MEMOIRS OF THE COLLEGE OF SCIENCE, KYOTO IMPERIAL UNIVERSITY, SERIES B,
VOL .III, NO. 3, ARTICLE 5, 1927.

Notes on some Subterranean Isopods and Amphipods of Japan[1].

By

MASUZÔ UÉNO

With 6 Text-figures

(Received September 7, 1927)

There are three species of amphipods and one species of isopod which have been reported as occurring in subterranean waters of Japan. In 1921, W. M. TATTERSALL described a new and curious form of subterranean isopod taken by Prof T. KAWAMURA at Ôtsu, naming it *Caecidotea kawamurai*. In the next year, 1922, K. AKATSUKA and T. KOMAI proposed a new generic name *Pseudocrangonyx* for several specimens of blind amphipod collected from certain localities of Japan and described three new species under that genus. Apart from these, there is no contribution to our subterranean crustacean fauna.

In the end of May, 1927, Mr. KENZÔ KIKUCHI of the Ôtsu Hydrobiological Station and the writer had an opportunity to visit the Takiana limestone cave in the Prefecture of Yamaguchi, and were able to collect some interesting crustaceans inside that cave. Examining those specimens, I have found that some of them represent a new species of the genus *Caecidotea* of the Isopoda. The descriptions and illustrations of this species together with those of other subterranean isopods and amphihods already known, are included in the following pages.

1). Contribution from the Zoological Institute and the Ôtsu Hydrobiological Station, Kyoto Imperial University.

ISOPODA

Familiy : Asellidae

Genus : Caecidotea PACKARD.

1. Caecidotea akiyoshiensis sp. nov.

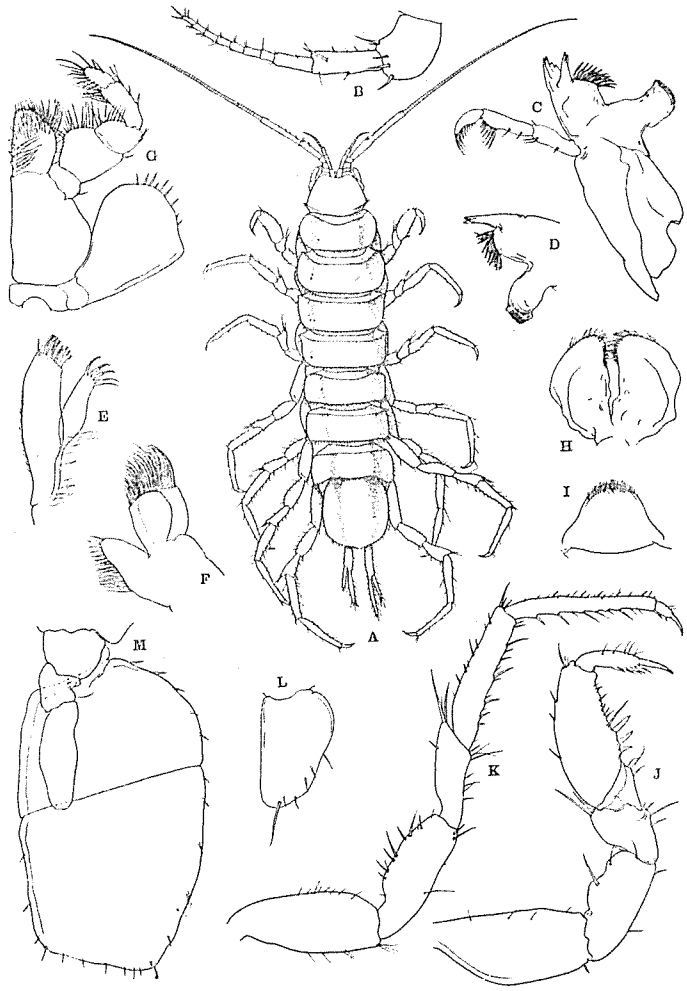
(Text-figures 1 and 2)

Description : Four specimens of various sizes.

