

Taxonomic and Floristic Accounts of the Genus *Trachelomonas* Ehrenberg 1833 (Euglenophyceae) from Korea

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한국산 담수조 *Trachelomonas*속 (Euglenophyceae)의 분류와 조류상. 김준태 · 부성민* · Alain Couté¹ (충남대학교 생물학과, ¹프랑스자연사박물관)

본 연구는 한국 담수산 *Trachelomonas* 속을 대상으로 분류학적 이해에 입각한 종속지를 마련하고자 함에 그 목적이 있다. 재료는 1994년 5월부터 1997년 6월 까지 한국 전역의 58 담수계에서 총 231회 채집되었다. 총 47 분류군의 분류학적 기재, 그림 및 사진을 제시하였다. 이 중 19 분류군이 한국산 *Trachelomonas* 종속지에 미기록으로 보고되었고, *T. curta* var. *reticulata*, *T. koreana*, *T. planctonica* var. *papillosa*, *T. spina*는 신종 또는 신 변종으로 기재한다. 따라서 한국산 *Trachelomonas* 종속지는 기 보고된 23 분류군과 더불어 총 70 분류군으로 정리되었다. *Trachelomonas* 종들은 방죽이나 자연늪 등과 같이 유기물질과 영양염류가 풍부한 오래된 정체수역에서 다양하게 출현하였다. *T. bacillifera*, *T. hispida*, *T. volvocina*는 춘계와 하계에 자연늪이나 양어장에서 대발생하는 경향을 보였다.

Key words : Euglenophyceae, Flora, Fresh waters, Monograph, *Trachelomonas*, Taxonomy, Korea

INTRODUCTION

The genus *Trachelomonas* (Ehrenberg, 1833) is a large genus including freeswimming members with lorica enclosing a cell body or protoplast. The lorica morphology has been criteria for the taxonomic accounts of the genus. Playfair (1915, 1921) and Conrad (1916) described many taxa based on the cell envelope. Deflandre (1926) defined above 200 species with 810 illustrations (including *Strombomonas* species) and proposed a taxonomic scheme on the basis of lorica features in the monograph. Since Huber-Pestalozzi (1955) described 235 species in the world, the morphological taxonomy of *Trachelomonas* has been studied in North America (Tiffany and

Britton, 1952), South America (Yacubson and Bravo, 1982-83; Tell and Domitrovic, 1985; Tell and Conforti, 1986; Conforti and Tell, 1988; Conforti, 1991), India (Ashtekar, 1982), and Europe (Wolowski, 1992; Wolowski and Hindak, 1996). The ultrastructural taxonomy also was studied (Couté and Iltis, 1981; Couté and Thérézien, 1985, 1994; Conforti and Tell, 1986; Conforti and Joo, 1994).

Trachelomonas species in Korea have been reported as a part of limnological studies on a local basis. For example, the taxonomic accounts were given in the Kyeonggi province (Skvortzov, 1932; Chung, 1956; Chung and Chang, 1957), in the Yeongnam province (Chung, 1970, 1982; Chung and Kim, 1992, 1993), in the Jeju province (Chung *et al.*, 1972), and in the Cheonnam

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Table 1. Water types and collection dates of sampling sites.

