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The Cave Trechines of the Subgenus *Yuadorgus*

(Coleoptera, Trechinae)[1)]

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The subgenus *Yuadorgus* was erected by the present writer (1955, p. 40) for a small troglobiontic trechine occurring in a limestone cave at the easternmost part of the Irazu Hills in the Island of Shikoku. It was originally described as a full genus, but was later (1965, pp. 3, 12) reduced to a subgenus of *Ryugadous* on the basis of previously unknown male characters. After that, nothing was added to our knowledge, and the subgenus remained monotypic. Since the single known locality of this interesting trechine was situated at the southeastern corner of the distributional range of *Ishikawatrechus*, it was considered that the species might be a relict somehow isolated from typical *Ryugadous* at the western side of the Kôchi Basin and that other members of the subgenus might not be expected to occur in the western continuation of the limestone hills.

However, this assumption proved wrong by recent investigations. The second species of the subgenus was discovered early in the spring of 1974 in a cave lying considerably to the west of the first locality, and soon afterwards, another species was obtained in a cave at an intermediate spot between the two, previously known stations. Thus, it has become apparent that the distributional range of *Yuadorgus* narrowly extends westwards along the southern periphery of the range of *Ishikawatrechus*. Still other members of the subgenus may exist in the Irazu Hills, but it will not be easy to find them out. As all the three species hitherto brought to light have been known by only a very few specimens in spite of careful collectings, such an exceeding rareness seems usual for every member of *Yuadorgus*.

In the present paper, the two new species will be described, and a key will be given to all the known forms of the subgenus *Yuadorgus*. The abbreviations used herein are the same as those explained in the writer's previous papers (*e.g.*, UÉNO, 1965, p. 1).

Before going further, the writer wishes to acknowledge his indebtedness to the following speleologists for their kind help in cave investigations, particularly in setting baited traps and recovering them: Messrs. Tetsuo KAWASAWA, Masazi UOZUMI, Mitsuru HIRAKE and Norio KAJIMOTO.

1) Contribution No. 153 from the Spelaeological Society of Japan.

Subgenus *Yuadorgus* S. UÉNO, 1955

Yuadorgus S. UÉNO, 1955, Mem. Coll. Sci. Univ. Kyoto, (B), **22**, p. 40; type-species: *Yuadorgus uozumii* S. UÉNO, 1955. —— JEANNEL, 1962, Rev. fr. Ent., **29**, p. 207.

Ryugadous subgen. *Yuadorgus*: UÉNO, 1965, Bull. Natn. Sci. Mus., Tokyo, **8**, pp. 3, 12; 1969, ibid., **12**, p. 21.

A full description of this subgenus was already given in one of the writer's previous papers (UÉNO, 1965, *loc. cit.*). Of the two new species to be described in this article, *R. kajimotoi* perfectly accords with that account, but *R. solidior* does not agree with it in two points, that is, entirely pubescent protibiae and robust aedeagus. The latter feature is not important, since all the other basic features of the male genitalia coincide well with those of the other members. However, a brief comment seems necessary on the normally pubescent protibia, considering that the peculiar protibial structure shown by the type-species was formerly regarded as one of the diagnostic characters of the subgenus.

Since a generic classification of trechines on the world-wide basis was first proposed by JEANNEL (1928, pp. 10–30) in his classic monograph of Trechinae, distribution of the pubescence on protibiae has been regarded nearly always as a taxonomic character of primary importance. His classification has been modified and/or commented (cf. LANEYRIE, 1974), but the frame of his system has not been much altered. He considered that the pubescent type, in which the protibia is as a rule entirely covered with pubescence, was a primitive condition and gave rise to the glabrous type, in which the protibia is devoid of pubescence on the anterior face. There are certain variations in the pubescent type, and the pubescence is in advanced forms reduced on the anterior face and remains only at its apical part.