Body narrow, elongate, about four times as long as broad (text-fig. 1, A). Head considerably narrower than the first thoracic segment; rather broader than long, tapering anteriorly, with a concave frontal and convex lateral margins. No trace of eyes. The first antenna (text-fig. 1, B) short, 1/3 the length of the fifth article of the peduncle of the second antenna; the first article about 2/3 as long as broad, the third article 1/2 as long as broad; the flagellum composed of 9 joints[1]). The second antenna about 3/4 as long as the body; first three articles of the peduncle short, the fourth about as long as the first three together; the flagellum composed of ca. 70 joints. Of the mouth-parts, shown in the text-figure 1 C to I, the mandible with a three-jointed palp, and the incisor process of the right mandible armed with a single large tubercle on its summit, while that of the left one is armed with two apical tubercles (text-fig. 1, C and D); molar process considerably elongated.

The anterior four thoracic segments subequal in length, the fifth a little shorter and narrower than these, and the sixth and the seventh again subequal; all segments quadrangular in the dorsal view, but the first somewhat rounded and the seventh with paired lateral expansions directed obliquely backward. Each segment provided with a transversal ridge-line across the anterior margin; that of the first segment somewhat curved, but not V-shaped as in the other Japanese species *C. kawamurai*. Lateral margins of each segment armed with a few bristle-like hairs. The last thoracic segment a little wider than long, with the angles rounded and the dorsal surface slightly convex.

1) Often 6, 7 or 10.



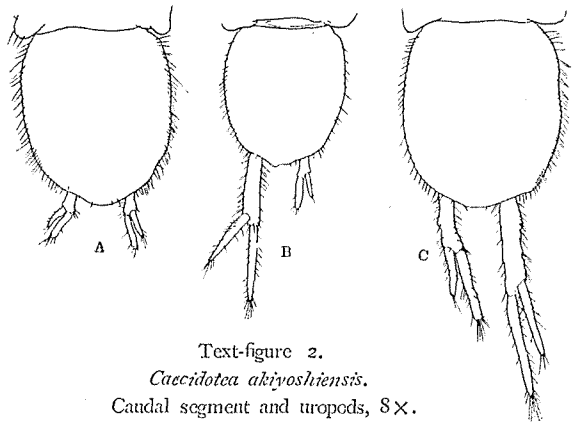
Text-figure 1.

Caecidotea akiyoshiensis sp. nov.

A. Female, dorsal view, 4×. B. First antenna, 20×.
C. Left mandible, 20×. D. Right mandible, 20×.
E. First maxilla, 20×. F. Second maxilla, 20×.
G. Maxilliped, 20×. H. Lower lip, 20×.
I. Upper lip, 20×. J. First leg, 20×.
K. Seventh leg, 16×. L. First pleopod of female, 20×.
M. Third pleopod of female, 20×.

Thoracic limbs show no special points of distinction as compared with *C. kawamurai*, except that they are somewhat more delicate. Unfortu-

nately, as the specimens were all female, I was unable to examine the peculiar male characteristic of the first three pairs of pleopods. Of uropods, the peduncle is about half as long as the last segment and slightly longer than the inner ramus, the outer ramus being about 2/3 as long as the inner ramus. The uropods show a remarkable asymmetry as shown in text-figure 2.



Text-figure 2.
Caecidotea akiyoshiensis.
Caudal segment and uropods, 8×.

This remarkable asymmetry is probably due to degeneration owing to the loss of function, or otherwise, TATTERSALL is right in saying that, "……the uropods of Asellidae are very easily broken off and it is difficult to distinguish regenerated appendages from those which have had a normal growth without injury"[1]).

The animal is colourless over the entire body and limbs, only the dorso-lateral portion of each sesment being mottled with minute grayish pigments.