Sampling sites		Water types	Collection dates
CB1	Chungjuho Danyang	lake	20 AUG 1996
CB2	Mihocheon Cheongju	urban drainage	6 OCT 1996, 4 JAN 1997
CB3	Mushimcheon Cheongju	urban drainage	6 OCT 1996, 4 JAN 1997
CLB1	Jiahm Wanju	swamp	29 JUN 1997
CLB2	Yeosan Yeosan	swamp	26 MAY 1997
CLB3	Yonghwa Iksan	swamp	26 MAY 1997
CLB4	Pyeongjang Iksan	fishery farm	26 MAY 1997
CLB5	Samcheoncheon Cheonju	urban drainage	15 SEP, 24 OCT, 30 NOV, 29 DEC 1996; 27 JAN, 28 FEB, 30 MAR, 27 APR, 26 MAY, 29 JUN, 25 JUL, 31 AUG 1997
CLB6	Duckjinmot Cheonju	pond	15 SEP 1996
CLB7	Unilahm Jinahn	mountainous stream	23 APR 1997
CLN1	Kwangjucheon Kwangju	urban drainage	29 DEC 1996; 5 APR, 31 AUG 1997
CLN2	Jungwoimot Kwangju	pond	5 APR 1997
CLN3	Uncheonmot Kwangju	swamp	10 NOV, 29 DEC 1996
CLN4	Haenam Haenam	reservoir	10 NOV 1996; 20 JAN 1997
CLN5	Gogun Jindo	reservoir	20 JAN 1997
CLN6	Suncheon Suncheon	roadside ditch	19 JAN 1997
CN1	Nambanje Asan	swamp	9 MAR, 4 APR 1997
CN2	Yesan Yesan	swamp	9 MAR 1997
CN3	Goahm Hongsung	swamp	22 JUN 1997
CN4	Dohwadam Boryeong	mountainous stream	19 AUG, 10 SEP, 9 OCT, 3 NOV 1994; 29 JUN, 16 SEP, 3 NOV 1995; 19 MAY, 21 JUN, 8 SEP, 3 NOV 1996
CN5	Neukjon Boryeong	mountainous stream	Same dates of CN4
CN6	Pyeongna Boryeong	mountainous stream	Same dates of CN4
CN7	Hwapyeong Boryeong	mountainous stream	Same dates of CN4
CN8	Kumgang Shintanjin	river	21 MAY, 20 JUN, 30 JUL, 20 AUG, 10 SEP, 21 OCT 1994; 21 JAN, 26 MAR, 28 MAY, 29 JUL, 29 OCT, 30 DEC 1995
CN9	Kumgang Daepyeong	river	Same dates of CN8
CN10	Kumgang Kongju	river	Same dates of CN8
CN11	Kumgang Buyeo	river	21 MAY, 20 JUN, 30 JUL, 20 AUG, 10 SEP, 21 OCT 1994; 21 JAN, 26 MAR, 28 MAY, 29 JUL, 29 OCT, 30 DEC 1995; 29 FEB, 4 APR, 23 JUN, 21 JUL, 25 AUG, 22 SEP, 27 OCT, 18 NOV, 15 DEC 1996; 27 JAN, 28 FEB, 30 MAR, 27 APR, 25 MAY, 29 JUN, 25 JUL, 31 AUG 1997
CN12	Kumgang Kanggyeong	river	Same dates of CN8
CN13	Kumgang Napo	river	Same dates of CN11
CN14	Sucksung Buyeo	roadside ditch	15 DEC 1996
CN15	Nonsan Nonsan	reservoir	26 MAY 1997
CN16	Daejoncheon Daejon	urban drainage	29 NOV, 21 DEC 1996; 27 JAN, 6 APR, 30 AUG 1997
CN17	Gapcheon Daejon	urban drainage	6 JUN, 25 JUN, 9 SEP 1995; 29 JUN, 25 SEP, 22 OCT, 21 DEC 1996
CN18	Yeongtapji Daejon	pond	16 AUG 1996
J1	Jeju Jeju	roadside ditch	15 JAN 1997
J2	Yeomiji Jeju	pond	15 JAN 1997
KB1	Andongho Andong	lake	25 DEC 1996
KB2	Naesungcheon Andong	urban drainage	25 DEC 1996
KB3	Jickjisa Kimcheon	roadside ditch	6 APR 1997
KB4	Kumhogang Daegu	urban drainage	25 DEC 1996; 6 APR, 30 AUG 1997
KB5	Bongmumot Daegu	pond	6 APR 1997

Table 1. Continued.

