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Cladocera and Rotatoria of Central China

(Studies of the Fresh-water Plankton of Central China, III.)

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Introduction

During the last war, the writer spent about three years (1940—1943) in Central China serving as a soldier, and he could avail himself of that oportunity to make a number of plankton collections in the area extending from Kiukiang to Lake Tungting-hu along the Yangtse-kiang. The present paper is the third report of his studies on the materials thus obtained. In the first report the writer dealt with a general discussion of the plankton collected then and comments upon the principal localities with special reference to the seasonal distribution of the plankton organisms, and in the second report he mainly dealt with the plankton fauna of the Yangtse-kiang and Lake Tungting-hu and gave systematic descriptions and remarks upon Copepoda identified in this work.

In carrying out the present studies the writer has been greatly indebted to many persons for their kindness and aid, as already mentioned in the first report. Here, he wishes to express his hirty thanks to Prof. M. KUMANO of the Zoological Institute of the University of Kanazawa for his kindness and aid in publishing the present studies. And, last but not least, it is the writer's pleasure to record here the sence of gratitude he feels toward Mrs. Rowena Hudson WINN, Professor of the Junier College for Teacher Training in Childhood Education, Kanazawa, who kindly read the manuscript and rendered helpful advice.

Explanation of the Principal Stations

A. Wu-han[1] region

H–1 : Han-kow[2] St. 1, a pond in front of the Kiang-hang High School.

H–2 : Han-kow St. 2, a lakelet in the north-eastern suburbs of the city ; water vegetation very rich.

H–3 : Han-kow St. 3, a lakelet of a comparatively deep basin in the north-eastern suburbs ; vegetation poor.

H–4 : Han-kow St. 4, a weedy lakelet beside St. 3, about 1.5–3 meters deep.

H–5 : Han-kow St. 5, a lakelet on the north of the city, about 10 meters deep ; vegetation very poor.

H–6 : Han-kow St. 6, a weedy lakelet of shallower depth beside St. 5.

H–8 : Han-kow St. 8, a small pond in the eastern part of Chun-shan Park.

H–9 : Han-kow St. 9, two large-sized ponds connected with each other, full of dirty water, situated in the western part of the city.

H–10 : Han-kow St. 10, a small pond by the roadside near St. 1.

H–11 : Han-kow St. 11, a small pond in the north-eastern suburbs of the city.

H–12 : Han-kow St. 12, a lakelet lying to the north of the city, the marginal part of

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the lakelet forming a wide lotus field.

W-1 : Wu-chang[3] St. 1, a shallow weedy pond behind the railroad station of Wu-chang.

B. Yo-yang[4] (Yo-chow) region (May 18, 1941).

G-1 : a pond behind the railroad station of Yo-yang.

G-2 : a pond to the north-west of Yo-yang Station.

G-3 : a pond in the west end of the town.

G-T : Lake Ta-chiao-hu[5]

C. Lake Tung-ting-hu[6]

T : off Yo-yang ; the lake being 10 meters deep at this station.

D. Yang-tse-kiang[7]

Y-HN : Hankow, July 29-30, 1942.

Y-HNX : Hankow, Oct. 5, 1941.

E. Yang-lou-tung[8] and Chao-li-chao[9] region (Province of Hu-peh[10]).

CY-1 : a pond in the southern suburbs of the town of Chao-li-chao.

F. Liu-chia[11] Hot Spring region (Pu-ki Prefecture[12], Province of Hu-peh).

P-1 : a small weedy pool by the hot spring ; the water temperature ranging from 34° to 38°C.

G. Chi-kung-shan[13] region (Province of Ho-nan[14]).

SK-1 : a swimming pool on Mt. Chi-kung-shan (*ca.* 800 m above sea level).

SK-10 : a pond near the town of Hsin-ten.[15]

H. Kiu-kiang[16] region (Province of Kiang-si[17]).

K-N : Lake Nan-men-hu.[18]

K-K : Lake Kan-tang-hu.[19]

These two lakes lie on the southern side of the city of Kiu-kiang side by side.

K-2 : a small pond on the western side of Lake Nan-men-hu.

L-6 : a small pond near the village of Lien-hwa-tung[20] which is situated at the foot of Mt. Lu-chan.[21]

A. CLADOCERA

List of Species and the Principal Localities

Fam. ***Sididae***

1. *Sida crystallina* (O. F. MÜLLER) : H-2, H-3, H-4, SK-10.
2. *Diaphanosoma brachyurum* LIEVIN : H-5, H-6, H-7, Y-HN, T, G-3, K-N, K-K.
3. *D. b.* var. *leuchtenbergianum* FISCHER : H-3, H-6.
4. *Latonopsis australis* G. O. SARS : H-4, P-1.

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1) 武漢, 2) 漢口, 3) 武昌, 4) 岳陽 (岳州), 5) 大橋湖, 6) 洞庭湖, 7) 揚子江, 8) 羊楼峒, 9) 趙李橋, 10) 湖北省, 11) 劉家, 12) 蒲圻県, 13) 雞公山, 14) 河南省, 15) 新店, 16) 九江, 17) 江西省, 18) 南門湖, 19) 甘棠湖, 20) 蓮花洞, 21) 廬山.

Fam. ***Daphniidae***

5. *Daphnia carinata* KING : H–8, H–9, H–10, SK–1.
6. *D. pulex* (DE GEER) : W–1, H–1, H–4, SK–1.
7. *D. longispina* O. F. MÜLLER *hyalina* (LEIDIG) : H–5, T, G–1, G–T.
8. *Scapholeberis kingi* G. O. SARS : H–6, H–8, H–10, T, K–N, K–K, L–6.
9. *Simosa vetula* (O. F. MÜLLER) : H–6.
10. *S. vetuloides* (G. O. SARS) : H–2, H–4, H–10, P–1, W–1.
11. *Ceriodaphnia laticaudata* P. E. MÜLLER : H–9, CY–1.
12. *C. rigaudi* RICHARD : Y–HN, H–4, K–K, K–N.
13. *Moina dubia* DE GUERNE et RICHARD var. *parva* RAMMNER : Y–HN, T, G–2, K–N, K–K, H–2, H–9.
14. *M. dubia* var. ? : H–1.
15. *M. macrocopa* STRAUS : H–6, H–11.

Fam. ***Bosminidae***

16. *Bosmina longirostris* O. F. MÜLLER : H–2, H–3, H–4.
17. *B. fatalis* BURCKHARDT : Y–HN, T, G–1, H–3, H–5, H–12, K–N, K–K.
18. *Bosminopsis deitersi* RICHARD : Y–HN, T, G–T, H–3.

Fam. ***Macrothricidae***

19. *Macrothrix rosea* (JURINE) : H–4, K–N, K–2.

Fam. ***Chydoridae***

20. *Alona rectangula* G. O. SARS : Y–HN, H–2, H–4, K–N, K–K.
21. *A. costata* G. O. SARS : H–4, K–N, K–K, W–1.
22. *A. karua* KING (?) : H–4.
23. *Pleuroxus trigonellus* O. F. MÜLLER : H–2, H–4, W–1.
24. *P. striatus* SCHOEDLER : H–4, H–5.
25. *P. aduncus* G. O. SARS (?) : H–5.
26. *Dunhevedia crassa* KING : H–4, P–1.
27. *Chidorus sphaericus* O. F. MÜLLER : H–2, H–3, H–4, H–5, W–1, K–N, K–K.

Fam. ***Leptodoridae***

28. *Leptodora Kindtii* (FOCKE) : Y–HN, H–5.

Note 1. The localities shown in this list mean the principal ones, but do not show all of them.

2. Some localities which were overlooked when the list given in the first report (1951a) was made are added here.

3. The question mark, in most cases, means that the samples which included the specimens which had been observed before were lost and are not at present in the writer's hand, and the exact identification of them is, therefore, more or less difficult.

Remarks on the Principal Species

Gen. *Diaphanosoma* S. FISCHER

In the present investigation, *D. brachyurum*, a northern cosmopolitan species, was more or less commonly collected at various localities, but *D. sarsi*, the tropical species, which was recorded by UÉNO as occurring in the Province of Szechwan, Formosa and Manchuria (UÉNO, 1932, 1937, 1940), could not be found. The latter species can be distinguished from the former by its peculiar angular emargination of the ventro-posterior free margin of the shell.

A variety, *D. b.* var. *leuchtenbergianum* which differs from the typical form in its elongated antennae which reach beyond the posterior border of the shell, was found in two lakelets in the suburbs of Hankow.

