

New Records of Three Oxytrichid Hypotrichs (Ciliophora: Hypotrichida: Oxytrichidae) from the Han River in Seoul, Korea

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Three species of oxytrichid hypotrichs collected from the Han River on June 6, and August 26, 1992 have been cultured at laboratory. They were identified as *Oxytricha hymenostoma* Stokes, 1887, *O. haematoplasma* Blatterer and Foissner, 1990 and *Tachysoma pellionellum* (Müller, 1773). These species are reported for the first time from Korea. Morphological and biometrical studies were carried out by observing both wild and cultured cells and the infraciliature of silver stained specimens. The present species were redescribed and analyzed biometrically.

KEY WORDS: Ciliophora, Hypotrichida, Oxytrichidae, infraciliature, biometry, Korea

The hypotrichs represent a highly diverse species displaying a wide range of form and function that reflects extensive radiation in a wide variety of habitats. The saprobic waters usually contain diverse assemblage of hypotrichs. However, because of their delicate morphology and small size, hypotrichs have been poorly characterized (Borror, 1972; Foissner, 1980, 1982; Shin and Kim, 1988; Berger and Foissner, 1989; Shin *et al.*, 1992). In this paper, we redescribed three species of oxytrichid hypotrichs collected from Korea.

was observed by using the protargol and wet silver impregnation method (Wilbert, 1975; Foissner, 1992; Lynn, 1992). The drawings of the impregnated specimens were made with aid of a camera lucida. All counts and measurements were undertaken at the magnifications of X400 - X1600. Biometrical analysis was performed using the methods described in Sokal and Rohlf (1973). We followed the terminology of Borror (1972), Foissner (1982), Hemberger (1981), and Corliss and Lom (1985). The classification scheme used was in accordance with that of Corliss (1979).

Materials and Methods

The specimens were collected from the Han River (37° 32' N, 127° 02' E) in Seoul, Korea on June 6, and August 26, 1992, respectively. Laboratory cultures were maintained in a commercial mineral water provided with boiled wheat grain and shrimp meats supplying fungal and bacterial nutrients for hypotrichs.

The shapes of the living specimens on slides were drawn without cover slips. The infraciliature

Systematic Accounts

Phylum Ciliophora Doflein, 1901
Class Polyhymenophora Jankowski, 1967
Order Hypotrichida Stein, 1859
Family Oxytrichidae Ehrenberg, 1838
Genus *Oxytricha* Ehrenberg, 1830

1. *Oxytricha hymenostoma* Stokes, 1887
(Fig. 1, Table 1)
Oxytricha hymenostoma Stokes, 1887 (pp.

111, fig. 10); Kahl, 1932 [p. 603, fig. 113(27)]; Foissner *et al.*, 1991 (pp. 289-291, figs. 1-5)

Oxytricha ludibunda: Kahl, 1932 [p. 603, fig. 121(1)]

Oxytricha hymenostomata: Hemberger, 1981 (pp. 149-150); Dragesco and Dragesco-Kernéis, 1986 (pp. 461-463, figs. 136a-j)

Material examined: 15 wild living specimens were collected from the Han River in Seoul, Korea on June 6 and August 26, 1992 and these were cultured. 7-13 protargol impregnated specimens were analyzed biometrically and their data were summarized in Table 1.

Description: General morphology: Body soft and flexible, subelliptical or oval in shape, flattened dorso-ventrally, 120-190 x 50-85 μm *in vivo*; anterior and posterior ends rounded; left-hand body margin concave anteriorly; dorsal surface convex. Movement rapid.

Frontal and buccal fields: Frontal cirri three and prominent; frontoventral cirri four; buccal cirri one. Adoral zone of membranelles 36-56 μm , coering approximately 41% of body length, with

prominent 26-31 adoral membranelles. Buccal field deep, comprising endoral membrane and paroral membrane, 22-38 μm long. Pharyngeal fibers at base of buccal field extending to middle of body.