KB6	Susungmot Daegu	pond	25 DEC 1996
KB7	Kyeongjucheon Kyeongju	urban drainage	19 JAN 1997
KB8	Bomunho Kyeongju	lake	22 APR 1997
KB9	Guryongpo Pohang	roadside ditch	22 APR 1997
KG1	Ilweolji Suwon	swamp	20 APR 1997
KG2	Seoho Suwon	reservoir	15 FEB, 20 APR 1997
KG3	Woncheon Suwon	reservoir	20 APR 1997
KN1	Sajipo Changnyeong	natural wetland	5 JUN 1997
KN2	Upo Changnyeong	natural wetland	5 JUN 1997
KN3	Daepyeong Hamahn	natural wetland	6 JUN 1997
KN4	Sidong Hamahn	natural wetland	6 JUN 1997
KN5	Jiral Hamahn	natural wetland	6 JUN 1997
KN6	Namgang Jinju	river	19 JAN 1997
KN7	Nakdonggang Gupo	river	19 JAN 1997
KW1	Kyeongpoho Kangneung	lake	25 DEC 1996, 25 FEB, 21 APR 1997
KW2	Samchuck Samchuck	roadside ditch	25 DEC 1996
KW3	Wonju Wonju	roadside ditch	18 JAN 1997

province (Chung, 1975; Wui and Kim, 1987). Most of Korean *Trachelomonas* species have been described with a very short description and/ or a few illustrations. There have furthermore been few works on *Trachelomonas* on a national scale.

The purpose of this study was to give the taxonomic and floristic accounts, and to try to understand the biological diversity of Korean *Trachelomonas*. This study provides the detailed descriptions and illustrations using specimens from various waters throughout whole country of Korea.

MATERIALS AND METHODS

A total of 231 water samples were collected from May 1994 to June 1997 in 58 waters throughout Korea (Table 1). Collections and observations of samples are in details described by Kim and Boo (1998) and Kim *et al.* (1998, 2000). All the specimens were observed under X1,000 using a light microscope (Olympus VANOX AHBT3). The alive materials were also observed under an inverted microscope (Olympus IX70). The illustrations were made using a drawing apparatus. Cell and organelle dimension was given as a mean from the measurement of 50~100 cells. The voucher specimens of this study have been deposited as liquid samples, slides, iconographs, and photographs in the herbarium of Chungnam National University, Daejeon, Korea. New reports for the world flora are marked with two asterisks (**), and for the Korean

flora with an asterisk (*) in front of the species name.

OBSERVATIONS

1. *Trachelomonas abrupta* (Swirenko) Deflandre var. *arcuata* (Playfair) Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours. p. 93. Figs. 366–368. 1926) Figs. 43, 75

Synonyms: *T. australis* var. *arcuata* Playfair 1915. *T. abrupta* var. *arcuata* f. *angustata* Deflandre 1926.

Lorica 23~30 µm long, 12~16 µm broad, cylindrical ellipsoid with nearly straight and parallel lateral sides, rounded anteriorly, broadly attenuated or conically rounded posteriorly, densely covered with minute spines. Flagellum aperture surrounded by circle of spines (3~4 µm in diameter). Chloroplasts parietal discoid without pyrenoid (8~13 in number). Paramylon bodies oval to rod shaped (below 3 µm). Nucleus 5~6 µm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CB2, CLB3, CLB5, CN11, CN13, CN16, KB6, KN1, KN3, KN4. It was previously reported as f. *angustata* by Wui and Kim (1987) in Cheonnam. It is a rare variety recorded in Australia and Europe (France, Russia).

Remarks: Playfair (1915) described *T. australis*, but Deflandre (1926) renamed it as an infraspecific taxon of *T. abrupta* based on the shape and dimensions of cells. The morphology of

Korean specimens accords with the protologue.