Latonopsis australis G. O. SARS
(Fig. 1, a-e)

The present species was first found among Cladocera raised from dried mud brought from Queensland, Australia, and described as a new genus and species by SARS (1888).

The writer found a number of specimens of this species in the samples collected at Hankow St. 4 (H-4). According to the figures shown by SARS, the antennules are about

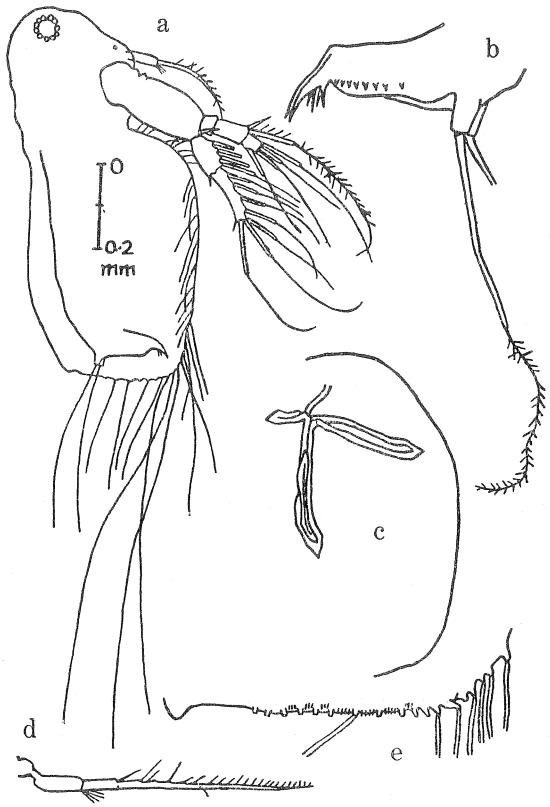

Fig. 1. *Latonopsis australis* (H-4, June 28). a. side view, b. postabdomen, c. shell gland, d. antennule, e. post-ventral margin of the shell.

half as long as the height of the head, but in the Hankow specimens the former are somewhat longer than the latter. In SARS' original description, the upper branch of the antenna has 12 natatory setae (5+7), while in the Hankow specimens it has always 11 (4+7). Regarding the number of these setae, UÉNO (1944) already pointed out a similar difference in his specimens obtained from Lake Si-hu, Chekiang, and he is of the opinion that this is a difference remarkable enough to regard the Si-hu specimens as a distinct variety. Considering also that the specimens of Hankow always have upper branches with 11 setae, this character may be regarded as a fixed and common one in the present species in Central China. It may also be a noteworthy fact that, in the Hankow race, three setae affixed to the infero-posterior corner of the shell are markedly long, being nearly as long as the whole body, while, in the figures shown by SARS and UÉNO, they are a half or two third times as long as the body length respectively.

BIRGE (1910) divided the species of *Latonopsis* into two groups, basing the division mainly upon the form of shell gland. One of the two groups contains *L. australis* G. O. SASR, *L. occidentalis* BIRGE and *L. breviremis* DADAY. These agree in having a shell gland with a conspicuously long posterior loop and simple anal spines on the postabdomen. The other group contains *L. serricauda* G. O. SARS and *L. fasciculata* DADAY, being characterized by a serrate crest on the postabdomen, anal spines in clusters, and a shell gland without large posterior loop. As BIRGE suggested, it seems also to be true that the antennule in the *fasciculata* group has a shorter flagellum as compared with that of the *australis* group.

This species has hitherto been recorded from Australia, Java, Sumatra and China, and is considered to be distributed widely in the tropical and subtropical region of South-Western Asia. Recently, UÉNO (1944) found this species in a lotus pond in an islet in Lake Si-hu near the city of Hangchow (Province of Chekiang) on Sep. 23, 1942. The present writer found this species at Hankow St. 4 (a weedy lakelet) on June 28, July 24 and Aug. 14, 1941.

Gen. *Daphnia* O. F. MÜLLER

SPANDL (1925) found two species of this genus, *viz.*, *D. magna* and *D. pulex*, in the material brought from Shanghai, and UÉNO (1944) described three species, *D. magna*, *D. carinata* and *D. pulex* in his study of the inland waters of the Yangtse Delta. The writer found, in the present investigation, three species, *viz.*, *D. carinata*, *D. pulex* and *D. longispina*, but could not find *D. magna* which had been expected to be common in Central China. In the writer's case, however, *D. longispina* which had not been recorded from Central China, was abundantly found at four stations and all of the specimens obtained were the pelagic form with the pointed head.

The geographical distribution of this genus in China and the adjacent teritories is as shown in Table 1.

Daphnia carinata KING

(Fig. 2, a-h)

Table 1.

Species	Central China	Formosa	Manchuria	Japanese Islands
D. magna	+	−	+	+
D. carinata	+	−	+	+
D. pulex	+	+	+	+
D. longispina	+	+	−	+
D. longiremis	−	−	−	+
D. cristata	−	−	+	−
Authors	SPANDL (1925) UÉNO (1944) MASHIKO	UÉNO (1939)	UÉNO (1940)	UÉNO (1939) MASHIKO et ITÔ (1951)

This species was found at four localities. In a swimming pool on Mt. Chikun-shan (*ca.* 800 m above sea level), a markedly large number of the parthenogenetic females occurred on July 16, 1941, though there was none to be found on Dec. 3, 1940. In two small ponds in Hankow (H–8 and H–10), all of the parthenogenetic females, the ephippial females and the males were abundantly collected on April 28 and May 28, respectively.

The head of the adult specimens collected by the writer is always rounded, but it is always pointed in the specimens of the very young stage. It must be added that the postabdomen of the male has a conspicuous concavity below the anal fissure, as seen in the figure, showing much the same appearance with that of *D. magna*, though it is of usual form in the female. The terminal claws carry two conspicuous combs of strong spines at the base on each side, the basal one consisting of 7–8 spines and the distal one of 11–12.

UÉNO (1944) found this species in Shanghai, but his race differs from the writer's in that it has a very short shell spine while in the writer's specimens the spine is 32–34 % of the body length.

This species was recorded by SPANDL (1925) from Peking and by UÉNO (1937, 1940) from various localities in Manchuria.

Daphnia longispina O. F. MÜLLER *hyalina* (LEIDIG)

(Fig. 2, n-s)

D. longispina occurred in three localities, *viz.*, Lake Tungting-hu (May 18, 1941), St. G–1 and H–5. All of the specimens collected are recognized as belonging to the subspecies *hyalina* which has a delicate hyaline shell and a long shell spine, and are almost always acutely point-headed (f. *galeata*).

In the lakelet in Hankow (H–5), the collections were made in various seasons except for midsummer. As already mentioned in the preceding paper (MASHIKO, 1951 a), the writer observed a very interesting fact that almost all of the specimens collected here even in the winter season were point-headed. Only one round-headed individual was found among the