Somatic infraciliature: Ventral cirri five, three of which positioning at near base of peristomial field, two at near transverse cirri; posterior region with five transverse cirri. Caudal cirri three. Both marginal cirri extending almost to posterior end; right marginal cirri beginning at region beside frontoventral cirri, right marginal cirri with 17-23; left marginal cirri beginning at region beneath 7-10th adoral membranelles, 14-20 in number; number of left marginal cirri less than that of right ones. Dorsal surface having six dorsal kineties, mid-dorsal kinety with approximately 15 cilia; cilia on dorsal surface bristle-like, approximately 5 μm long, some of them more or less shortened.

Nuclear organelles with two oval macronuclei, 18-20 x 10-11 μm ; two micronuclei spherical, approximately 4 x 4 μm . Contractile vacuole spherical, positioning at near center of left margin

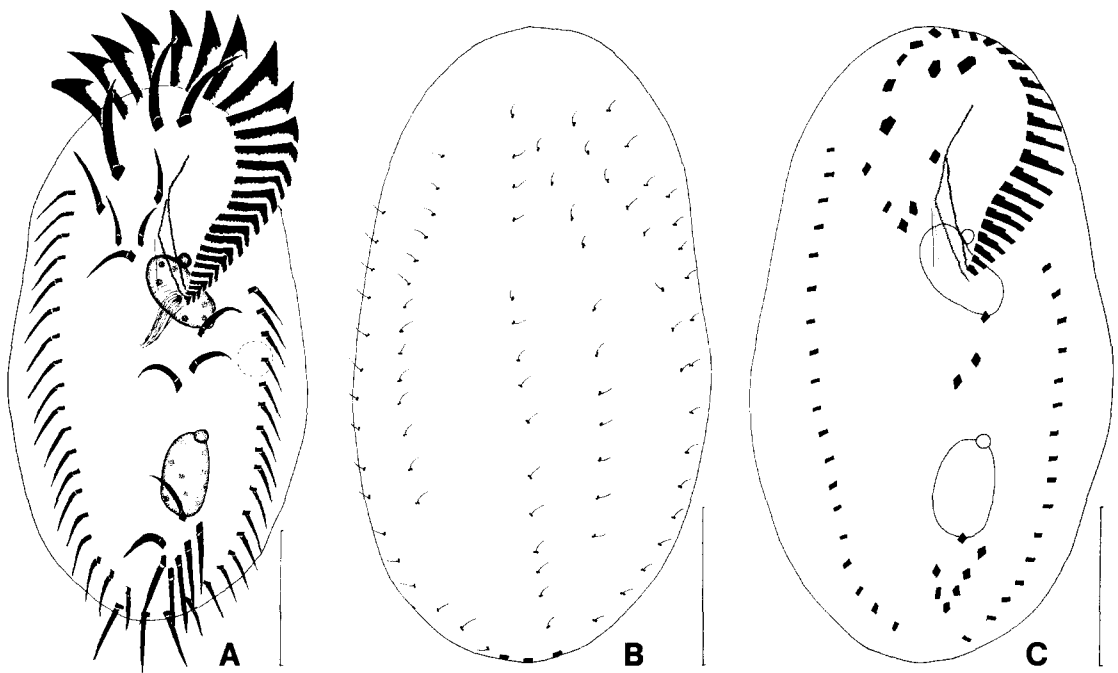


Fig. 1. *Oxytricha hymenostomata* Stokes: A, living specimen, ventral view. B, same, lateral view. C, infraciliature after protargol impregnation, dorsal view (Scale bar = 30 μm).

of body.

Remarks: The variation ranges of present specimens were poorly overlapped with those of American population (Stokes, 1887) and European populations (Kahl, 1932; Hemberger, 1981; Foissner *et al.*, 1991), while well overlapped with those of African population (Dragesco and Dragesco-Kernéis, 1986) in body size, proportion of body length to body width and number of various cirri. We think that Korean population is one of the ecological races of this species, which has close affinity with African population.

The present species is related to *Oxytricha haematoplasma* Blatterer and Foissner, 1990 but distinguishable from the latter in several respects. First of all, in the proportions of body length to peristomial length, the latter is larger than the former. Second, the former has six dorsal kineties, while the latter has four. Third, the former has

three caudal cirri, while the latter has one. Fourth, the former has more right marginal cirri than the left one has, while the latter has more left marginal cirri than the right one has.