2a. *Trachelomonas acanthostoma* (Stokes)

Deflandre var. *acanthostoma* (Stokes) Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours. p. 60–61. Figs. 60, 66, 76–77. 1926) Figs. 17, 66

Lorica 25–34 μm long, 21–26 μm broad, subglobose to broadly ellipsoid with slightly swelled lateral sides, densely porous in surface. Flagellum aperture encircled by one or two rows of short blunt spines (4–6 μm in diameter). Chloroplasts parietal discoid with double sheathed pyrenoid (5–8 in number, 5–8 μm in diameter). Paramylon bodies oval to rod shaped (below 4 μm). Nucleus 8–13 μm in diameter. Flagellum same to one and half times lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB4, CLB5, CLB6, CN9, CN11, CN13, KN3, KN4, KN5. It was previously recorded in Cheonnam (Chung, 1975). It is a cosmopolitan and common variety. It was recorded in America (Argentina, USA), Asia (Soviet Union) and Europe (France, Poland).

Remarks: *Trachelomonas acanthostoma* Stokes was emended by Deflandre (1926) based on the spines circumscribing the flagellum aperture. That peculiar arrangement of short spines is observed in Korean specimens. Korean specimens have chloroplasts with a double sheathed pyrenoid.

2b. **Trachelomonas acanthostoma* (Stokes)

Deflandre var. *minor* Drezepolski (Kosmos 50: 259. Fig. 23. 1925) Figs. 12, 61

Lorica 18–21 μm long, 15–19 μm broad. Flagellum aperture encircled by one row of short blunt spines (2–3 μm in diameter). Chloroplasts two parietal discoid with double sheathed pyrenoid. Flagellum two to three times to lorica length. This variety is distinguished by the cell dimensions. The two doubly sheathed chloroplasts are similar with *T. volvocina*.

Occurrence and world distribution: CLB1, CLB3, CLB5, KN1, KN2, KN3, KN5. It is a cosmopolitan, but not common variety. It was recorded in Asia (Soviet Union) and Europe (France, Poland).

3. *Trachelomonas anguste-ovata* Conrad in

Conrad and Van Meel 1952 (Mém. Inst. R. Sci. Nat. Belg. 124: p. 75. Pl. 7, Fig. 11. 1952) Figs.

46, 85

Synonym: *T. conica* var. *ovata* Playfair 1915.

Lorica 32–37 μm long, 13–19 μm broad, cylindrical to ovoid with slightly swelled and angulate lateral margin, narrowed and angularly rounded anteriorly, narrowed into bluntly conical apex posteriorly, densely pitted with minute pinhole and entirely beset with sharp spines (1–2 μm long). Flagellum aperture with low collar; collar surrounded by circle of spines at mouth (1–2 μm in height, 3–5 μm in diameter). Chloroplasts parietal discoid without pyrenoid (10–20 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 8–10 μm in diameter. Flagellum one and half to twice to times lorica length.

Occurrence and world distribution: CLB2, CLB3, KG3, KN3, KN4. It was previously recorded in Kyeongnam (Chung and Kim, 1993). It is a rare species recorded in Australia (Playfair, 1915), Netherlands (Conrad and Van Meel, 1952), and Argentina (Conforti, 1986).

Remarks: This variety is distinguished by the spiny surface of lorica. It is similar to the infra-specific taxa of *T. conica* by the angulate and ovoid cell with the conical apiculation in posterior end. However, it is peculiar in having minute spines on the lorica surface.

4a. *Trachelomonas armata* (Ehrenberg) Stein

var. *armata* (Ehrenberg) Stein (Der Organismus Infusion. 3: Pl. 22, Figs. 37–38. 1878) Figs. 37, 93

Synonym: *T. armata* var. *nana* Balech 1944.