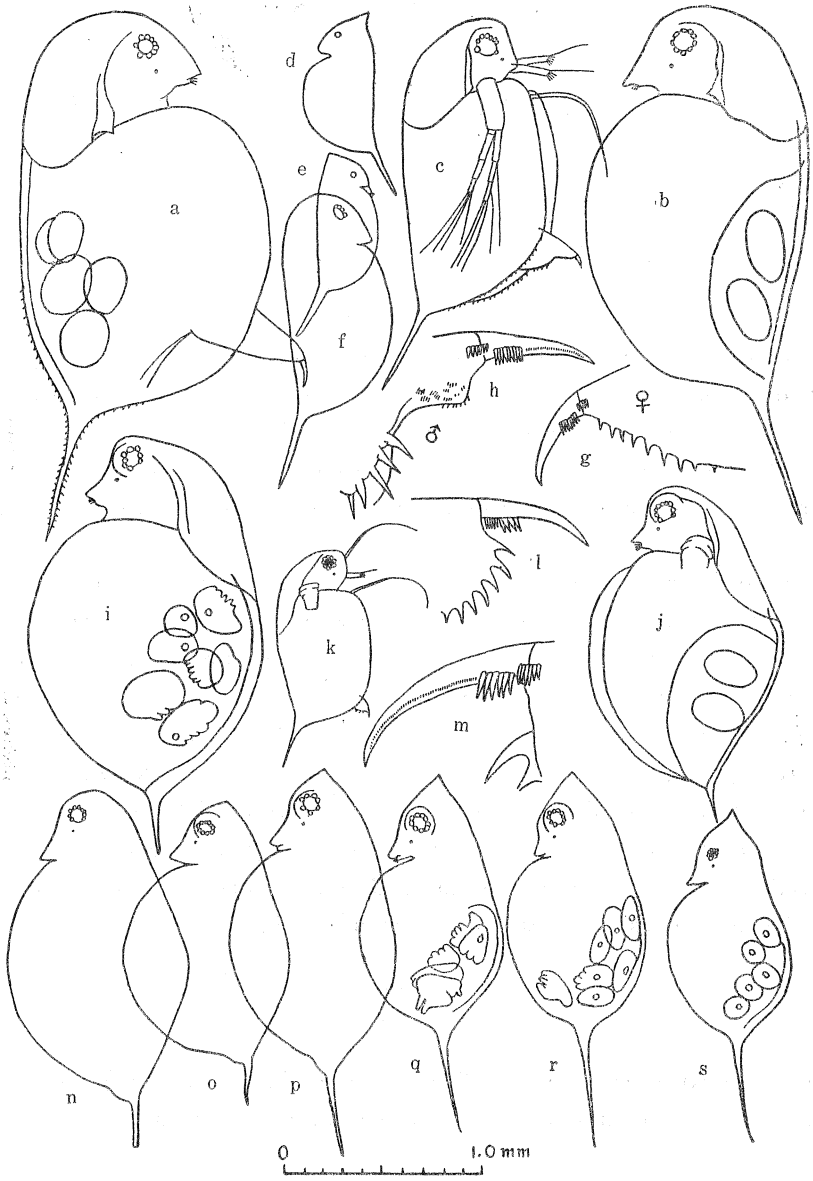

Fig. 2. a-e. *Daphnia carinata* ; a. p-female (SK-1, July 16), b. e-female (H-10, May 28), c. male (H-10, May 28), d-f. young specimens, g. postabdomen (female), h. postabdomen (male) ; i-m. *D. pulex* : i. p-female (H-4, April 1), j. e-female (H-1, May 6), k. male (H-1, May 6), l. postabdomen (male), m. postabdomen (female) ; n-s. *D. longispina* (H-5) : n-p. (Jan. 18), q-s. (Dec. 9).

many point-headed ones collected in January.

The general feature of the occurrence of this species at Hankow St. 5 is as shown in Table 2.

Table 2.

date	1941								1942
	20/II	24/III	28/IV	14/IX	21/IX	12/X	1/XI	9/XII	18/I
water temp.	9.5	•	20.0	21.0	23.2	22.5	•	•	4.5
occurrence	r	—	cc	—	—	—	r	c	cc
body length μ	—	—	young	—	—	—	—	1000-1310	1290-1560
spine % / body length	—	—	—	—	—	—	—	39.7-47.3	20.2-29.0

In this lakelet, the parthenogenetic female was abundantly found in the period from November to January. Though a small number of the males and detached ephippia were seen in January, none of the specimen which carried the ephippium could be found. Among the specimens collected in January, a considerable number of individuals with less pointed heads and rather short shell spines was found, and there was seen only one round-headed individual.

All of the specimens collected in Lake Tungting-hu and a pond of Yoyang were those of the young stage, and in the latter locality a detached ephippium regarded as that of this species was found. This pond which is situated behind the railroad station of Yoyang is a comparatively small-sized one and is filled with dirty water. In this pond, besides this species, such species as *Bosmina fatalis*, *Alona costata*, *Ceratium hirundinella*, *Eudorina elegans*, *Spirogyra* sp., *Closterium* sp., *Pediastrum* spp. were found. It may be a remarkable fact that *D. longispina hyalina* and *B. fatalis* which are generally regarded to be pelagic forms were found in such a small and dirty pond together with *Spirogira* and *Closterium*. The writer is inclined to consider that these pelagic forms in this pond may safely be regarded as examples of relic forms of Lake Tungting-hu.

Daphnia pulex (DE GEER)

(Fig. 2, i–m)

This species was collected at four localities. The terminal claws of the postabdomen of this species carry two combs of very strong spines on either basal side.

Scapholeberis kingi G. O. SARS

(Fig. 3, a–e)

This species was first described by G. O. SARS (1903) as occurring in Sumatra, and the Australian form recorded by KING as *Daphnia mucronata* was also regarded by SARS to be identical with this species. In 1928, RAMMNER published a revision of this genus, dealing with the specific characters of *S. kingi* and *S. mucronata*.

The specimens collected by the writer are identified as *S. kingi* for their following characters : the rather low head ; the conspicuous transverse striae in the posterior part of the shell of mature individuals ; the hind edges of the valves without distinct concavity just

behind the mucro.

In the writer's specimens, the rostrum is apparently more produced as compared with the figure shown by SARS. According to the figures shown by RAMMNER, however, the rostrum in *S. kingi* is distinctly longer than in *S. mucronata*. In the writer's specimens, the eye fillets (die Augenleiste) which extend from the fornices, over the compound eye, to the rostrum on either side of the head, are very conspicuous, forming the so-called "Öhrchen" in its front view. And the rostrum fillets (die Rostrumleiste) which were shown by RAMMNER as well-marked ridges parallel to the under border of the head, are rather obscure. The ocellus is somewhat elongated elliptically as compared with the typical form. In these points, the race of Central China seems to have some resemblance to the European species, *S. aurita*, but it is quite different in its blunt rostrum and the position of the ocellus which is located close to the base of antennules.

S. kingi is generally regarded as a warm water species, having been found in such regions as Sumatra, Australia, South Africa (G. O. SARS, 1916) and Formosa (UÉNO, 1939). According to UÉNO's studies on the Chinese Cladocera fauna, he found this species in the samples from Chunking (Province of Szechwan)(1932) and Shanghai (1935), but he did not find it in his materials from Si-hu (Province of Chekiang) and the Yangtse Delta (1944), in spite of the rather common occurrence of *S. mucronata*t here. SPANDL (1925), however, found *S. kingi* in the material from North China (Peking), and RAMMNER (1928) reported its occurrence in Germany (Leipzig) and even in Northern Manchuria (Tsitsihar). UÉNO (1931, 1940) also obtained this species at three localities in Manchuria.

Gen. *Simosa* NORMAN
(Fig. 3, f)

As the generic name *Simocephalus* which had been given by SCHOEDLER and used in general by subsequent authors, was proved to be preoccupied for a genus of snakes, A. M. NORMAN substituted the name of *Simosa* for the later *Simocephalus* of SCHOEDLER in 1903. Afterwards, the name *Simosa* was used by such authors as G. O. SARS (1916), NORMAN and BRADY (1921), JENKIN (1934) and UÉNO (1935). The present writer employs here the name *Simosa*, following the examples of these authors.

Two species of this genus, *S. vetula* (O. F. MÜLLER) and *S. vetuloides* (G. O. SARS) were found in the present investigation. *S. vetuloides* is characterized by the presence of the terminal protuberance of the shell and a rather strongly denticulated dorsal margin of the posterior part of the shell. In Central China, so far as the writer's observation is concerned, *S. vetuloides* seems to be very commonly distributed, while *S. vetula* was rarely to be met with. But it is sometimes difficult to distinguish these two species from each other, because the above mentioned characteristics are not always very clear, and some transitional forms seem to exist.

Fig. 3. a-e. *Scapholeberis kingi* (H-10, May 28) : a. p-female, b. e-female, c. p-female, d. head (side view), e. head (front view) ; f. *Simosa vetuloides* (H-10, May 28) ; g, h. *Ceriodaphnia laticaudata* (CY-1, May 23) ; i-l. *C. rigaudi* : i, j. (Y-HN, Aug. 30), k, l. (K-K, Oct. 6).

Ceriodaphnia laticaudata P. E. MÜLLER
(Fig. 3, g, h.)

This species is a cosmopolitan one which is known to Europe, Asia, Africa, Madagascar, North America and Australia. SPANDL (1925) recorded this species from the Province of Szechwan and UÉNO (1937, 1940) from Formosa and Manchuria.

In the writer's investigation, this species was met with at two stations, *viz.*, a pond near the town of Chaolichao (May 23, 1941) and Hankow St. 9 (Sept. 14, 1941).