For the evaluation of biometrical data, we calculated the coefficients of variation (CV) (see Table 1). The following characters showed the CV of 0.00: the number of buccal cirri, frontal cirri, frontoventral cirri, transverse cirri and caudal cirri. Thus these characters are found to be very constant and therefore important as the diagnostic features of the species or the genus. Comparatively low CV ranging from 5.02 to 10.90 were shown in the following characters: length and width of macronucleus, number of the dorsal kineties, the adoral membranelles and the marginal cirri. These characters are also very important for identification of species because of their low variability. Other characters showed fairly high value of CV ranging from 11.54 to 17.61.

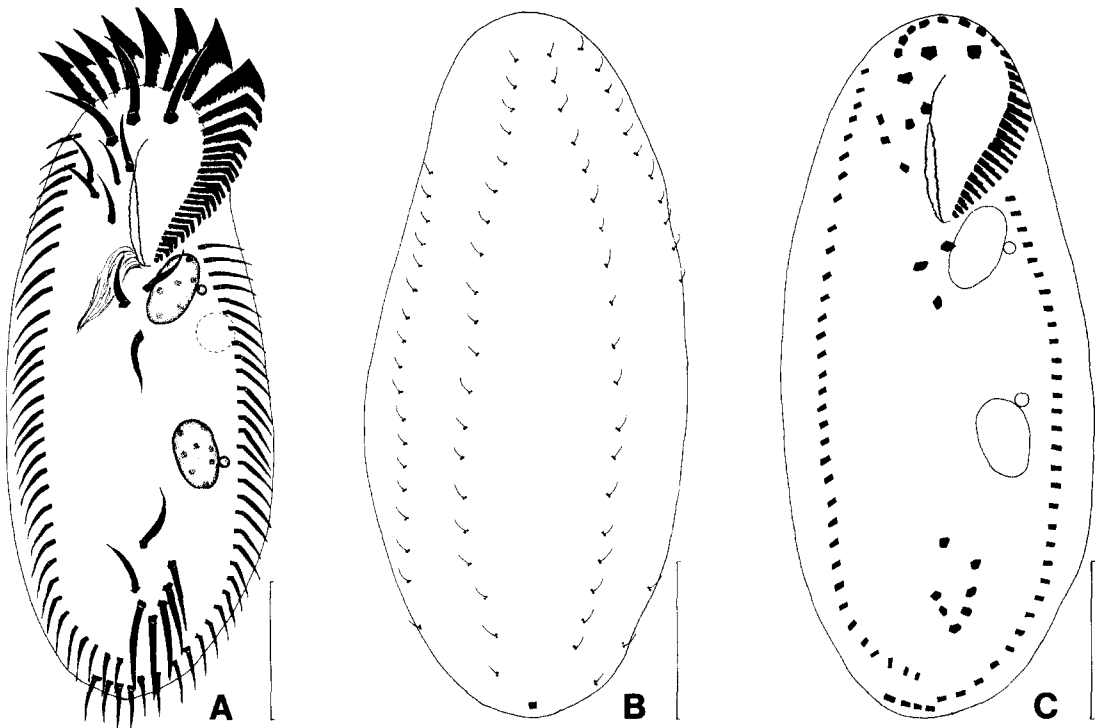


Fig. 2. *Oxytricha haematoplasma* Blatterer and Foissner: A, living specimen, ventral view. B, same, lateral view. C, infraciliature after protargol impregnation, dorsal view (Scale bar = 30 μm).

Table 1. Biometrical characterization of *Oxytricha hymenostoma* Stokes¹⁾, *O. haematoplasma* Blatterer & Foissner²⁾ and *Tachysoma pellionellum* (Müller)³⁾. All data were based on protargol-impregnated specimens.