Lorica 29–36 μm long, 22–27 μm broad, broadly ellipsoid to ovoid, irregularly and densely porous in surface: in front slightly narrowed and rounded with or without several short conical spines; at backward broadly rounded with or without short and robust spines. Flagellum aperture surrounded by short annular thickening, sometimes slightly denticulate at rim (4–6 μm in diameter). Chloroplasts parietal discoid without pyrenoid (12–21 in number, 5–8 μm in diameter). Paramylon bodies oval to rod shaped (below 3 μm). Flagellum one and half to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB5, CLB6, CLN4, CN9, CN11, CN13, KG2, KN1, KN3, KN4. It was previously recorded in Jeju (Chung *et al.*, 1972) and Cheonnam (Wui and Kim, 1987). It is a cosmopolitan

and common species. It was recorded in Africa (Egypt, Congo), America (Brazil, Argentina, USA), Asia (India, Japan, Soviet Union) and Europe (Belgium, Denmark, France, Holland, Italy, Poland).

Remarks: Bicudo and De-Lamonica-Freire (1993) established a taxonomic category of Stein's species on fulfillment of the original illustrations. In Korean specimens, the distinct short spines are erect in the circumference of flagellum pore in an anterior portion or in both anterior and posterior portion.

4b. *Trachelomonas armata (Ehrenberg) Stein var. *armata* f. *inevoluta* Deflandre (Mou. du genre *Trachelomonas* Ehr. Nemours. p. 88. Figs. 321, 325. 1926) Figs. 38, 90

Synonym: *T. ovalis* Playfair 1921.

Lorica 30~41 μm long, 24~30 μm broad, irregularly and densely punctate. This forma is distinguished by the lorica surface lacking the spines. The exterior features of Korean specimens accord those of previous studies (Deflandre, 1926; Philipose, 1988).

Occurrence and world distribution: CLB2, CLB3, CLB5, CLB6, KB6, KN3, KN4. It is a cosmopolitan, but not common species. It was recorded in America (Argentina, Brazil) and Europe (France).

4c. Trachelomonas armata (Ehrenberg) Stein var. *steinii* (Lemmermann) Deflandre emend. Bicudo et De-Lamonica-Freire (Arch. Hydrobiol. Suppl. **69**: 64-65. Figs. 6-14. 1993) Figs. 40, 92

Synonyms: *T. armata* var. *punctata* Swirenko 1913. *T. armata* var. *ovata* Swirenko 1915. *T. armata* var. *duplex* Playfair 1921. *T. armata* var. *duplex* Playfair f. *jorhatensis* Philipose 1988. *T. armata* var. *steinii* (Lemmermann) Deflandre 1926. *T. armata* var. *steinii* Lemmermann f. *punctata* (Swirenko) Deflandre 1926. *T. armata* var. *longispina* (Playfair) Deflandre 1926. *T. armata* var. *longispina* f. *punctata* Philipose 1988. *T. armata* var. *longa* Deflandre 1926. *T. armata* var. *longa* f. *pseudolongispina* Deflandre 1926. *T. armata* var. *nana* f. *javanica* Huber-Pestalozzi 1955. *T. armata sensu* Tiffany et Britton 1952. *T. armata* var. *litoralensis* Tell et Dimitrovic 1985. *T. armata* var. *malabarica* Philipose 1988.

Lorica 32~45 μm long, 25~35 μm broad, in

front slightly narrowed and rounded with irregular series of short conical spines (2~5 μm in length), at backward broadly rounded with a series of long, robust, curved and convergent spines (8~17 μm long), with or without short conical spines. Flagellum aperture surrounded by short annular thickening and by circle of spines in circumference of pore (4~6 μm in diameter). This variety is distinguished by the features of lorica spines. Bicudo and De-Lamonica-Freire (1993) reviewed the diagnostic features of *T. armata* and proposed that many infraspecific taxa by the lorica spines should be synonymized to var. *steinii*.