Ceriodaphnia rigaudi RICHARD
(Fig. 3, i-l)

This species can be easily recognized by its very conspicuous acuminate rostrum. A small number of specimens among those obtained from the Yangtse-kiang has a horn-like

projection on the dorsal part of the head, but there is none which has two projections, as have sometimes been described hitherto. Judging from its geographical distribution known at present, this species is regarded as either a tropical or a subtropical form which was found in Africa, Palestine, Ceylon, Sumatra, Java, New Guinea, Australia, Central and Southern China, Manchuria, Formosa, and South-western and Middle Japan.

According to UÉNO (1937), this species occurs, only in the warmer seasons of the year, in the vicinity of Kyoto, Japan.

Length : up to 0.43 mm.

Moina dubia DE GUERNE et RICHARD var. *parva* RAMMNER

(Fig. 4, a-f)

This species was more or less commonly found at six localities in the present investigation. *M. dubia* may be characterized by its thin and pellucid carapace, rather small number of the feathered triangular setae and the manner of armature of the terminal claws. And, according to JENKIN (1934), the present variety is distinguished by its small size and the slanting arrangement of fine hairs on either side of the postabdomen.

The specimens collected by the writer are divided into two types. One of them is rather large-shaped (about 0.7 mm), having a complex eye of larger size, and has almost always six feathered setae. The other type is smaller in size (up to 0.6 mm), having a remarkably small eye, and the number of the feathered setae is 4 or 5. The former type may be regarded as the typical form of var. *parva*. The latter type seems to have a close resemblance, especially in side view, to the Manchurian species, *M. chankensis*, described by UÉNO (1939), but the shell is not compressed bilaterally as in the latter species. And the number of the feathered setae is 4 or 5 in the writer's specimens, but it is 8 in *M. chankensis*.

Both the parthenogenetic and ephippial females of the large-eye type were found at almost all of the localities. The small-eye type was found in Nanmen-hu, Kantang-hu and the Yangtse-kiang, but no ephippial female was to be found. The large-eye type may possibly be considered as that of the older age.

Moina dubia var. ?

(Fig. 4, g-l)

A markedly abundant occurrence of a questionable form of *Moina* was observed at Hankow St. 1. The shell is somewhat less pellucid as compared with the typical form. The number of the feathered setae on either side of the postabdomen is eight and the terminal claws carry a row of comparatively small spines on either basal side and fine hairs throughout the whole length. The antennule of the male has four hooks at the apex.

The writer provisionally records here this form as *Moina dubia* var.

Moina macrocopa STRAUS

(Fig. 4, m-o)

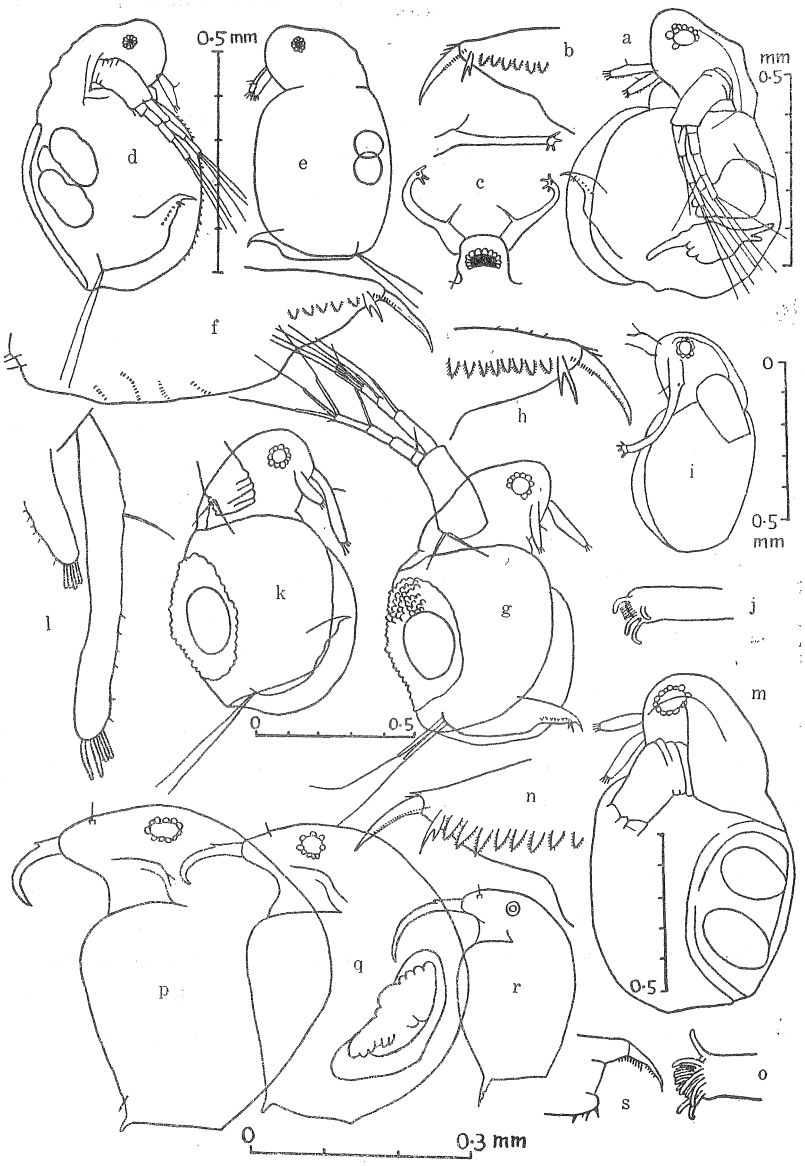

Fig. 4. a–f. *Moina dubia* : a. p-female (K–N, Aug. 31), b. postabdomen (female), c. antennules (male), d, e. small eye type (K–K, Aug. 29), f. do. postabdomen ; g–l. *M. dubia* var. ? (H–1, May 6) : g. e-female, h. do. postabdomen, i. male, j. apex of antennule (male), k. e-female with abnormal antennules, l. do. antennules ; m–o. *M. macrocopa* (H–9) : m. e-female, n. postabdomen, o. apex of antennule (male) ; p–s. *Bosmina longirostris* (H–3, Dec. 7).

This species was found abundantly to occur in two ponds in Hankow in early summer, containing many specimens of the ephippial female and the male. This is a species which is commonly distributed in Japan, Manchuria and China.

Bosmina fatalis BURCKHARDT
(Fig. 5, a-q)

This is one of the most characteristic species in the Yangtse-kiang fauna. This species was first described by BURCKHARDT (1924) as occurring in the lowermost area of the Yangtse-kiang and has hitherto been recorded as occurring in Central China, Manchuria and the Philippine Islands. This species is distinguished from the three other species of this genus (*B. longirostris*, *B. coregoni* and *B. hangmani*) by the following characteristics which it has :

Position of seta basalis, small eye, slender and smooth mucro, obliquely truncated end of the postabdomen, manner of the armature of the terminal claws.

The frontal setae (seta basalis) are situated distinctly nearer the rostrum end as compared with *B. longirostris*, so that this species has sometimes been erroneously identified as *B. coregoni*. Regarding the position of this setae, AURICH (1934) has shown in detail a comparison of four species of this genus. In the writer's specimens of Central China, these setae seem to be situated nearer the rostrum end than those of the Philippine specimens shown by AURICH.

According to AURICH, one of the important characters of this species is that both of the fornix-lines are bified, one at the posterior and the other at the anterior tip. UÉNO (1939) admitted this character in his study of Manchurian specimens. In BURCKHARDT's original figures, however, bifurcatoins of that kind are not shown as already pointed out by AURICH himself. In many specimens examined by the present writer too, the posterior bifurcation is very obscure, especially in mature individuals, and the writer tends to consider it nearly impossible to regard the existence of these bifurcations as one of the specific characters as asserted by AURICH, concerning, at least, the forms in Central China.

The terminal claw is armed with a comb which consists of 6–9 strong spines on its basal part, immediately followed by a row of fine spines up to the tip of the claw. Such an intermediate group of short spines or denticles as seen in *B. longirostris* cannot be seen. Mucro is long, slender and pointed in general, being about twice as long as the diameter of the eye. But a form of very short mucro, the length of which is equal to or less than the diameter of the eye, was found in two localities, *viz.*, Nanmen-hu and a pond behind the railroad station of Yoyang (G–1). The incision is not seen on both sides of the mucro in adult animals but in young ones one or two incisions are sometimes recognizable on either side.