JEANNEL's opinion seems sound so far as the evolutionary trend is concerned, and though there are rare exceptions,[2] the character can be used for discriminating trechine genera. However, here arises the problem posed by *Ryugadous uozumii* and *R. kajimotoi*. These species have the protibia of pubescent type, but the apical portion of the anterior face is devoid of pubescence. Such a strange pattern has not been known in any of the other genera of the tribe Trechini, and was considered by the present writer to be a character of some taxonomic importance. With the discovery of *R. solidior*, in which the protibia is entirely pubescent and does not differ from that of typical *Ryugadous*, it has become necessary to modify the subgeneric diagnosis of *Yuadorgus*. Since no other fundamental difference is observed, this new species is a member of *Yuadorgus* beyond all doubt and seems to retain the original condition of the protibial pubescence. The peculiar pattern found in the other two species must be an aberrant condition somehow brought about during the course of differentiation.

2) For instance, *Trechiama insolitus* S. UÉNO (1959, pp. 31, 32, figs. 1–2) and *T. ohruii* S. UÉNO (1972, p. 111, figs. 1–4) have some pubescence at the antero-apical part of each protibia, although the genus *Trechiama* belongs to the glabrous type.

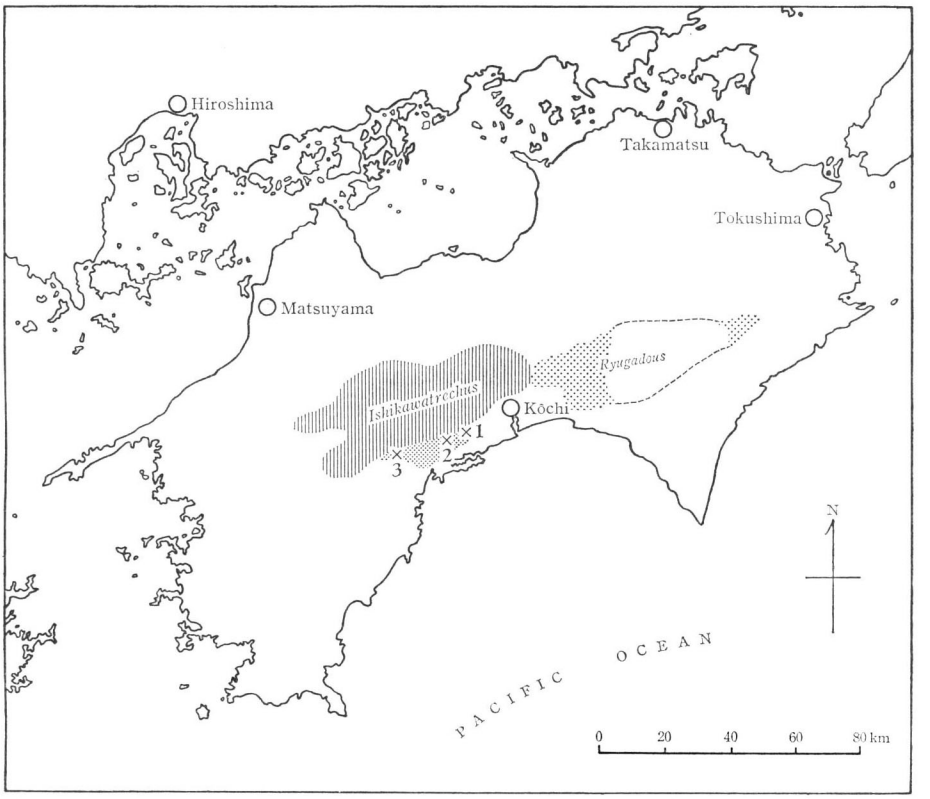


Fig. 1. Map showing the distribution of *Yuadorgus* and its relationship with the ranges of *Ishikawatrechus* and *Ryugadous* (s. str.). —— 1, Narukawa-no-Shimizu-dô Cave (*R.* (*Y.*) *uozumii* (S. UÉNO); 2, Kôtoko-dô Cave (*R.* (*Y.*) *kajimotoi* S. UÉNO, sp. nov.); 3, Ryûjin-dô Cave (*R.* (*Y.*) *solidior* S. UÉNO, sp. nov.).