Differential diagnosis : This animal is much related to *C. kawamurai*, but does not agree with it in the following features :

(i). The contour of head and body is very different from that of *C. kawamurai* which has a narrower and more elongated body, and the head nearly as broad as the first thoracic segment. In this respect the present new species rather approaches the North American species *C. richardsonae*

1) TATTERSALL (1921), p. 418.

TABLE I.

Measurements of the Type of *Caecidotea akiyoshiensis* (in mm.).

Length of body		13·0
Length of last segment		2·8
Width of last segment		2·5
Length of first antennae	*r.**	2.0
	l.	2·0
Length of second antennae	*r.*	10·0
	l.	10·5
Uropods: length of peduncles	*r.*	1·3
	l.	1·0
Uropods: length of inner rami	*r.*	1·3
	l.	1·0
Uropods: length of outer rami	*r.*	1·0
	l.	0·7
Number of joints of flagellum of first antennae	*r.*	9
	l.	9
Number of joints of flagellum of second antennae	*r.*	69
	l.	67

* *r.*—right; l.-left.

HAY[1]). In *C. richardsonae*, however, the anterior corner of the first thoracic segment is strongly produced, while in *C. akiyoshiensis* it is rounded.

(ii). There is no trace of eyes, whereas *C. kawamurai* has distinct eyes[2]).

(iii). The first antenna extends over one-third of the fifth article of the peduncle of the second antenna, and the flagellum is composed of less than 10 joints; in *C. kawamurai* the first antenna does not extend beyond the distal end of the fourth article of the peduncle of the second antenna, and the flagellum is composed usually of from 11 to 13 joints[3]).

(iv). The second antenna of the present species is about 3/4 as long as the body; in *C. kawamurai* it is a little longer than half of the body.

(v). The caudal segment exhibits a remarkable difference, being

1) HAY (1902), pp. 424—428.

2) By careful examination I found that this form never has any trace of eyes, whereas *C. kawamurai* has usually very small, but distinct black eye-spots even when young.

3) Often as many as 21. The above mentioned characteristics of the antenna remind us of those in *C. richardsonae*.

slightly longer than broad, whereas in *C. kawamurai* it is considerably longer.

Locality : Taki-ana[1]) limestone cave at Akiyoshi, Pref. of Yamaguchi (May 1927).

Remarks on habitat, etc : Four female specimens of various sizes were captured in the subterranean stream "Koto-ga-fuchi" at the innermost spot of the cave. The water of this place was clear and remarkably alkaline, pH value being 8, 2. The temperature of the water was 16° C at 3 p.m. on May 27th. The animal was crawling slowly over the muddy bottom of the stream. It was found to be very sensitive to light. When mechanically disturbed or stimulated with a flash light, its locomotion became very rapid, being directed toward the water surface. Of these four specimens one was carrying 53 white spherical eggs in its brood-pouch.

In examination of the intestinal content, no food materials were detected.

2. Caecidotea kawamurai TATTERSALL.

(*Text-figure 3*)

TATTERSALL (1921), pp. 417—419, Pl. XV, figs. 11—18;
KOMAI (1922), p. 76; SPANDL (1926), p. 69.

Localities : Wells in the city of Ôtsu, Pref. Shiga (*Type ;* three specimens); Tomioka, Pref. Tokushima in Shikoku (four specimens); a well in the city of Kyôto (seven specimens).