BURCKHARDT divided this species into three subspecies (using sometimes the terms variety or forma), *viz.*, *megalolimnetis* (Ta-hu, 72 individuals), *supolites* (Sutchau River, 5 individuals) and *Cyanopotamia* (Yangtse-kiang, 5 individuals). AURICH distinguished the Philippine form with its short mucro as a race, *fatalis-philippinensis*, from the typical form. And UÉNO (1940) described a forma, *chankensis*, which occurred in Lake Chanka-hu in Manchuria. Recently, UÉNO (1944) divided his specimens collected in the Yangtse Delta into three types, of which the first is correlated with *philippinensis* and the third is allied

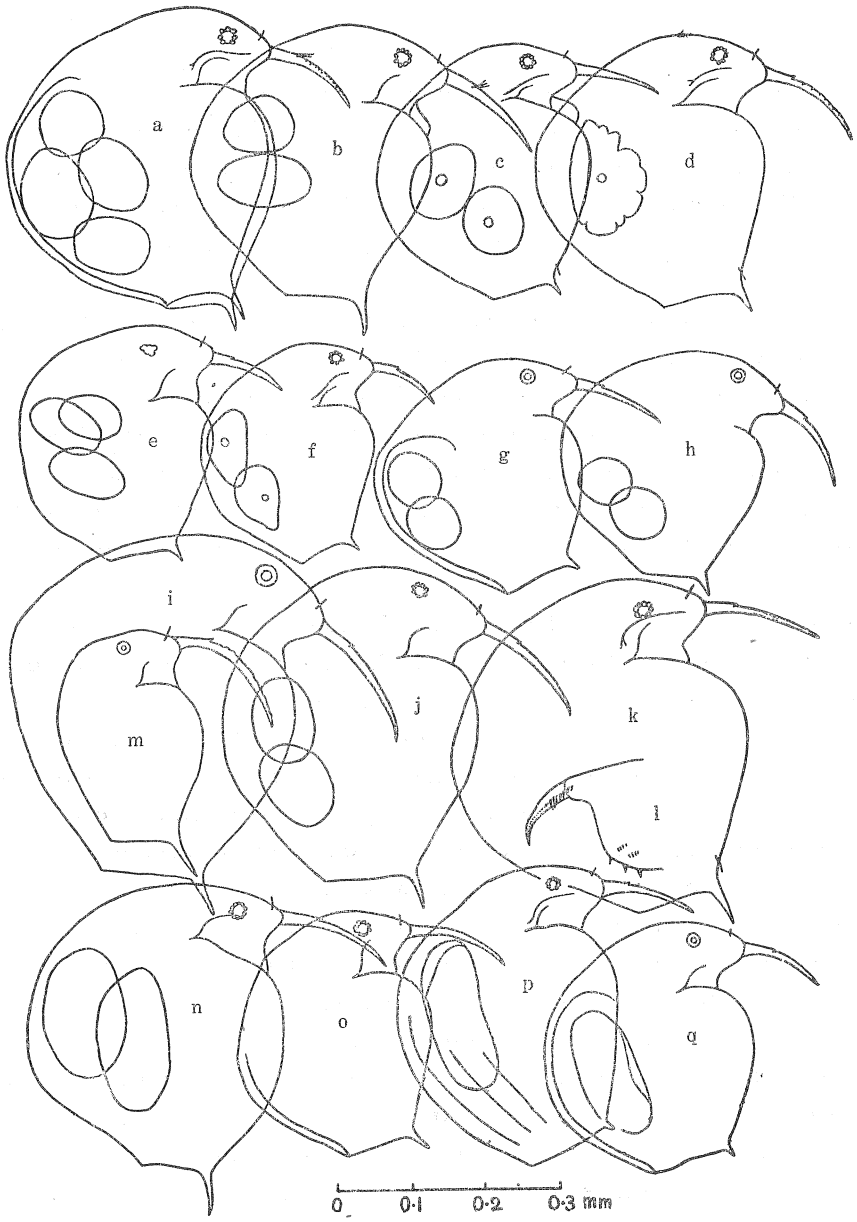

Fig. 5. *Bosmina fatalis* : a–d. K–K. a, b (Oct. 6), c, d (Aug. 31) ; e–h : K–N, e, f (Oct. 6), g, h (Aug. 31) : i, j, m. G-1 (May 18) ; k, l. T (May 18) ; n, o. Y–HN (July 30) ; p, q. H-3 (Dec. 7).

to *megalolimnetis*. And the second type shows some resemblance with *cyanopotamia* but apparently differs from it in its very long mucro which extends in the direction of the extension of the ventral border-line of the shell. To this race UÉNO gave the name *fatalis-chianguensis*.

In many specimens collected by the writer, however, the shape of the shell is very

variable even in one collection and it seems that the individuals in older age tend to increase the height of the shell, resulting in an approach to the *cyanopotamia* type.

The body length is very variable according to localities as seen in the following table.

Table 3.

Station	Date	Body length (e ♀)
Y-HN	July 29, 1942	310-360, 475 μ
K-K	Aug. 30, 1941	325-350
	Oct. 6, 1941	355-395
K-N	Aug. 30, 1941	290-300
	Oct. 6, 1941	270-300
G-1	May 18, 1941	410-460
T	May 18, 1941	up to 440

At Hankow St. 3, *B. fatalis* was collected in company with *B. longirostris*, and these two species were also found together by UÉNO (1944) in Lake Si-hu in his survey of the Yangtse Delta. Such an association as included these two species of *Bosmina* together, however, may rarely be seen, because, in Central China, *B. fatalis* is usually found in the pelagic environment, while *B. longirostris* seems mainly to occur in weedy waters. In Manchuria too, UÉNO (1940) recorded ten localities of *B. fatalis* and two of *B. longirostris*, but there was no occurrence of these two species at the same time.

It may also be a noticeable fact that these two species seemed to show considerably obvious difference in their seasonal distribution. Namely, *B. fatalis* was mainly collected in the period from summer to autumn, while *B. longirostris* was abundantly found in the winter season in general. The general aspect of the occurrence of *B. fatalis* at the principal stations in the writer's investigation is as seen in Table 4.

Table 4.

Station	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
H-3	—	·	—	—	—	—	—	—	+	rr	r	rr
H-5	—	—	—	rr	·	·	rr	·	+	—	—	—
Y-HN	·	·	·	·	cc	·	·	cc	·	r	·	—
T	·	·	·	·	c	·	·	·	·	·	·	·
G-1	·	·	·	·	·	·	·	·	·	·	·	·
K-N	·	·	·	·	·	·	·	c	·	+	·	·
K-K	·	·	·	·	·	·	·	+	·	r	·	·

Bosmina longirostris (O. F. MÜLLER)

(Fig. 4, p-s)

This species was found at three stations in the Hankow region. All of the specimens obtained are of *contorta* (JURINE) form, with the hook-shaped antennules. In the adult form, the mucro is very short and blunt, having no incision on its either side, but in the

Table. 5

St.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
H-2	r	r	r	·	·	·	—	—	rr	rr	cc	c
H-3	—	cc	rr	rr	rr	—	—	rr	r	r	c	·
H-4	—	—	—	—	—	—	—	—	rr	rr	+	—

case of the younger one the mucro is slender and has almost always one or two incisions on one or both sides.

The seasonal distribution of this species observed in the writer's collections is as seen in Table 5.

Bosminopsis deitersi RICHARD

This species occurred in the collections of the Yangtse-kiang, Lake Tungting-hu and Tachao-hu near Yoyang.

As its occurrence in the potamoplankton has hitherto been rather commonly known, this species seems to have a comparatively remarkable adaptability to the running-water environment. UÉNO (1937) reported its occurrence in Non-ho, the northern branch of the River Sungari, Manchuria.

Macrothrix rosea (JURINE)

A comparatively small number of specimens was found at several localities.

Alona rectangula G. O. SARS

(Fig. 6, a, b)

Among the three species of *Alona* which were identified in the present investigation, this species was the commonest one, being found at various stations.

Alona costata G. O. SARS

(Fig. 6, c, d)

This species occurred at several stations, being found, in most cases, together with the preceding species.

Alona karua KING ?

(Fig. 6, e, f)

A small number of not fully matured specimens which were regarded as this species was found in the collection of Hankow St. 4.

A. karua may be recognized by its characters which follow : distinctly striated shell, presence of three teeth on the post-ventral corner of the shell, markedly expanded postabdomen, very small basal spine of the terminal claw.

A. karua has been recorded from Africa, Indo-Malayan Region, South America and

Australia. SPANDL (1925) recorded this species from Kwantung (South China) and Peking (North China), and UÉNO (1936) reported an occurrence of this species in Lake Ngardok in Babelthaop, Palau Islands.