Occurrence and world distribution: CB3, CLB1, CLB2, CLB3, CLB5, CLB6, CN3, CN9, CN11, CN13, KG3, KG2, KN1, KN2, KN3, KN4. It was previously recorded in Cheonnam (Chung, 1975; Wui and Kim, 1987). It is a cosmopolitan and common variety. It was recorded in America (Argentina, Brazil, USA, Venezuela), Asia (India, Japan, Soviet Union) and Europe (France, Italy).

5a. *Trachelomonas bacillifera Playfair var. *bacillifera* Playfair (Proc. Linn. Soc. New South Wales. **40**(1): 22. Pl. 3, Fig. 13. 1915) Figs. 23, 79

Synonym: *T. hispida* var. *niezabitowskii* Dreze-polski 1925.

Lorica 30~37 μm long, 23~28 μm broad, subspherical to broadly ellipsoid with swelled lateral sides, broadly rounded at both end, porous and irregularly covered with short rod-like obtuse spines (2~3 μm in length). Flagellum aperture with or without annular thickening and irregularly encircled with blunt spines (2~3 μm in diameter). Chloroplasts parietal discoid with double sheathed pyrenoid (5~7 in number). Paramylon bodies oval to rod shaped (below 4 μm). Nucleus positioned in cell center (9~12 μm in diameter). Flagellum same to one and half times to lorica length.

Occurrence and world distribution: CB2, CLB2, CLB3, CLB4, CLB5, CN14, KG3, KN1, KN2, KN5. It is a cosmopolitan, but not common species. It was recorded in Asia (India), Australia and Europe (Belgium).

Remarks: *Trachelomonas bacillifera* is distinguished by the feature of lorica spines. The spines are not spiny but bluntly pointed like a short rod. The chloroplasts of Korean specimens have doubly sheathed by paramylon caps.

5b. *Trachelomonas bacillifera* Playfair var. *minima* Playfair (Proc. Linn. Soc. New South Wales. **40**(1): 22. Pl. 3, Figs. 15–16. 1915) Figs. 21, 74

Lorica 20–25 μm long, 17–22 μm broad, densely covered with short rod-like obtuse spines (below 2 μm long). This variety is distinguished by the rod-like blunt spines and small size. It bloomed in the old and highly nutritive waters such as fishery farms and small-sized reservoirs. During blooming, the watercolor varied from light yellowish brown to deeply reddish brown. Moreover, the distribution and strength (robustness) of the spines is very variable.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB4, CLB5, CLB6, CLN1, CLN5, CN9, CN11, CN13, CN15, KB4, KB9, KG2, KG3, KN1, KN2, KN3, KN4, KN5. It was previously recorded in Kyeongnam (Chung and Kim 1993). It is a cosmopolitan and common variety. It was recorded in America (Argentina, Brazil), Asia (India), Australia and Europe (Belgium, France, Germany).

6a. **Trachelomonas curta* Da Cunha var. *curta* Da Cunha (Mem. Inst. Oswaldo Curz. **5**(2): p. 111. Pl. 10, Fig. 5. 1913) Figs. 2, 48

Synonyms: *T. lismorensis* var. *inermis* Playfair 1915. *T. lismorensis* var. *oblonga* Playfair 1915. *T. volvocina* var. *compressa* Drezepolski 1925. *T. volvocina* var. *compressa* (Drezepolski) Deflandre 1926.

Lorica 13–16 μm long, 15–19 μm broad, compressed globose or transversely ellipsoid with round sides in lateral view, circular in apical view, smooth or minutely papillate in surface. Flagellum aperture surrounded by slightly thickened annular ring (1.4–2.0 μm in diameter). Chloroplasts parietal discoid without pyrenoid (8–12 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 5–8 μm in diameter. Flagellum about two times lorica length.

Occurrence and world distribution: CB2, CLB1, CLB2, CLB3, CLB5, CLN5, CN6, CN10, CN16, KB4, KG3, KN3, KN5, KN6. It was reported in America (Argentina, Venezuela), Asia (Burma, India, Japan), Australia, and Europe (France, Holland, Poland).