Being deleted the protibial feature from the subgeneric characteristics, *Yuadorgus* is mainly characterized by the presence of two setiferous dorsal pores on the 5th elytral stria and by the absence of sclerotized teeth inside the aedeagal inner sac. Other differences of lesser importance between this and the nominate subgenera were already summarized in 1965.

It is to be mentioned here that *Himiseus* S. UÉNO (1969, pp. 21, 27), originally described as a subgenus of *Ryugadous*, had better be regarded as a full genus, in view of its unique articulation of pronotum and elytra and of the peculiar armature of the aedeagal inner sac. The new combination caused from this change of rank is as given in the foot-note of this page.

Himiseus kiuchii (S. UÉNO, 1969), comb. nov.

Ryugadous (*Himiseus*) *kiuchii* S. UÉNO, 1969, Bull. Natn. Sci. Mus., Tokyo, **12**, pp. 21, 29, figs. 6–7; type-locality: Himisé-dô Cave in Tokushima Pref.

Range. All the three caves that are known to harbour *Yuadorgus* lie at the southern side of the Irazu Hills stretching from east to west at the western side of the Kôchi Basin. As was already noticed, this distributional range extends along the southern periphery of that of *Ishikawatrechus*, but it does not appear to spread much farther to the west. It is widely separated by lowland from the range of the nominate subgenus.

Key to the Species

1 (4) Protibiae glabrous on the anterior face between the comb organ and the apex; aedeagus slender, with smaller copulatory piece which is less than a third as long as aedeagus; each style with two or three apical setae.

2 (3) Pronotum shorter and more contracted anteriad, with strongly arcuate sides and more acute hind angles; prehumeral borders of elytra less oblique; aedeagus hardly arcuate at middle and moderately curved at the basal part, with the apical lobe curved ventrad and gradually attenuated towards the blunt tip in dorsal view; (Narukawa-no-Shimizu-dô Cave) ..... *R. uozumii* (S. UÉNO).

3 (2) Pronotum more elongate and less contracted anteriad, with less arcuate sides and less acute hind angles; prehumeral borders of elytra more oblique; aedeagus regularly arcuate from base to apex and not curved at the basal part; aedeagal apical lobe not curved ventrad, fairly wide to near apex and forming a triangular terminal portion in dorsal view; (Kôtoko-dô Cave).... ..... *R. kajimotoi* sp. nov.

4 (1) Protibiae entirely pubescent; aedeagus robust, with larger copulatory piece which is about two-fifths as long as aedeagus; each style with four apical setae; (Ryûjin-dô Cave) ..... *R. solidior* sp. nov.

Ryugadous (Yuadorgus) uozumii (S. UÉNO, 1955)

(Figs. 2–3)