Characters	Mean	Median	Max.	Min.	SD	SE	CV	n
Body length ¹⁾	119.90	120	150	90	17.51	5.54	14.60	10
Body length ²⁾	133.22	128	160	112	18.12	6.04	13.60	9
Body length ³⁾	87.50	86.5	100	79	6.87	2.43	7.85	8
Body width ¹⁾	63.60	64	80	47	11.20	3.54	17.61	10
Body width ²⁾	62.78	70	80	42	13.67	4.56	21.78	9
Body width ³⁾	38.86	38	45	35	3.44	1.30	8.84	7
Body length/width ¹⁾	1.90	1.85	2.19	1.79	0.13	0.04	6.64	10
Body length/width ²⁾	2.18	2.15	2.86	1.78	0.34	0.11	15.75	9
Body length/width ³⁾	2.27	2.29	2.58	1.98	0.21	0.08	9.06	7
AZM length ¹⁾	49.56	50	56	36	6.54	2.18	13.20	9
AZM length ²⁾	44.00	42	51	34	6.10	2.03	13.87	9
AZM length ³⁾	26.75	26.5	32	20	3.58	1.26	13.37	8
Body/AZM length ¹⁾	2.44	2.50	2.90	1.91	0.35	0.12	14.21	9
Body/AZM length ²⁾	3.04	3.05	3.53	2.44	0.30	0.10	9.91	9
Body/AZM length ³⁾	3.32	3.17	4.50	2.86	0.51	0.18	15.27	8
UM length ¹⁾	32.33	34	38	22	5.07	1.69	15.69	9
UM length ²⁾	33.56	32	52	25	7.57	2.52	22.55	9
UM length ³⁾	20.63	21	23	16	2.45	0.86	11.86	8
UM/AZM length ¹⁾	0.65	0.64	0.76	0.59	0.06	0.02	8.55	9
UM/AZM length ²⁾	0.76	0.74	1.02	0.57	0.13	0.04	16.61	9
UM/AZM length ³⁾	0.77	0.79	0.85	0.70	0.05	0.02	7.03	8
Ma length ¹⁾	19.43	20	20	18	0.98	0.37	5.02	7
Ma length ²⁾	19.56	20	22	17	1.88	0.63	9.60	9
Ma length ³⁾	13.14	14	15	11	1.77	0.67	13.49	7
Ma width ¹⁾	10.57	11	11	10	0.53	0.20	5.06	7
Ma width ²⁾	10.67	11	12	9	1.12	0.37	10.48	9
Ma width ³⁾	5.86	6	7	5	0.69	0.26	11.78	7
Mi length ¹⁾	2.89	3	3	2	0.33	0.11	11.54	9
Mi length ²⁾	3.33	3	4	3	0.50	0.17	15.00	9
Mi length ³⁾	3.89	4	4	3	0.33	0.11	8.57	9
Ma number ¹⁾	1.90	2	2	1	0.32	0.10	16.64	10
Ma number ²⁾	2.00	2	2	2	0.00	0.00	0.00	10
Ma number ³⁾	2.00	2	2	2	0.00	0.00	0.00	8
Mi number ¹⁾	2.11	2	3	2	0.33	0.11	15.79	9
Mi number ²⁾	2.00	2	2	2	0.00	0.00	0.00	8
Mi number ³⁾	1.00	1	1	1	0.00	0.00	0.00	8
DK number ¹⁾	5.90	6	6	5	0.32	0.10	5.36	10
DK number ²⁾	4.13	4	5	4	0.35	0.13	8.57	8
DK number ³⁾	6.00	6	7	5	0.50	0.17	8.33	9
AM number ¹⁾	28.15	28	31	26	1.52	0.42	5.40	13
AM number ²⁾	25.80	26	30	21	3.52	1.11	13.65	10
AM number ³⁾	20.63	20.5	22	19	1.06	0.38	5.14	8
BC number ¹⁾	1.00	1	1	1	0.00	0.00	0.00	10
BC number ²⁾	1.00	1	1	1	0.00	0.00	0.00	10
BC number ³⁾	1.00	1	1	1	0.00	0.00	0.00	10
FC number ¹⁾	3.00	3	3	3	0.00	0.00	0.00	10
FC number ²⁾	3.00	3	3	3	0.00	0.00	0.00	10

