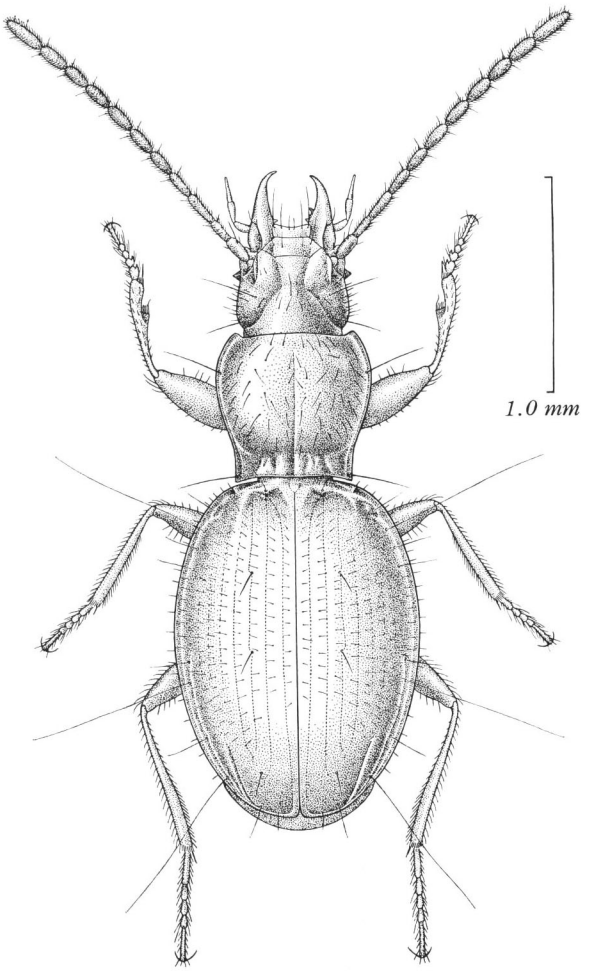


Fig. 5. *Kurasawatrechus hirakei hirakei* S. UÉNO, sp. et subsp. nov., ♂, from Koya-no-kômori-ana Cave.

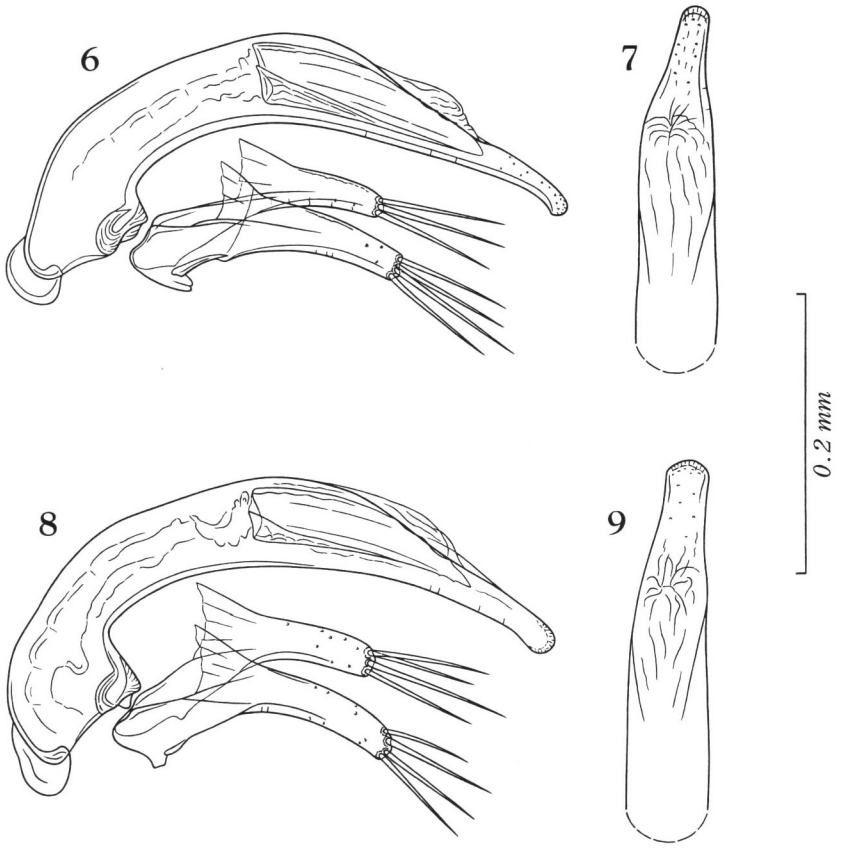
piece is larger and more elongate.