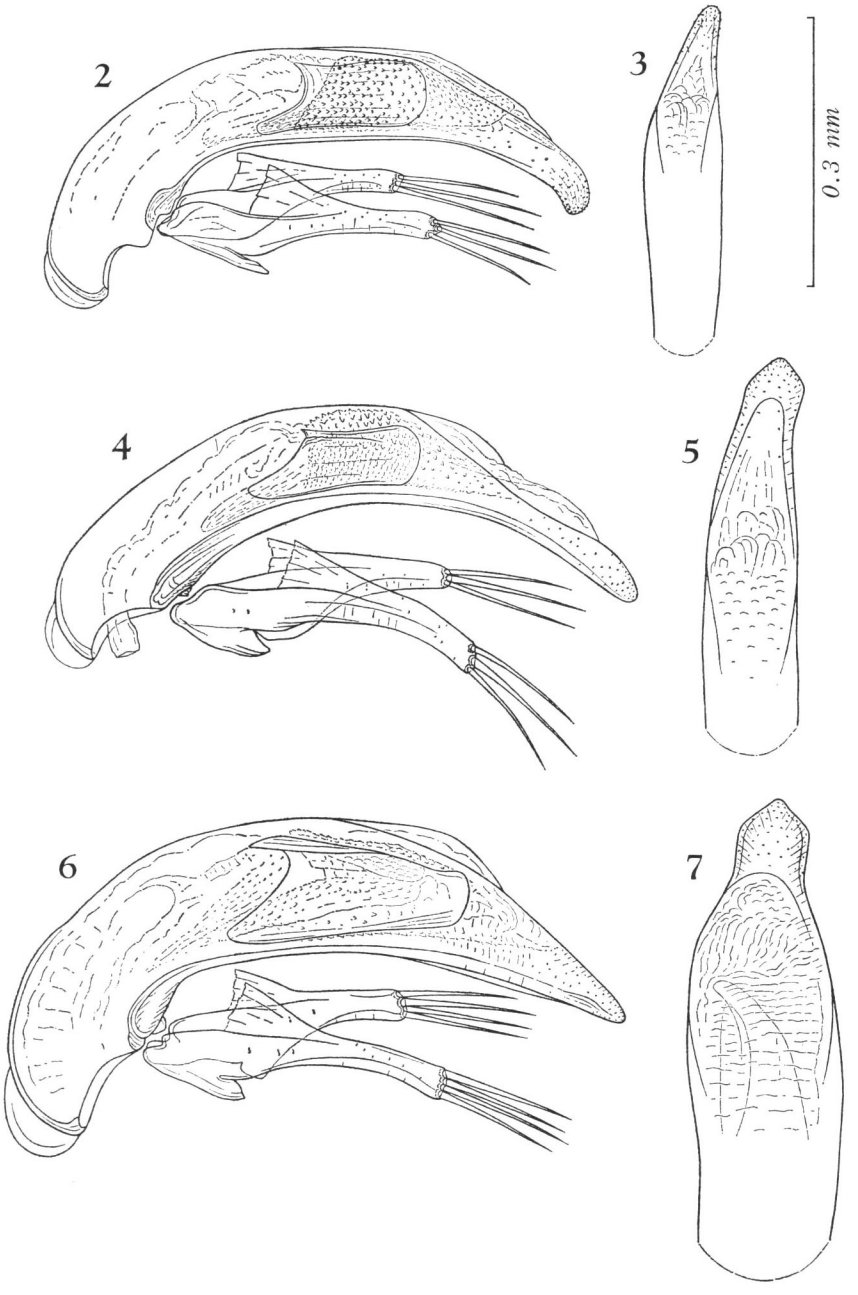
Yuadorgus uozumii S. UÉNO, 1953, Shin Konchû, Tokyo, **6** (11), p. 45 [*nom. nud.*]; 1955, Mem. Coll. Sci. Univ. Kyoto, (B), **22**, p. 41, fig. 3; type-locality: Narukawa-no-Shimizu-dô Cave in Kôchi Pref.

Yuadorgus Uozumii: JEANNEL, 1962, Rev. fr. Ent., **29**, p. 207.

Yuadorgus uozumil: JEANNEL, 1962, ibid., p. 207 [err.].

Ryugadous (Yuadorgus) uozumii: UÉNO, 1965, Bull. Natn. Sci. Mus., Tokyo, **8**, pp. 3, 13, fig. 9; 1969, ibid., **12**, p. 21.

Notes. No additional record. This rare species has never been re-obtained since 1961, when the entrance to its type cave was closed by local people.



Figs. 2–7. Male genitalia of *Ryugadous* (*Yuadorgus*) spp.; left lateral view (2, 4 and 6), and apical part of aedeagus, dorsal view (3, 5 and 7). —— 2–3. *R.* (*Y.*) *uozumii* (S. UÉNO), of Narukawa-no-Shimizu-dô Cave. —— 4–5. *R.* (*Y.*) *kajimotoi* S. UÉNO, sp. nov., of Kôtoko-dô Cave. —— 6–7. *R.* (*Y.*) *solidior* S. UÉNO, sp. nov., of Ryûjin-dô Cave.

Ryugadous* (*Yuadorgus*) *kajimotoi S. UÉNO, sp. nov.

(Figs. 4–5)

Length: 3.60–3.90 mm (from apical margin of clypeus to apices of elytra).