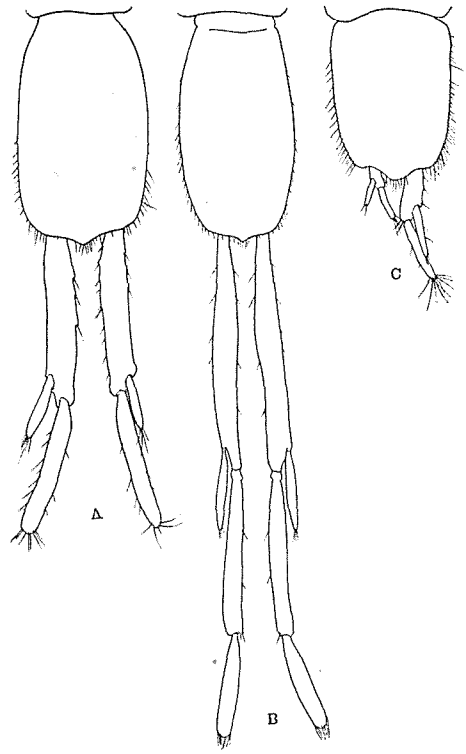
Remarks : This remarkable species which has distinct but minute eye-spots was first taken by Prof. T. KAWAMURA, and was brought to Europe by the late Dr. T. N. ANNANDALE of the Indian Museum on the occasion of his tour in Japan in 1915.

Some specimens from Tomioka are peculiar in their form and size, of which one male has uropods with three-jointed inner rami (text-fig. 3, B).

The measurements of the representatives from different localities are given in Table II.

1) Meaning "waterfall" cave. The Taki-ana (or Shuho-do) is one of the best-known limestone cave in Japan. It is said to be more than one km. in longitudinal extension, and a water stream runs through its entire length, making a waterfall at the entrance.

The validity of the genus *Caecidotea* is very doubtful, as already discussed by various authors. After a careful comparative study of the specimens of *Caecidotea* and *Asellus*, I am inclined to think that it is better, as maintained by several authors, to unite *Caecidotea* with *Asellus*, the former being in my opinion nothing more than a type of the latter which is adapted to the subterranean life. For the present, however, I retain the name *Caecidotea* for our subterranean forms.



Text-figure 3.
Caecidotea kawamurai Tattersall.
Caudal segment and uropods; A. and B. Male.
C. Female. A. and C. 8×, B. 4×.

AMPHIPODA

Family: Gammaridae.

Genus: Pseudocrangonyx Akatsuka et Komai.

It is interesting to find this peculiar genus, which has a long and 2-jointed outer ramus in the third uropod, among our subterranean fauna. There have been recorded three blind species under this genus.

1. Pseudocrangonyx shikokunis Akatsuka et Komai

(*Text-figure 4*)

Akatsuka and Komai (1922), pp. 120—122, figs. 1 and 2:
Spandl (1926), p. 77; Chappuis (1927), p. 78.

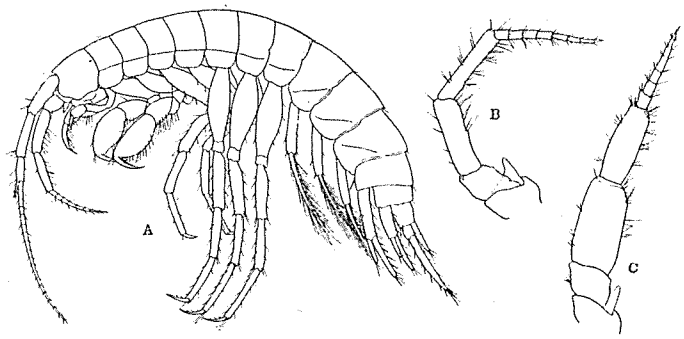
Since first taken from Tomioka in Shikoku, this remarkable blind

TABLE II.

Measurements of *Caecidotea kawamurai* (in mm.).

Locarity	Otsu	Otsu	Tomioka	Tomioka
Sex	Male	Female	Male	Female
Length of body	14·0	8·5	14·3	21·5
Length of last segment	4·0	2·5	3·5	5·0
Width of last segment	2·5	2·0	2·2	3·0
Length of first antennae	*r.* 2·5	1·3	2·5	4·0
	l. 3·0	1·2	2·5	4·0
Length of second antennae	*r.* 8·5	6·5	10·5	17·0
	l. 8·5	6·0	9·8	16·5
Uropods: length of peduncles	*r.* 2·5	0·9	2·2	6·5
	l. 2·5	0·4	2·8	6·8
Uropods: length of inner rami	*r.* 2·5	0·9	2·0	4·0+2·5*
	l. 2·5	0·5	2·0	3·5+2·8
Uropods: length of outer rami	*r.* 1·5	0·6	1·0	1·6
	l. 1·5	0·3	1·0	1·6
Number of joints of flagellum of first antennae	*r.* 12	9	16	21
	l. 12	9	17	19
Number of joints of flagellum of second antenne	*r.* 60	66	85	95
	l. 62	45	78	92