Colour as in *K. ichihashii*, though the appendages are usually a little darker. Head and pronotum similar to those in *K. ichihashii*, but differing from the latter in the following points: frontal furrows more or less angulate at middle, widely divergent posteriad in either straight or slightly sinuate lines, and then curving round to neck constriction; pronotum with the median line more sharply impressed at the basal portion, hind angles more or less sharper, and basal area not shagreened with coarse microsculpture; PW/HW 1.31–1.39 (M 1.35), PW/PL 1.07–1.17 (M 1.13), PW/PA 1.21–1.36 (M 1.29), PW/PB 1.21–1.33 (M 1.27), PB/PA 0.97–1.05 (M 1.02). Antennae usually reaching basal one-third of elytra in ♂ and basal two-sevenths of elytra in ♀, though the length varies to some extent according to individuals.

Elytra a little larger and more round than in *K. ichihashii*, widest at about four-ninths from base and equally contracted towards bases and towards apices, with effaced shoulders and regularly arcuate sides; EW/PW 1.46–1.60 (M 1.54), EL/EW 1.34–1.43 (M 1.38); striae superficial, more or less crenulate, becoming shallower towards the side though even stria 7 is usually traceable at middle, stria 8 fragmentary though deeper than stria 7; scutellar striole either absent or vestigial; apical striole deeply impressed and nearly straight, usually directed to but sometimes joining stria 7; intervals flat, each bearing a row of short erect pubescence; apical carina not salient.

Microsculpture of head distinct, largely consisting of isodiametric or polygonal meshes on frons and supraorbital areas but of coarse wide meshes on vertex; that of pronotum composed of polygonal meshes though largely obliterated; that of elytra mostly obsolete though remains of reticulation are partially perceptible. Chaetotaxy normal; elytral stria 3 with two setiferous dorsal pores at 2/9–2/7 (usually about 1/4) from base and around middle. Ventral surface pubescent except for lateral parts. Legs short though slender; protibiae slightly bowed, entirely pubescent and not externally grooved; tarsi fairly thin, segment 1 a little shorter than segments 2–3 combined in mesotarsus, about as long as or slightly longer than segments 2–3 combined in metatarsus; in ♂, two proximal segments of each protarsus dilated and inwardly denticulate at apices.

Male genital organ very small and lightly sclerotized. Aedeagus about two-sevenths as long as elytra, tubular, more or less arcuate though the curvature is variable to some extent according to individuals, sometimes regularly curved in basal third and sometimes almost straight in apical half; basal part small, with small basal orifice, the sides of which are only slightly emarginate; sagittal aileron usually well developed though hyaline, sometimes narrow but still distinct; apical lobe long and narrow, inclined to the left, and slightly curved down at the extremity, which is narrowly rounded; viewed laterally, ventral margin widely emarginate before middle but almost straight or only slightly emarginate in apical half. Copulatory piece very large, elongate and spatulate, with pointed apex. Styles rather broad, left style being larger than the right; each usually provided with three stout setae at apex, though the



Figs. 6–9. Male genitalia of *Kurasawatrechus hirakei* subspp.; left lateral view (6, 8), and apical part of aedeagus, dorsal view (7, 9). —— 6–7. *K. h. hirakei* S. UÉNO, sp. et subsp. nov., from Koya-no-kômori-ana Cave. —— 8–9. *K. h. iwasakii* S. UÉNO, subsp. nov., from Shûrei-no-mizu-ana Cave.

number of apical setae is variable according to individuals, sometimes two and rarely four.