Length : about 0.41 mm.

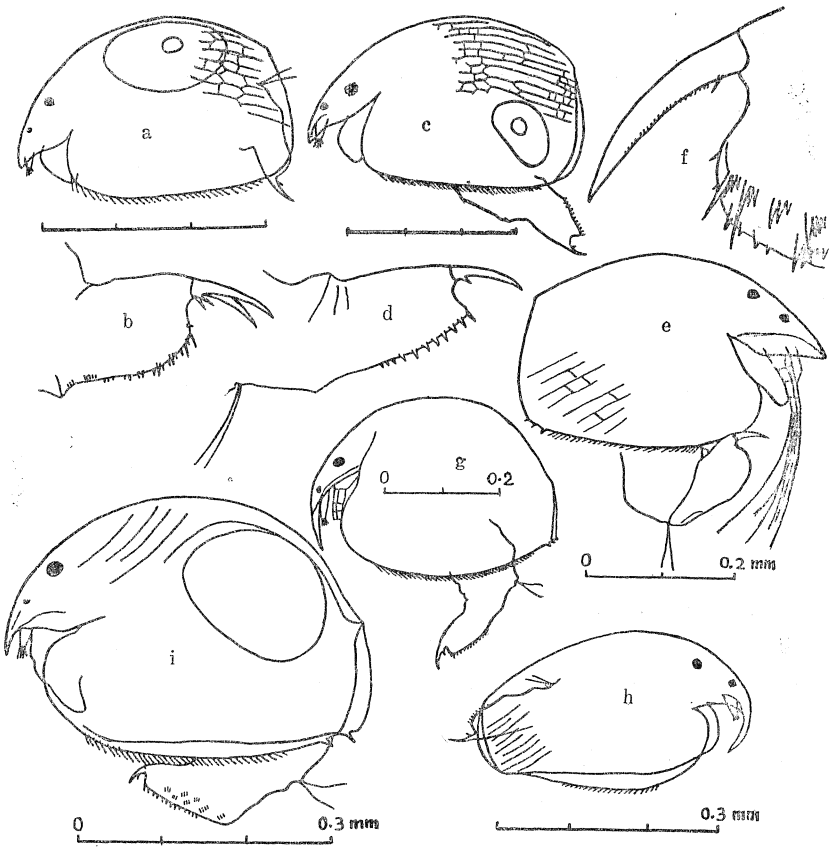

Fig. 6. a, b. *Alona rectangula* (H-4, April 22) ; c, d : *A. costata* (W-1, March 30) ; e, f. *A. karua* ? (H-3, July 24) ; g. *Pleuroxus trigonellus* (H-4, June 1) ; h. *Pl. striata* (H-4, July 24) ; i. *Dunhevedia crassa* (P-1, May 17).

Pleuroxus trigonellus O. F. Müller
(Fig. 6, g)

This species was more or less commonly found at many stations.

Pleuroxus striatus SCHOEDLER
(Fig. 6, h)

This species was found by UÉNO (1940, 1944) in Manchuria and Central China, but has not hitherto been recorded in the Japanese Islands.

Dunhevedia crassa KING
(Fig. 6, i)

This species is easily recognizable by the following characters :

Shell tumid, rounded oval in form, with a short tooth-like projection on each ventral edge near the posterior corner ; postabdomen short and broad, and markedly angular beyond the anal orifice ; caudal claws short and much curved.

A study on the geographical distribution of this species was offered by DECKSBACH in 1930. According to him, about 75 localities scattered in a considerably wide area almost throughout the world were known before that time. The localities of this species hitherto known in China and Japan are as follows : Kwanuntg (SPANDL, 1925), Hangchow (UÉNO, 1944), Tsitsihar, Manchuria (UÉNO, 1940), two lakes in Ishikawa Prefecture, Japan (MASHIKO et INOUÉ, 1952).

BREHM (1914) pointed out that there was a close resemblance between the distribution of *D. crassa* and that of *Diaptomus salinus*. According to FADEEW, *D. crassa* was found in a salt-water lake by the Tiflis, co-existing with such salt-water forms as *D. salinus*, *Brachionus plicatilis*, *Pedalia fennica* etc. (DECKSBACH, 1930). Recently, the writer found *D. crassa* in two lakes in Japan, Kiba-gata and Shibayama-gata, which are situated near the coast of the Sea of Japan and have the chlorinity of about 57–271 and 50–215 mg/L, respectively (MASHIKO et INOUÉ, 1952).

In the present investigation, *D. crassa* was found at two stations, *viz.*, P–1 and H–4. The station P–1 is a small weedy pool beside the hot spring of Liuchia, and here a comparatively large number of individuals was collected. As this pool was connected, at its one end, with the warm water which overflowed from the hot spring and, at the other end, with the cold water which slowly flowed into it, the water temperature of the pool ranged from 34° to 38°C. (May 16, 1941). The following forms were seen together at this station :

Macrocyclops fuscus (c), *Eucyclops serrulatus* (cc), *Simosa vetuloides* (c), *Alona rectangula* (r), *D. crassa* (c), *Testudinella patina* (c), *Monostyla quadridentata* (r), and an ostracod, *Herpetocypris* sp. (c).

The Hankow St. 4 (H–4) is a weedy lakelet of typical eutrophic type and here a small number of *D. crassa* was collected on June 28 and Aug. 14, 1941. The principal forms found in this station at the same time are as follows :

Eucyclops serrulatus, *Thermocyclops hyalinus*, *Latonopsis australis*, *Sida crystallina*, *Simosa vetuloides*, *Asplanchna brightwellii*, *Filinia longiseta*, *Perdinium* sp. and *Anabaena* sp.

These plankton associations seem to be nearly of the same type as that of a pond in an islet in Lake Si-hu near the city of Hangchow. This pond is another locality of *D. crassa* in Central China, where, besides this species, UÉNO (1944) found such Cladocera as *L. australis*, *S. crystallina*, *Streblocerus* sp., *Chidorus sphaericus* and *Alona rectangula*. Judging from these facts, the high salinity itself is not always indispensable to *D. crassa*,

though it is a halophilous form which can be distributed in a considerably wide range of salinity.

Leptodora kindtii (FOCKE)

This large-shaped cladoceran occurred in the Yangtse-kiang and Hankow St. 5.

This species is known to have a wide distribution in the northern hemisphere. In the Japanese Islands, it is also widely found in Kiushu, Honshu, Hokkaidô, and the Kurile Islands, though the number of lakes in which it occurs is rather limited. In Manchuria, UÉNO (1936, 1937) reported its occurrence in Non-ho, the northern branch ot the River Sungari.

B. ROTATORIA

YAMAMOTO (1944) recorded 26 genera and 65 species in his investigation of the rotifers from the fresh-waters of the Yangtse Delta. In the present investigation, the writer could identify the following 20 genera and 42 species and varieties. The localities mentioned here include the principal ones but not all of them. Though the writer observed some more species in his collections, they are excluded here, because the samples in which were they contained have been lost and their exact identification is difficult at present.

Fam. ***Asplanchnidae***

1. *Asplanchna brightwellii* GOSSE (Fig. 7, a) : H–1, H–2, H–3, H–4, H–5, H–6.
2. *A. sieboldi* (LEIDIG) (Fig. 7, b) : K–N, K–K.

Fam. ***Synchaetidae***

3. *Synchaeta* sp. : H–7, Y–HN.

Fam. ***Filinidae***

4. *Filinia longiseta* (EHRBG,) var. *limnetica* ZACHARIAS (Fig. 7, d) : H–1, H–3, H–4, H–5, K–N, K–K.
5. *F. terminalis* (PLATE) (Fig. 7, c) : H–2.
6. *Tetramastix opoliensis* ZACH. var. *brevispina* AHLSTROM (Fig. 7, e, f) : H–3, K–K.
7. *Polyarthra euryptera* WIERZYSKI (Fig. 7, j, k) : H–3, H–5.
8. *P. trigla* (EHRENBERG) (Fig. 7, g, i) : H–1, H–2, H–3, H–4, H–9, K–N, K–K.

Fam. ***Trichocercidae***

9. *Trichocerca bicristata* (GOSSE) (Fig. 7, l) : H–5.
10. *T. cylindrica* (IMHOF) : H–3, H–4, H–5, K–N, K–K.
11. *T.* sp. (Fig. 7, m) : H–5, K–N, K–K.
12. *Diurella stylata* EYFERTH : K–K, K–N.