* In this specimen, the inner rami are two jointed as shown in Text-fig. 3, B.



Text-figure 4.

*Pseudocrangonyx shikokuni*s AKATSUKA et KOMAI

A. Female, lateral view, 6×. B. Second antenna of female, 13×, C. Second antenna of male, 13×.

animal has been known from a few localities of Japan. From sinter-pools "Sencho-da" in the Taki-ana cave, four females and a single male were found mingled with a number of *Gammarus pulex*. Another immature specimen was obtained at "Koto-ga-fuchi" where the preceding isopod *Caecidotea akiyoshiensis* was caught. "Sencho-da" is composed of many shallow pools, about 20 cm. deep, and the temperature of the water was 16,°5 C. at 3·50 p. m. on May 27th. The animals were walking slowly through the soft ooze on the bottom of the pools. The measurements of these specimens from Taki-ana are given below.

TABLE III.

Measurements of *Pseudocrangonyx shikokuni's* from Taki-ana (in mm.).

		Female	Male
Length of body		10·0	8·5
Length of first antennae	*r.*	5·5	5·0
	l.	5·5	5·0
Length of second antennae	*r.*	3·0	—
	l.	3·0	3·0
First uropods, inner rami	*r.*	1·0	0·9
	l.	1·0	0·9
First uropods, outer rami	*r.*	0·5	0·5
	l.	0·5	0·4
Second uropods, inner rami	*r.*	0·8	0·5
	l.	0·9	0·5
Second uropods, outer rami	*r.*	0·4	0·5
	l.	0·4	0·4
Third uropods, peduncles	*r.*	0·3	0·3
	l.	0·3	0·3
Third uropods, first joint of outer rami	*r.*	1·0	1·1
	l.	1·0	1·0
Third uropods, second joint of outer rami	*r.*	0·2	0·2
	l.	0·2	0·2
Number of joints of flagellum of first antennae	*r.*	19	19
	l.	20	19
Number of joints of flagellum of second antennae	*r.*	8	7
	l.	8	7

The first antenna is slightly longer than one half the body length; the number of the joints of the flagellum is usually 18 to 19, but may be variable as shown in Table III. The second antenna is nearly one half as long as the first; the flagellum is composed of 7 or 8 joints; the articles of the peduncle in the male are stouter than in the female. The mouth-parts conform well with the original description and figures, except that the first maxilla in the type specimen is provided with 3 spinous setae and 2 or 3 delicate hairs on its palp, while in our specimen of Taki-ana it has 5 spinous setae and 3 delicate hairs. In the third uropod, the first joint is about five times as long as the peduncle, the second, on the contrary, being very small.

2. Pseudocrangonyx yezonis AKATSUKA et KOMAI.

AKATSUKA and KOMAI (1921), p. 123. fig. 3.

Locality: Sapporo in Hokkaido.

This form which resembles closely the preceding species has not come under my examination.

3. Pseudocrangonyx kyotonis AKATSUKA et KOMAI.

(*Text-figure 5*)

AKATSUKA and KOMAI (1922), pp. 123—126, fig. 4.