Type-series. Holotype: ♂, allotype: ♀, 15–XII–1973, S. UÉNO & K. KATO leg. Paratypes: 1 ♂, 1 ♀, 2–IX–1973, M. HIRAKE leg.; 2 ♂♂, 1 ♀, 21–X–1973, M. HIRAKE leg.; 1 ♂, 15–XII–1973, S. UÉNO & K. KATO leg.; 36 ♂♂, 27 ♀♀, 16–II–1975, H. IWASAKI leg., all found in baited traps; 3 ♂♂, 2 ♀♀, 29–V–1975, H. ICHIHASHI leg.

All the specimens of the type-series are deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

Type-locality. Limestone cave called Koya-no-kômori-ana (also called Nanaho-no-kômori-ana), at Koya of Ohmiya-chô in Mié Prefecture, at the eastern part of the Kii Peninsula, Central Japan.

Further specimens examined. 1 ♂, Kurotengu-no-ana Cave (also called Fujigano-no-ana Cave), at Fujigano, Ohmiya-chô, Mié Pref., 15–XII–1973, S. UÉNO leg.; 1 ♀, same locality, 4–VI–1976, H. ICHIHASHI leg.; 1 ♂, 1 ♀, same locality, 23–X–1976, A. AMAGASU leg. All in the collection of the National Science Museum (Nat. Hist.), Tokyo.

Notes. Though coexisting with *Trechiama apicedentatus*, this new species seems to have a wider range of habitat preference than the long-legged trechine. It occurs anywhere in the type cave, though rather sporadically, and is usually found from beneath large stones embedded in wet clay. Judging from this, *K. hirakei* is not so much a troglobiontic as an endogean species, although it has never been met with outside of caves. Its actual population density in the type cave seems considerably high in contrast to the number of individuals met with by ordinary collectings, since Mr. IWASAKI once took a long series of its specimens by baited traps.

The specimens from Kurotengu-no-ana Cave, which lies about 8.2 km west-southwest of Koya-no-kômori-ana Cave, agree well with the type-series. They were found as isolated individuals. The standard ratios of the four specimens examined are as follows: PW/HW 1.30–1.39 (M 1.35), PW/PL 1.07–1.13 (M 1.11), PW/PA 1.27–1.33 (M 1.30), PW/PB 1.22–1.31 (M 1.26), PB/PA 1.00–1.06 (M 1.03), EW/PW 1.53–1.60 (M 1.56), EL/EW 1.32–1.36 (M 1.34).

Kurasawatrechus hirakei iwasakii S. UÉNO, subsp. nov.

[Japanese name: Iwasaki-mekura-chibigomimushi]

(Figs. 8–9)

Length: 2.60 mm (from apical margin of clypeus to apices of elytra).

Distinguished from the nominate subspecies by the following points: Antennae somewhat longer, reaching basal three-eighths of elytra; pronotum relatively wide at base, with the basal area more distintly shagreened with isodiametric microsculpture than in the nominate subspecies, though not so coarsely shagreened as in *K. ichihashii*; elytra less contracted towards bases, with obviously ampler basal area and less strongly arcuate sides, whose reflexed borders are narrower, especially in basal half; microsculpture distinct on pronotum, consisting of polygonal, almost isodiametric meshes, that of elytra largely obliterated though a little less so than in the nominate subspecies. The standard ratios of body parts are as follows: PW/HW 1.32, PW/PL 1.13, PW/PA 1.26, PW/PB 1.20, PB/PA 1.05, EW/PW 1.50, EL/EW 1.41.