Very closely allied to the preceding species, with which it agrees in every external detail except for the following points: Body a little more elongate than in *R. uozumii*. Head smaller and parallel-sided, with genae not convex at middle. Pronotum more elongate and less contracted anteriad, with the sides less strongly arcuate in front, more shallowly sinuate behind, and hardly divergent towards hind angles at the basal portion; PW/HW 1.45–1.46, PW/PL 1.05–1.08, PW/PA 1.39–1.41, PW/PB 1.39–1.44, PB/PA 0.98–1.00; front angles a little more salient; hind angles sharp but less so than those in *R. uozumii*, not projecting outwards. Elytra less ample and more convex than in *R. uozumii*, a little more elongate, narrower at the humeral part, and more pointed at apices; EW/PW 1.73, EL/EW 1.45–1.46; humeral angles distinctly tuberculate, with prehumeral borders more oblique and more distinctly emarginate than in *R. uozumii*; basal carina longer and more prominent; sides more strongly arcuate at middle, and less evenly rounded at the apical part.

Male genital organ considerably different in shape from that of *R. uozumii*, though basically similar in structure to the latter. Aedeagus only two-sevenths as long as elytra, regularly arcuate from base to apex, and not particularly curved at the basal part, which is short and bears a hyaline sagittal aileron; lateral sides of basal orifice widely emarginate; apical orifice large and elongate; apical part moderately flattened and somewhat spatulate; viewed laterally, apical lobe elongate, not curved ventrad, and blunt at the extremity; viewed dorsally, apical lobe inclined to the left, not much narrowed to near apex, and then abruptly tapering towards the extremity, forming a triangular terminal portion; ventral side evenly emarginate in profile. Inner sac similar to that of *R. uozumii*; copulatory piece less than a third as long as aedeagus, with a fold along the dorsal margin. Each style provided with three long apical setae in the holotype, but with only two apical setae in the paratype.

Female unknown.

Type-series. Holotype: ♂ (17–III–1975, S. UÉNO and M. UOZUMI leg.). Paratype: 1 ♂ (16–VI–1974, N. KAJIMOTO leg.). Both preserved in the collection of the National Science Museum (Nat. Hist.), Tokyo.

Type-locality. Limestone cave called "Kôtoko-dô", at Jitoko-dani of Kanbara, in Tosa-shi, Kôchi Prefecture, on the Pacific side of the Island of Shikoku, Japan.

Notes. It was most unexpected that a troglobiontic trechine beetle did occur in Kôtoko-dô Cave, which had been investigated for more than twenty years by several biospeologists, including the present writer himself, and never yielded trechines before. The cave is a small one, lying on the left side of the Jitoko-dani Valley near the southern foot of the easternmost part of the Irazu Hills, and is about 4.2 km apart to WSW from Narukawa-no-Shimizu-dô Cave, which is the single known locality of *R. uozumii*. The entrance is a 2 m drop opening in a scrub about 50 m above sea-level. From its

bottom, a squeeze leads to the upper edge of another 2 m drop, which opens into one of three small rooms connected successively by tight squeezes. The floors of these rooms gently slope down towards the innermost and become wet and muddy near the end. It was at this place that the first specimen (paratype) of the present new species was found by Mr. KAJIMOTO in one of the baited traps set about a month before. Extensive trappings and hand-collectings had been made since then, but all the efforts had failed until this spring, when the second specimen alive (holotype) was taken at about the same spot as the paratype was caught by the trap. It was found from under a stone lying on a very wet, muddy floor, so that the habitat condition was nearly the same as in the case of *R. uozumii*.