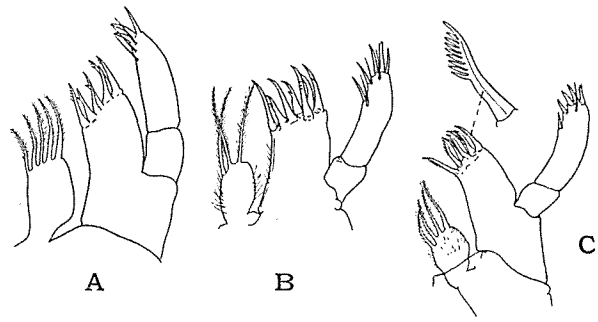
Localitiy: Kyôto.

One female (*Type*); one male and one female (M. IWATA 1923); one female (T. KURODA 1923); one male (J. MAKIYAMA).

Remarks: This species is characterized by the first antenna being shorter in length than either of the preceding two species and the inner lobe the first maxilla having 3 setae on apex and uropods being more slender and elongated.

This species is extremely variable especially in the form and size of antennae and uropods. In the specimens caught by Messrs. KURODA and IWATA from wells in their houses, the flegellum of the first antenna is 24- or 25-jointed (15-jointed in the type) and the outer ramus of

the third uropod is 3·5 to 4 times as long as the peduncle (7 times in the *type*). In the male taken by Prof. MAKIYAMA the flagellum of the



Text-figure 5.
First maxilla; A. *Ps. shikokuni*s. 60×. B. *Ps. kyotonis*. 50×. C. *Ps. kyotonis* 50×. another specimen.

first antenna is 27 (right)–and 28 (left)–jointed; the inner lobe of the first maxilla is provided with 4 hairy setae (3 in the other specimens of *Ps. kyotonis*), and 5 spinous and 1 delicate hair on the apical margin of the palp (text-fig. 5).

4, Gammarus pulex L.

(*Text-figure 6*)

In the sinter-pools "Sencho-da" in the Taki-ana cave, a number of individuals of the present species were captured. Careful examinations of these materials revealed no point of special importance. Only I mention the following features as characteristic of the specimens before me.

(i). In the present specimens there are two strong setae on the lower border of the third pleon segment, though TATTERSALL mentions[1]) that he found only one strong seta on the lower border in his specimens from Japan brought by ANNANDALE.

(ii). The accessory flagellum of the first antenna has 5 joints.

(iii). Both the eyes and the pigments of the body-surface are present.

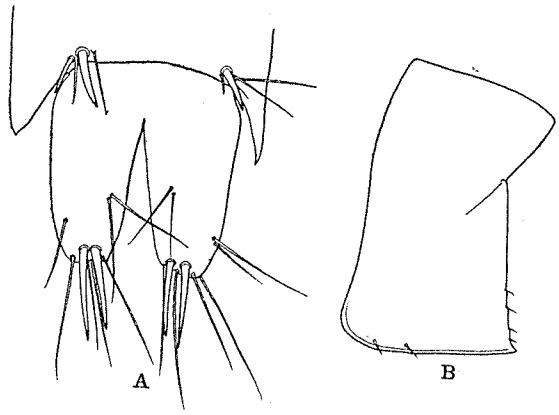
1) TATTERSALL (1922), p. 451.

TABLE IV.

Measurements of *Pseudocrangonyx kyotonis* (in mm.).

Collector			M. IWATA	M. IWATA	J. MAKIYAMA
Sex			Female	Male	Male
Length of body			10·5	9·5	10·5
Length of first antennae		*r.*	6·3	6·0	7·5
		l.	6·3	6·2	7·5
Length of second antennae		*r.*	5·0	3·0	3·2
		l.	5·0	3·0	3·5
First uropods	peduncless	*r.*	1·5	1·0	1·2
		l.	1·5	1·1	1·1
	inner rami	*r.*	1·1	0·8	1·0
		l.	1·0	0·95	1·0
	outer rami	*r.*	0·9	0·5	0·4
		l.	0·9	0·5	0·4
Second uropods	peduncle	*r.*	0·7	0·5	0·5
		l.	0·7	0·5	0·5
	inner ramis	*r.*	0·9	0·7	0·7
		l.	0·8	0·6	0·7
	outer rami	*r.*	0·5	0·4	0·4
		l.	0·5	0·4	0·4
Third uropods	peduncles	*r.*	0·4	0·3	0·4
		l.	0·4	0·3	0·4
	first joint of outer rami	*r.*	1·2	1·2	1·2
		l.	1·3	1·2	1·3
	second joint of outer rami	*r.*	0·2	0·2	0·2
		l.	0·2	0·2	0·2
Number of joints of flagellum of first antennae		*r.*	25	24	27
		l.	25	24	28
Number of joints of flagellum of second antennae		*r.*	11	6	6
		l.	10	6	7