Fam. ***Trichotridae***

13. *Trichotria tetractis* (EHRENBERG) (Fig. 7, n) : H–2, H–5, CY–2, T.

Fam. ***Mytilinidae***

14. *Mytilina mucronata* (O. F. MÜLLER) (Fig. 7, p) : W–1.
15. *M. ventralis* (EHRENBERG) (Fig. 7, o) : H–2, H–3, H–4, K–N, K–K, W–1.

Fam. ***Euchlanidae***

16. *Euchlanis dilatata* EHRENBERG (Fig. 7, u) : H-2, H-5, K-N, K-K.

Fam. ***Lecanidae***

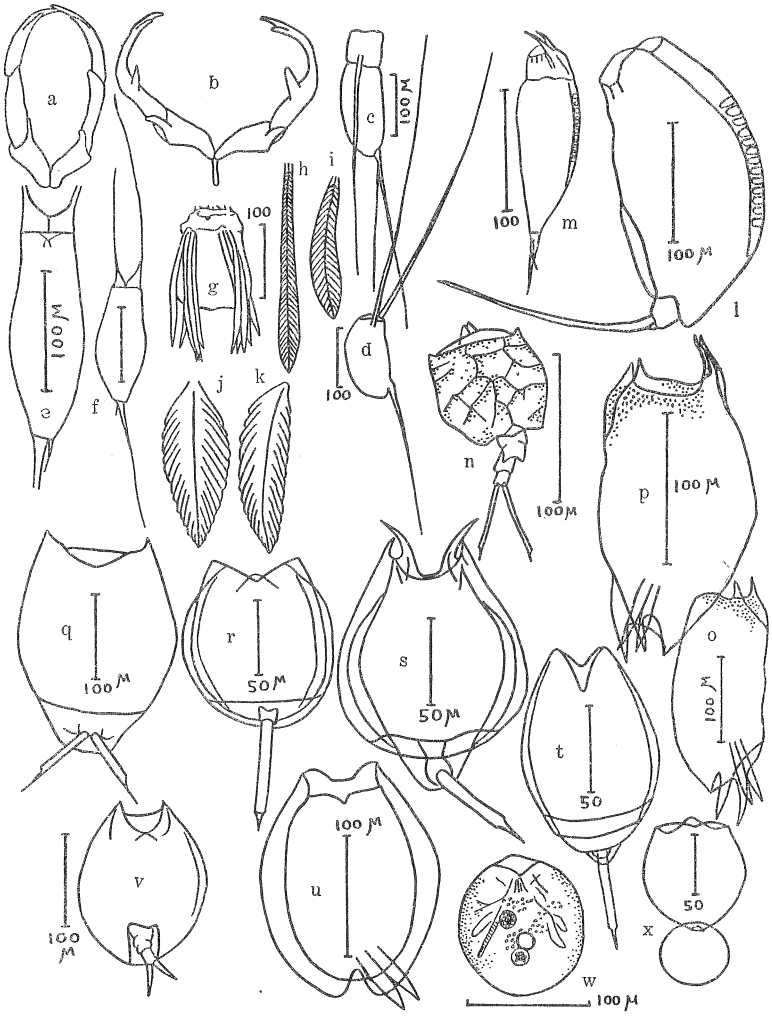

Fig. 7. a. *As. brightwellii*, trophi (H-1, Mar. 28) ; b. *As. sieboldi*, trophi, (K-K, Aug. 31) ; c. *F. terminalis* (H-1, Feb. 10) ; d. *F. longiseta* var. *limnetica* (H-3, Aug. 14) ; e. f. *Tet. opoliensis* var. *brevispina* (K-K, Oct. 6 ; H-3, Sept. 10) ; g. *P. trigla* (H-3, Jan. 27) ; h, i. do. (H-3, Oct. 16) : j, k. *P. euryptera* (H-5, Dec. 9) ; l. *Trca. bicristata* (H-5, Nov. 17) ; m. *Trca.* sp. (K-K, Oct. 6) ; n. *Trtr. tetractis* (H-5, Nov. 16) ; o. *Myt. ventralis* (W-1, Nov. 22) ; p. *Myt. mucronata* ; q. *L. ungulata* (K-N, Aug. 31) ; r. *Mon. lunaris* (H-5, Nov. 17) ; s. *Mon. quadridentata* (K-N, Oct. 6) ; t. *Mon. bulla* (H-2, May 6) ; u. *Eu. dilatata* (H-5, Apr. 28) ; v. *Lep. ovalis* (H-4, Mar. 15) ; w. *Test. patina* (T, May 18) ; x. *Pom. complanata* (H-5, Oct. 12).

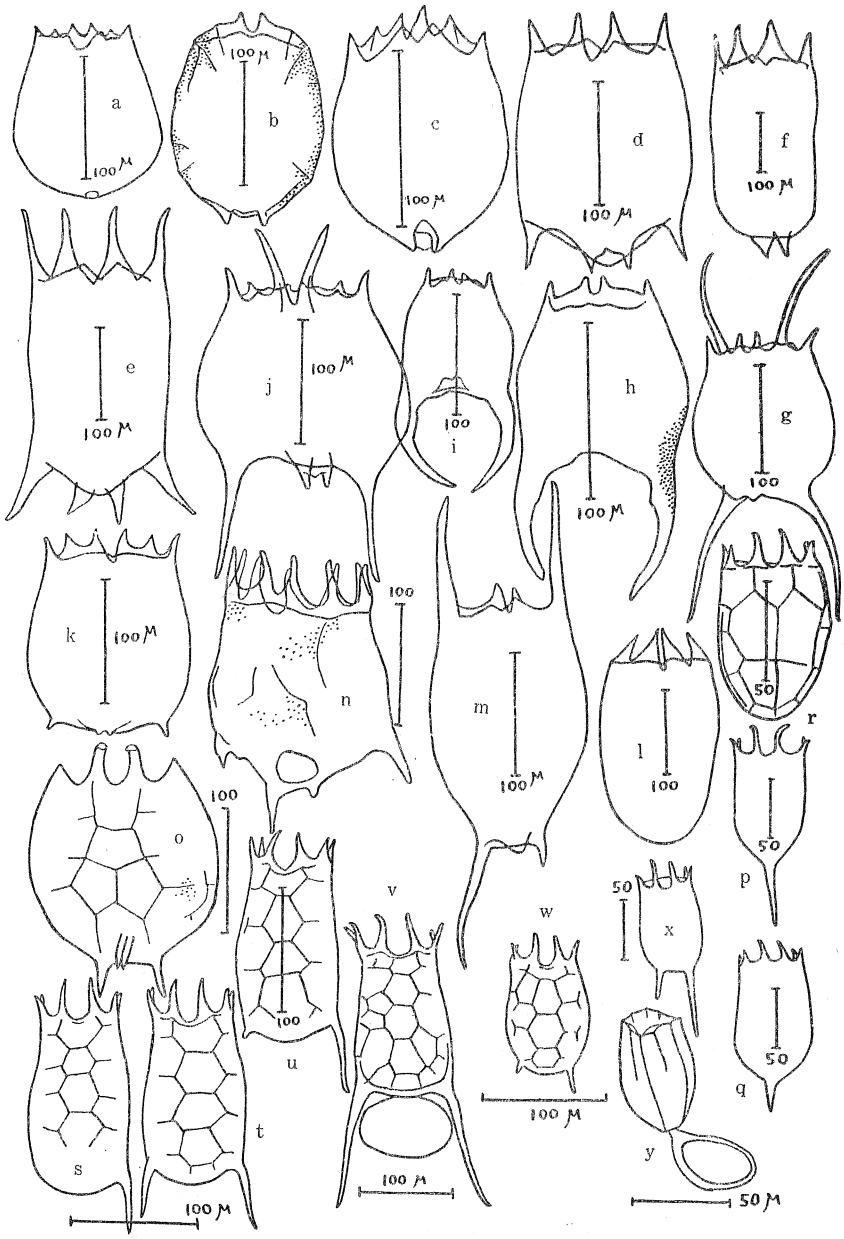

Fig. 8. a. *Br. urceolaris*? (H-5, June 28) ; b. *Br. angularis* (H-2, Jan. 13) ; c. *Br. rubens* (H-1, May 6) ; d, e. *Br. calyciflorus* (H-5, Oct. 12 ; H-3, Mar. 15) ; f. *Br.* c. var. *dorcus* (H-3, Jan. 13) ; g. *Br. falcatus* H 2, Sept. 10) ;h, i. *Br. forficula* (K N, Oct. 6 ; H-5, Apr. 28) ; j, k. *Br. quadridentatus* (H-4, Aug. 14 ; H-2, May 6) ; l. *Br. budapestinensis* (H-4, Jan. 13) ; m. *Sch. diversicornis* (H-5, Sept. 14) ; n. *Pl. patulus* (H-3, Dec. 7) ; o. *Pl. quadricornis* (H-4, Aug. 14) ; p, q. *K. cochlearis* (G-T, May 18; H-3, June 28) ; r. *K. c.* var. *tecta* (K-N, Oct. 6) ; s-v. *K. quadrata*; s, t. H-4, Jan. 19; u. H-2, Jan. 13; v. H-1, Feb. 14 ; w, x. *K. valga* (H-5, Oct. 12 ; Y-HN, July 30); y. *An. fissa* (H-5, Oct. 12).