Table 1. Continued

Characters	Mean	Median	Max.	Min.	SD	SE	CV	n
FC number ³⁾	3.00	3	3	3	0.00	0.00	0.00	10
FVC number ¹⁾	4.00	4	4	4	0.00	0.00	0.00	10
FVC number ²⁾	4.00	4	4	4	0.00	0.00	0.00	10
FVC number ³⁾	4.00	4	4	4	0.00	0.00	0.00	10
VC number ¹⁾	4.90	5	5	4	0.32	0.10	6.45	10
VC number ²⁾	5.00	5	5	5	0.00	0.00	0.00	10
VC number ³⁾	5.00	5	5	5	0.00	0.00	0.00	10
TC number ¹⁾	50..	5	5	5	0.00	0.00	0.00	10
TC number ²⁾	5.00	5	5	5	0.00	0.00	0.00	10
TC number ³⁾	5.00	5	5	5	0.00	0.00	0.00	10
CC number ¹⁾	3.00	3	3	3	0.00	0.00	0.00	10
CC number ²⁾	0.70	1	1	0	0.48	0.15	69.01	10
LMC number ¹⁾	17.64	18	20	14	1.69	0.51	9.58	11
LMC number ²⁾	32.33	32	35	27	2.40	0.80	7.42	9
LMC number ³⁾	16.00	16	17	15	0.53	0.19	3.34	8
RMC number ¹⁾	20.00	20	23	17	1.90	0.57	9.49	11
RMC number ²⁾	31.00	32	35	27	2.98	0.94	9.62	10
RMC number ³⁾	15.50	15.5	17	14	0.93	0.33	5.97	8

The abbreviations in the table are as follows: AM: adoral membranelles; AZM: adoral zone of membranelles; BC: buccal cirrus; CC: caudal cirri; CV: coefficient of variation in %; DK: dorsal kinety; FC: frontal cirri; FVC: frontoventral cirri; LMC: left marginal cirri; Ma: macronucleus; Max.: maximum; Mi: micronucleus; Min.: minimum; n: size of individuals examined; RMC: right marginal cirri; SD: standard deviation; SE: standard error of the mean; TC: transverse cirri; UM: undulating membrane; VC: ventral cirri.

2. *Oxytricha haematoplasma* Blatterer and Foissner, 1990 (Fig. 2, Table 1)

Oxytricha haematoplasma Blatterer & Foissner, 1990 (pp. 106-113, figs. 5a-e, tab. 4); Foissner *et al.*, 1991 (pp. 287-288, figs. 1-5)

Material examined: 15 wild living specimens were collected from the Han River in Seoul, Korea on June 6 and August 26, 1992 and these were cultured. 8-10 protargol impregnated specimens were analyzed biometrically and their data were summarized in Table 1.

Description: General morphology: Body soft and flexible, elongate, elliptical in shape, flattened dorso-ventrally, 100-180 × 50-90 μm *in vivo*; anterior and posterior ends rounded; central part parallel; dorsal surface convex. Movement rapid.

Frontal and buccal fields: Frontal cirri three and prominent; frontoventral cirri four; buccal cirri one. Adoral zone of membranelles 34-51 μm, covering approximately 33% of body length, with prominent 21-30 adoral membranelles. Buccal

field deep, with endoral membrane and paroral membrane, 25-52 μm long. Pharyngeal fibers at base of buccal field extending to middle of body.

Somatic infraciliature: Ventral cirri five, three of them positioning at near the base of peristomial field, two at near transverse cirri; posterior region with five transverse cirri. Caudal cirri one or none. Both marginal cirri extending almost to posterior end; right marginal cirri beginning at region beside first frontal cirri, right marginal cirri with 27-35; left marginal cirri beginning at region beneath 7-10th adoral membranelles; number of left marginal cirri more than right ones. Dorsal surface having four dorsal kineties, mid-dorsal kinety with approximately 20 cilia; cilia on dorsal surface bristle-like, approximately 5 μm long, some of them more or less shortened.

Nuclear organelles with two elliptical macronuclei, 17-22 × 9-12 μm; two micronuclei spherical, 3 × 3 μm. Contractile vacuole located behind adoral zone of membranelles.