The easternmost part of the Irazu Hills, which stretches for about 10 km in a WSW–ENE direction and is about 4 km wide, is the area that exhibits the most remarkable speciation of cave trechines in the Japanese Islands. Five caves in this small area have been known to harbour five distinctive, allopatric species, three of which belong to the genus *Ishikawatrechus* and the remaining two belong to the subgenus *Yuadorgus* of the genus *Ryugadous*. These caves are geographically very close to one another, and the type caves of the two *Yuadorgus* are nearer to the known localities of *Ishikawatrechus* than to each other, namely, Kôtoko-dô Cave is only 2.5 km distant to the south from Saruta-dô Cave (type-locality of *I. nipponicus*) and Narukawa-no-Shimizu-dô Cave is only 2.9 km distant to the southeast from Ishida-dô Cave (type-locality of *I. humeralis*). There is a minor topographic difference between the distributional ranges of the two genera: all the three species of *Ishikawatrechus* occur at the northern side of the watershed ridge, whereas the two species of *Yuadorgus* are confined to the southern side. However, the ridge is by no means elevated, being only 467 m in altitude even at the highest point. At present, it is difficult to find a plausible explanation how such an intricate distributional pattern has been formed, although the watershed ridge must have served as an effective barrier against the dispersal of trechine beetles however insignificant it appears to be.

Ryugadous* (*Yuadorgus*) *solidior S. UÉNO, sp. nov.

(Figs. 6–8)

Length: 3.90 mm (from apical margin of clypeus to apices of elytra).

Closely similar to *R. kajimotoi* both in facies and in other external details, but readily distinguished from that species and also from *R. uozumii* by the entirely pubescent protibiae. Decidedly different from the two eastern species in the robust aedeagus having very large copulatory piece.

Colour as in the other species of the subgenus. Head relatively small, though the genae are gently convex; microsculpture somewhat coarser and generally less transverse. Pronotum a little more contracted at base than in *R. kajimotoi*, widest at about three-fourths from base, with the sides moderately rounded in front, shallowly sinuate at about basal two-ninths, and nearly parallel-sided behind the sinuation;

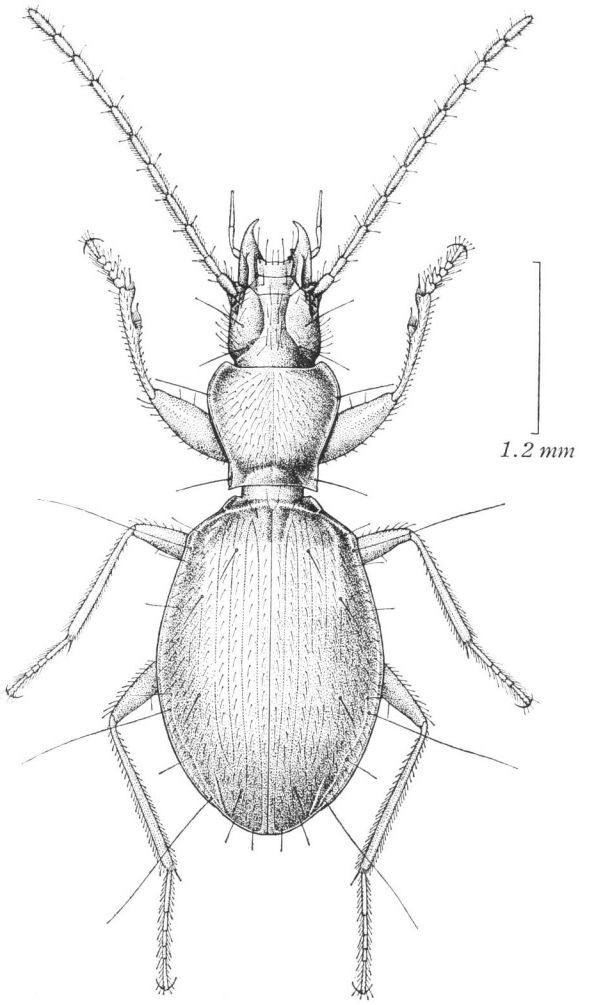


Fig. 8. *Ryugadous* (*Yuadorgus*) *solidior* S. UÉNO, sp. nov., ♂, of Ryûjin-dô Cave.

base narrower than apex and moderately emarginate; hind angles sharp, though hardly projecting outwards; PW/HW 1.42, PW/PL 1.09, PW/PA 1.40, PW/PB 1.48, PB/PA 0.95. Elytra similar to those in *R. uozumii*, though the disk is more convex and the prehumeral borders are a little more oblique; EW/PW 1.74, EL/EW 1.44; humeral tubercles rather obtuse, prehumeral borders nearly straight, basal carina not prominent; sides more strongly arcuate at middle than in *R. uozumii*; striae shallower than in the other species of the subgenus and nearly obsolete at the side. Legs generally similar to those in the other species, but each protibia is entirely pubescent, without a bare portion on the anterior face near apex.