Aedeagus more regularly arcuate than in the nominate subspecies, only one-fourth as long as elytra, with the basal part larger and more strongly bent towards the ventral side; apical lobe broader in both lateral and dorsal views, with the extremity more widely rounded; ventral margin widely and regularly emarginate in profile; copulatory piece a little smaller; each style provided with four apical setae.

Female unknown.

Type-specimen. Holotype: ♂, 23–II–1974, H. IWASAKI leg., preserved in coll. National Science Museum (Nat. Hist.), Tokyo.

Type-locality. Limestone cave called Shûrei-no-mizu-ana, at Shimomura of Yamochi-chô in Isé-shi, at the eastern part of the Kii Peninsula, Central Japan.

Notes. I cannot decide with confidence the true systematic status of this new form, since no other specimen than the holotype has been available for my study. It could be considered to be a full species, if the range of individual variation were determined on the basis of ample material. In any case, the present trechine is no doubt very close to *K. hirakei* in both the external and genitalic features and is regarded, for the time being, as a geographical race of that species.

Shûrei-no-mizu-ana Cave lies on the southern side of Shû-rei Hill at an elevation of about 220 m, and is a little more than 20 km distant to the east-northeast from Koya-no-kômori-ana Cave. It is a cave of debouchure, of complex development, and is about 650 m in total length. Trechine beetles are extremely rare in this cave, only three specimens having been met with during the past thirty years. Two of them are *Trechiama imadatei iwatai* S. UÉNO (1954, pp. 32, 37, fig. 4 C), obtained on 2 May 1954 from among gravel on the banks of the underground stream. The remaining one is the holotype of the present species, which was found from under a stone lying on a muddy floor near the innermost of the cave.

It seems worth noting that though *Trechiama* shows a remarkable speciation between the two caves, Koya-no-kômori-ana and Shûrei-no-mizu-ana, the *Kurasawatrechus* of those caves have not become differentiated to the same extent, even if they should be specifically distinct from each other. Perhaps the long-legged *Trechiama* have a longer history of isolated subterranean life than the short-legged *Kurasawatrechus*, which may have remained endogean until rather recently, or at least have stayed near the surface of the earth. A similar difference in the grade of speciation between *Trechiama* and *Kurasawatrechus* was already reported from the Fuji-Hakoné area (cf. UÉNO, 1978 b).

Kurasawatrechus hirakei subsp.?

Specimens examined. 1 ♀, Hiuchiishi-no-ana Cave, Okushimaji, Isé-shi, 30–IX–1975, A. AMAGASU leg.; 1 ♀, same locality, 6–IV–1977, H. ICHIHASHI leg. Both deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

Notes. The two specimens recorded above were obtained in the limestone cave called Hiuchiishi-no-ana, which lies at the southeastern part of Shimaji-yama Hill and is about 5.8 km distant to the east by north from Shûrei-no-mizu-ana Cave. In the body form, and especially in the form of elytra, they are closer to *K. hirakei hirakei* than to *K. hirakei iwasakii*, although they are similar to the latter in the mode of microsculpture. The standard ratios of their body parts are as follows: PW/HW 1.31–1.37, PW/PL 1.15–1.18, PW/PA 1.31–1.32, PW/PB 1.24–1.30, PB/PA 1.02–1.05, EW/PW 1.51–1.57, EL/EW 1.39–1.42. The elytra are unusually variolate in AMA-

GASU's specimen, but as they are quite normal in ICHIHASHI's one, the peculiar condition may be attributed to an individual aberrancy. It is possible that the Hiuchiishi-no-ana population can be separated as a new geographical race, but without seeing any males, I cannot express settled opinion on its systematic status.

As in the cases of Koya-no-kômori-ana and Shûrei-no-mizu-ana Caves, two anophthalmic species of trechine beetles coexist in Hiuchiishi-no-ana Cave. One of them is the *Kurasawatrechus* recorded above, and the other is *Trechiama imadatei imadatei* S. UÉNO et SHIBANAI (cf. UÉNO, 1954, p. 36).

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