Remarks: The variation ranges of Korean

population was well overlapped with those of European population except several characters (Blatterer and Foissner, 1990). First of all, the former is bigger than the latter. Second, the former is more stout than the latter, with the proportion of body length to body width 2.18 and 2.74 respectively. Third, the density of membranelle in the adoral zone of the former is lower than that of the latter, the former has approximately 25.8 adoral membranelles while the latter has 38.4. Fourth, the former has more sparse marginal cirri than the latter has.

The following characters showed the CV of 0.00: the number of macronucleus and micronucleus, buccal cirri, frontal cirri, frontoventral cirri, ventral cirri and transverse cirri. Thus these characters are found to be very constant and therefore important as the diagnostic features of the species or the genus. Comparatively low CV ranging from 7.42 to 10.48 were shown in the following characters: length

and width of macronucleus, number of dorsal kineties, and number of both marginal cirri. These characters are also very important for the identification of species because of their low variability. Other characters showed fairly high value of CV ranging from 13.60 to 69.01 (Table 1).

3. *Tachysoma pellionellum* (Müller, 1773) (Fig. 3, Table 1)

Trichoda pellionella Müller, 1773 (cited from Foissner *et al.* 1991, p. 304)

Oxytricha (Tachysoma) pellionella: Kahl, 1932 [p. 606, fig. 113(31)]

Tachysoma pellionella: Wang and Nie, 1935 (pp. 497-500, fig. 68); Borror, 1972 (p. 15, fig. 36); Grolière, 1975 (pp. 491-492, fig. 19); Foissner and Didier, 1981 (pp. 259-260, figs. 4a-e, tab. 4); Hemberger, 1981 (pp. 243-248, figs. 44a-h)

Tachysoma pellionellum: Foissner *et al.*, 1991

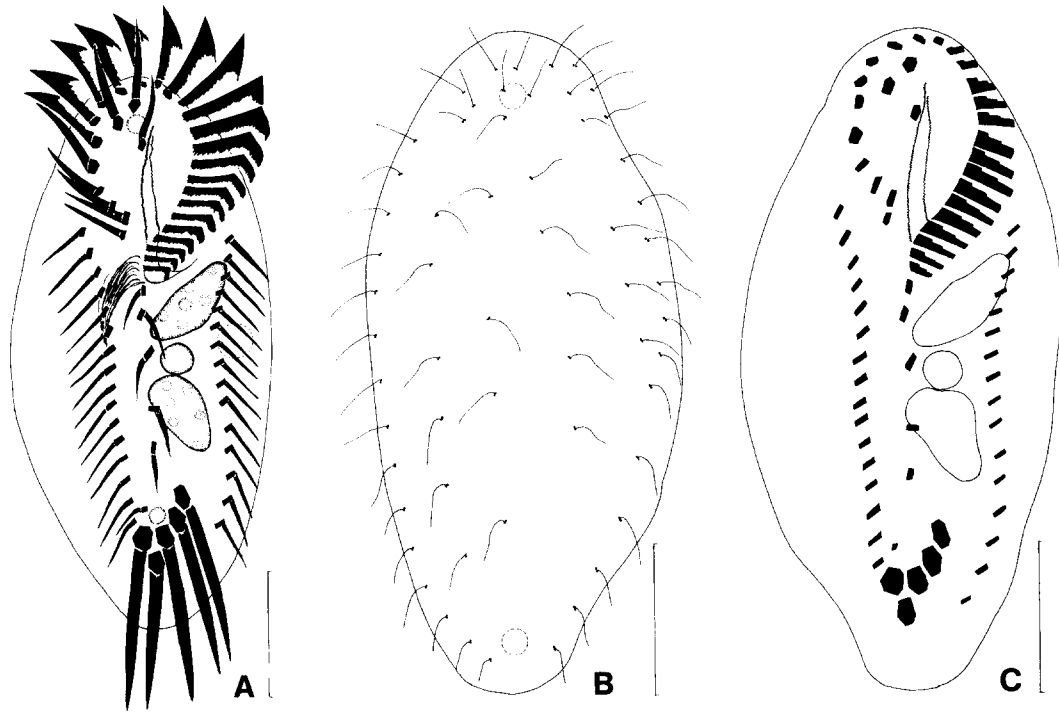


Fig. 3. *Tachysoma pellionellum* (Müller): A, living specimen, ventral view. B, same, lateral view. C, infraciliature after protargol impregnation, dorsal view (Scale bar = 20 μ m).