Male genital organ much more robust than in the other two species. Aedeagus

voluminous, about three-tenths as long as elytra, gently arcuate, and moderately curved ventrad at the basal part; basal orifice fairly large, with shallowly emarginate sides; sagittal aileron not very small, though thin and hyaline; dorsal side semicircularly rounded in profile; apical orifice large; viewed laterally, apical part simply tapering towards the blunt tip; viewed dorsally, apical part produced into a pentagonal lobe; ventral side evenly but shallowly emarginate in profile. Inner sac scaly though devoid of sclerotized teeth; copulatory piece very large, about two-fifths as long as aedeagus, spatulate or rather rolled with the convex face towards the right side, gradually narrowed towards apex, which curves to the right and is roundly subtruncated. Styles slender, left style being longer than the right, each provided with four setae at apex.

Female unknown.

Type-specimen. Holotype: ♂ (5–V–1974, S. UÉNO leg. and in coll. Natn. Sci. Mus. (Nat. Hist.), Tokyo).

Type-locality. Limestone cave called "Ryûjin-dô", at Kainokawa of Hayama-mura, in Kôchi Prefecture, on the Pacific side of the Island of Shikoku, Japan.

Notes. Ryûjin-dô Cave lies at the southern side of the central part of the Irazu Hills, and is about 15 km distant to the west by south from Kôtoko-dô Cave, the type-locality of *R. kajimotoi.* It is developed on the left side of a narrow valley at an elevation of about 370 m, and has two small openings, one above the other. The lower entrance is a debouchure of the underground stream that flows through the lowermost level of the cave. The upper one leads into the upper passages, which are almost horizontal and intricately connected with the lower through vertical drops and squeezes. The cave is typically oligotrophic and is poor in the fauna, although it is fairly long as a whole.

An evidence for the existence of *R. solidior* was first brought to light by Mr. KAWASAWA on March 23, 1974. Digging in a sand and gravel deposit at the innermost part of the upper level, he found a pair of elytra of a trechine beetle and sent them to the present writer for examination. After a careful study, it became apparent that the elytra belonged to a species of *Yuadorgus* but that more accurate determination was not possible. Late in the spring of the same year, the writer revisited the cave with Mr. KAWASAWA and succeeded in obtaining a specimen of the beetle at the same spot as the remains had been found for the first time. This perfect specimen was met with on the bed rock beneath the sand deposit, at a depth of about 20 cm. It was not so active when exposed, but tried to take refuge in the soil. No additional specimens have been obtained since then, in spite of every possible effort made by Mr. KAWASAWA and his collaborators.

Summary

Two new species of cave trechines belonging to the subgenus *Yuadorgus* are described under the names of *Ryugadous* (*Y.*) *kajimotoi* and *R.* (*Y.*) *solidior.* They are very similar to the type-species in external features, but are definitely discriminated

from one another on the basis of their aedeagi. With the discovery of these new species, it became evident that the distributional range of the subgenus narrowly extends from east to west along the southern periphery of that of *Ishikawatrechus*.

Postscript

On June 22, 1975, just before the first proof of this paper appeared, the fourth population of *Yuadorgus* was discovered in the limestone cave called "Tsukiiké-dainidô". This cave belongs to the group of small caves in the Sakawa area, where no cave trechines were previously known in spite of repeated investigations made during nearly thirty years. It lies at about the middle point of the bee-line drawn from Ryûjin-dô Cave to Kôtoko-dô Cave, but is developed in a small low hill at the *northern* foot of the watershed range.

At the present moment, the trechine is known by only two females and cannot be determined satisfactorily, although it possibly belongs to a new species. Judging from external features, it may be closer to *R. solidior* than to *R. kajimotoi* and *R. uozumii*. Its real affinity will be clarified when male specimens are obtained from the same population and their aedeagal characters are studied.

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