17. *Lecane luna* (O. F. MÜLLER) : H-2, H-4, K-N, K-K.
18. *L. ungulata* (GOSSE) (Fig. 7, q) : K-N, K-K.
19. *Monostyla bulla* GOSSE (Fig. 7, t) : H-2, H-4, K-N, K-K.
20. *M. quadridentata* EHRENBERG (Fig. 7, s) : H-4, K-N, K-K, P-1.
21. *M. lunaris* (EHRENBERG) (Fig. 7, r) : H-4, H-5, K-N, K-K.

Fam. ***Colurellidae***

22. *Lepadella ovalis* (O. F. MÜLLER) (Fig. 7, v) : H-4.

Fam. ***Testudinellidae***

23. *Testudinella patina* (O. F. MÜLLER) (Fig. 7, w) : H-2, H-4, K-N, K-K, P-1, T.
24. *Pompholyx complanata* GOSSE (Fig. 7, x) : H-1, H-5, K-N, K-K.

Fam. ***Brachionidae***

25. *Brachionus angularis* GOSSE (Fig. 8, b) : H-2, H-3, K-N, K-K.
26. *B. budapestinensis* DADAY (Fig. 8, l) : H-4.
27. *B. calciflorus* PALLAS (Fig. 8, d, e) :
    f. *amphiceros* : H-1, H-5, K-N, K-K.
    f. *spinosus* : H-2, H-3, K-N, K-K.
28. *B. c.* var. *dorcus* GOSSE (Fig. 8, f) : H-1, H-3, K-N, K-K, G-2, G-3.
29. *B. falcatus* ZACHARIAS (Fig. 8, g) : H-2.
30. *B. forficula* WIERZYSKI (Fig. 8, h, i) : H-3, H-5, K-N, K-K.
31. *B. quadridentatus* HERMANN (Fig. 8,j, k) : H-2, H-4, K-N, K-K, P-1.
32. *B. rubens* EHRENBERG (Fig. 8, c) : H-1, H-2, H-3.
33. *B. urceolaris* O. F. MÜLLER (Fig. 8, a) : H-4, H-5 (?).
34. *Schizocerca diversicornis* DADAY (Fig. 8, m) : H-1, H-3, H-5, H-7, K-N, K-K.
35. *Platyias patulus* (O. F. MÜLLER) (Fig. 8, n) : H-2, H-3, H-4, H-10.
36. *P. quadricornis* (EHRENBERG) (Fig. 8, o) : H-2, H-4.
37. *Keratella cochlearis* (GOSSE) (Fig. 8, p, q) : H-2, H-3, H-4, H-5, K-K.
38. *K. c.* var. *tecta* (GOSSE) (Fig. 8, r) : H-1, H-2, H-3, H-4, H-5, K-N, K-K.
39. *K. valga* (EHRENBERG) (Fig. 8, w, x) :
    f. *asymmetrica* : H-3, H-5, K-N, K-K.
    f. *tropica* : Y-HN.
    f. *monostrosa* : H-4, K-N, K-K.
40. *K. quadrata* (O. F. MÜLLER) (Fig. 8, s, t) : H-1, H-2, H-3, H-5.
41. *Anuraeopsis fissa* GOSSE (Fig. 8, y) : H-5.

Fam. ***Pedalionidae***

42. *Pedalia mira* (HUDSON) : H-3, H-4.

The stations where the rotifers were especially rich in number of species as well as of individuals were Hankow St. 2, St. 4, weedy lakelets in the northern suburbs of the city, and St. 5, a comparatively deep lakelet on the north-western side of the city, and two lakelets on the southern side of the city of Kiukiang, Nanmen-hu and Kantang-hu. It may be a striking phenomenon that the rotifers in the Yangtse-kiang are, as is unusual in large rivers,

extremely scanty through the year both in number of species and of individuals. Except for a small number of *K. valga* and a few individuals of some other species, non of the rotifers could be found in the writer's collections. This phenomenon may be due, as already mentioned by LEMMREMANN (1907), to the fact that the rotifers cannot adapt themselves to the turbid stream of the Yangtse-kiang.

Of the two species of *Asplanchna*, *A. brightwellii* was widely found in the Hankow region, being abundant especially in the period from winter to early spring. Hankow St. 4, a weedy lakelet, was the only exceptional locality, where this species occurred in the summer period, but not in other seasons. *A. sieboldi* was collected in two lakes of Kiukiang, Nanmen-hu and Kantang-hu, in summer and autumn. It may be an interesting fact that, so far as the writer's collections are concerned, these common forms of the rotifers seem to have entirely different geographical distribution in Central China respectively.

According to the study of Manchurian rotifers by YAMASAKI (1938), *Keratella quadrata* which is regarded as a cold-water species is not found in the summer period even in the southern plain of Manchuria, while the closely allied form, *K. valga*, which is regarded as a warm-water species is never found in the winter period. In Central China, *K. quadrata* was collected at four localities, being, in most cases, of typical *divergens* form. Only at Hankow St. 2, f. *quadrata s. str.* with asymmetric posterior spines occurred very abundantly together with a small number of f. *valgoides* in January. In the writer's collections also, *K. quadrata* was generally found in the winter period. At Hankow St. 1, however, it occurred commonly, if not abundantly, in March and even in April, but never in January and February. *K. valga* was found at six localities mainly in the period from summer to autumn. Most of the specimens of this species collected in the present investigation belong to f. *asymmetrica*, and a small number of individuals found in the Yangtse-kiang is regarded as f. *tropica*. Generally speaking, *K. valga* is apparently smaller in size than *K. quadrata*. In Central China, the distribution of various forms of *K. valga* was reported by YAMAMOTO (1944) and other authors, but the occurrence of *K. quadrata* has never been recorded. It may be due to the fact that the collections of the previous authors were not made in the winter season.

B. forficula was found at four stations, being apparently abundant in summer or early autumn. *B. falcatus* occurred only in the sample collected at Hankow St. 2 on Sept. 10, and *Tetramastix opoliensis* var. *brevispina* was rarely found in the samples collected in summer and autumn at three localities. These three species are known as tropical or subtropical species.

Generally speaking, the predominant occurrence of the tropical or subtropical forms seems to be in the season more or less later than midsummer, and that of the boreal forms in the season later than midwinter. This tendency of late appearance seems to take place not only in the case of Rotatoria but in the case of Cladocera.

Br. calici florus seems to be predominant in the winter as well as the summer season.

At the Hankow St. 1, a pond in front of the Kiang-hang High School, a remarkable

Table 6.

date(1941-42)	Jan. 27	Feb. 14	March 14	April 15	May 6	May 30	Sept. 26
surface water temperature °C	5.5	4.0	19	22	26.5	29	·
As. brightwellii	—	+	cc	c	rr	—	rr
Br. rubens	—	—	—	—	r	cc	—
Br. calyciflorus	+	—	r	+	—	—	—
P. trigla	cc	r	r	r	—	—	—
F. longiseta	+	ccc	+	ccc	—	—	—
Cyclops vicinus	cc	c	+	r	rr	+	r
Moina dubia var.	—	—	—	—	ccc	ccc	+

alternation of the dominant species of the rotifers was observed during a comparatively short period as shown in Table 6.

At St. P–1, a small weedy pool beside the hot spring of Liuchia, *Testudinella patina* and *Monostyla quadridentata* were found, and the former species was considerably abundant. The water temperature of this station was between 34° and 38°C.

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