(pp.304-308, figs.1-11)

Material examined: 30 wild living specimens were collected from the Han River in Seoul, Korea on June 6 and August 26, 1992 and these were cultured. 7-10 protargol impregnated specimens were analyzed biometrically and their data were summarized in Table 1.

Description: General morphology: Body flexible, elongate, spindle-form in shape, flattened dorso-ventrally, 80-110 x 35-55 μm *in vivo*; anterior and posterior ends rounded; widest at middle; dorsal surface convex. Movement rapid.

Frontal and buccal fields : Frontal cirri three and prominent; frontoventral cirri four; buccal cirri one. Adoral zone of membranelles 20-32 μm , covering approximately 30 % of body length, with prominent 19-22 adoral membranelles. Buccal field deep, comprising endoral membrane and paroral membrane, 16-23 μm long. Pharyngeal fibers at base of buccal field extending to middle of body.

Somatic infraciliature : Ventral cirri five, located at middle region of body. Transverse cirri five, strong and situated at posterior region of body, projecting beyond posterior end for a considerable distance. Caudal cirri absent. Right and left marginal cirri not joining posteriorly; right marginal cirri beginning at region beside third frontoventral cirrus, number of right one 14-17; left marginal cirri beginning at region beneath seventh adoral membranelle, number of left one 15-17. Dorsal surface having six kineties; mid-dorsal kinety with approximately 8 cilia, rather loosely arranged; cilia on dorsal surface fine and very long, approximately 10-15 μm , some of them more or less shortened.

Nuclear organelles with two elliptical macronuclei, 11-15 x 5-7 μm ; one micronucleus spherical, positioning at between two macronuclei, 4 x 4 μm . Cytoplasm transparent. Contractile vacuole located at left margin of body. Two fat vacuoles positioning at anterior and posterior region

Remarks: This Korean population was well accorded with other local populations except several characters. First, the body sizes of individuals of Korean and Chinese populations (Wang and Nie, 1935) was slightly bigger than

those of German (Kahl, 1932; Foissner *et al.*, 1991) and French (Grolière, 1975; Foissner and Didier, 1981) populations. Second, our specimens and Foissner group's (Foissner and Didier, 1981; Foissner *et al.*, 1991) had six dorsal kineties while Grolière's (1975) had five. Third, fat vacuoles were described only in the Korean, Chinese and German populations.

The following characters showed the CV of 0.00: the number of macronucleus and micronucleus, buccal cirri, frontal cirri, frontoventral cirri, ventral cirri and transverse cirri. Thus these characters are found to be very constant and therefore important as the diagnostic features of the species or the genus. Comparatively low CV ranging from 3.34 to 9.06 were shown in the following characters: length and width of body, length of micronucleus, number of dorsal kineties, adoral membranelles and both marginal cirri. These characters are also very important for the identification of species because of their low variability. Other characters showed fairly high value of CV ranging from 11.78 to 15.27 (Table 1).

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서울지역 한강에 서식하는 3종의 미기록 하모충류
신만균 · 김 원 (서울대학교 자연과학대학 분자생물학과)

1992년 6월 6일과 8월 26일에 서울의 한강에서 채집하여 실험실에서 배양된 하모충류가 *Oxytricha hymenostoma* Stokes, 1887, *O. haematoplasma* Blatterer and Foissner, 1990와 *Tachysoma pellionellum* (Müller, 1773) 등 3종이 밝혀졌다. 이 종들은 과거 한국에서 기록이 없던 것이다. 서식처에서 채집된 표본과 배양된 것을 생체로 관찰하고 Protargol로 염색하여 섬모하부구조를 관찰하여 통계처리 하였으며 재기재 하였다.