The habitat is the same as that of the foregoing *Ps. shikokuuis*. Some more specimens of the same species were collected at two other places of Taki-ana namely, "Roku-jizô" near the waterfall at the entrance of the cave and in a stream flowing out of the cave.



Text-figure 6.
Gammarus pulex L.
A. Telson, dorsal view, 60×. B. Third pleon, 20×.

In closing I wish to express my best thanks to Prof. T. KAWAMURA for his kind criticism of this work. Sincere thanks are also due to Prof. T. KOMAI who kindly allowed me to examine his materials and gave me many helpful suggestions.

Zoological Institute, Kyoto Imperial University.
September 1927.

REFERENCES

1. AKATSUKA, K. and T. KOMAI (1921). "*Pseudocrangonyx*, a New Genus of subterranean Amphipoda from Japan" *Ann. Zool., Jap.*, Vol. X, Art. 12.
2. BANTA, A. M. (1907). "The Fauna of Mayfield's Cave," CARNEGIE *Inst.* of *Washington*, Publ. No. 67, 1907.
3. CHAPPUIS, P. A. (1927). „Die Tierwelt der unterirdischen Gewässer," in Sammlung "*Binnengewässer*" Bd. III, Stuttgart.
4. CHEVREUX, ED. and L. FAGE (1925). Faune de France, T. 9, *Amphipodes*. Paris.
5. HAY, W. P. (1902). "Observations on the Crustacean Fauna of Nickajak Cave, Tennessee, and Vicinity," *Proc. U. S. Nat. Mus.*, Vol. XXV.
6. HESSE, R, (1924) Tiergeographie auf ökologisher Grundlage. Jena.
7. KOMAI, T. (1922). "Blind Amphipods from the Subterranean Waters of Japan," (in Japanese), *Dôbutsugaku-Zasshi*, Vol. 34, p. 28.
8. bid. (1922). "A Curious Subterranean Isopod from Japan," (in Japanese) *Dôbutsugaku Zasshi*, Vol. 34, p. 76.
9. PACKARD, A. S. (1885). "On the structure of the Brain of *Asellus* and the eyeless form *Caecidotea*," *Amer. Naturalist*, Vol, XIX, pp. 85--86.
10. ibid. (1891). "On the origin of the subterranean fauna of North America," *Amer. Naturalist*, Vol. XXVIII, pp. 727—751.
11. SARS, G. O. (1899). An Account of the Crustacea of Norway, II. Amphipoda.
12. SPANDL, H. (1926). „Die Tirwelt der unterirdischen Gewässer," in *Spelaeologische Monographien*, Bd. XI, Wien.
13. TATTERSALL, W. M. (1921). "Zoological Results of a Tour in Far East VII, Mysidacea, Tanaidacea and Isopoda," *Mem. Asiatic Soc. Bengal*, Vol. VI, pp. 406—433.
14. ibid. (1922). "Zool. Res. Tour in Far East VIII. Amphipoda with notes on an additional species of Isopoda," *Mem. Asiat. Soc. Bengal*, Vol. VI, pp 435—459.
15. THIENEMANN, A. (1925). „Die Binnengewässer Mitteleuropas," in Sammlung „*Binnengewässer*," Bd. I, Stuttgart.