Remarks: *Trachelomonas curta* is distinguished by the compressed and globose cells. This species has been confused with *T. volvocina* mem-

bers in being globose in the apical and bottom view, but compressed in the side view. The cell dimensions are in a range of 9–30 \times 11–32 μm (Skvortzov, 1937; Conrad and Van Meel, 1952; Philipose, 1988).

6b. **Trachelomonas curta* (Da Cunha) Deflandre var. *punctata* Skvortzov (Arch. Protistenkund **90**: 69–87, 1937) Figs. 3, 49

Synonyms: *T. lismorensis* f. *punctata* Playfair 1915.

Lorica 12–19 μm long, 16–21 μm broad, densely porous in surface. This variety is distinguished by the punctate surface of lorica, but var. *curta* has a papillate lorica. The cells with this feature had been named under *T. lismorensis* (Playfair, 1915; Skvortzov, 1937).

Occurrence and world distribution: CLB5, CLN1, CLN6, KN1, KN3. It is a cosmopolitan, but not common variety. It was recorded in Asia (Soviet Union) and Australia and Europe (France).

6c. *Trachelomonas curta*** (Da Cunha) Deflandre var. *reticulata* var. nov. Figs. 4, 50

Diagnosis: a typo nova varietas lorica reticulata differt. Loricae longitudo: 11–15 μm ; latitudo: 14–18 μm

Holotypus: figura nostra 4.

Locus typicus: in magnopere nutritorio vel polluto stagno Yonghwa Iksan, Korea.

Lorica 11–15 μm long, 14–18 μm broad, elaborately reticulate in surface. This variety is distinguished by surface feature of lorica. Although var. *curta* has a smooth surface without any ornamentation (Da Cunha, 1913; Philipose, 1988), this new variety from Korea has a reticulate structure on the lorica surface. This feature also contrasts with the warty surface of *T. perlata* Deflandre.

Holotype: Fig. 4.

Etymology: Latin reticulata, possesses a reticulate lorica.

Type locality: Yonghwa Iksan (CLB3), Korea. It was also collected in eutrophicated or polluted waters; CLB1, CLB2, CLB5, KG2.

7. *Trachelomonas cylindrica* (Ehrenberg) Playfair var. *decollata* Playfair (Proc. Linn. Soc. New South Wales **40**(1): p. 13. Pl. 1, Fig. 30. 1915) Figs. 41, 71

Synonyms: *T. abrupta* var. *minor* Deflandre

1926. *T. euchlora* var. *parvula* (Massart) Conrad and Van Meel 1952.

Lorica 19~23 μm long, 9~12 μm broad, cylindrical with parallel sides, broadly rounded at both end, minutely punctate. Flagellum aperture 2~3 μm in diameter, without collar. Chloroplasts discoid without pyrenoid (below ten in number). Paramylon bodies oval to rod shaped (below 2 μm). Nucleus 5~7 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CB3, CLB5, CLN3, CN9, CN10, J2, KB2, KB4, KN2, KN4. It was previously recorded in Cheonnam (Wui and Kim, 1987). It is a cosmopolitan and common variety. It was recorded in America (Argentina), Asia (India, Japan), Australia and Europe (Belgium, Denmark, Germany).

Remarks: This variety is distinguished by flagellum aperture without collar. It is different from *T. abrupta* in having minute spines and from *T. lacustris* in having a large dimension.

8. **Trachelomonas flava* Palmer (Proc. Acad. Nat. Sci. Philadelphia 77: 17. Pl. 1, Fig. 3. 1925) Figs. 1, 51

Lorica 8~10 μm long, 11~16 μm broad, compressed globose or transversely ellipsoid with round sides in lateral view, circular in apical view, sparsely or irregularly beset with very short and blunt papillae-like spines. Flagellum aperture surrounded by slightly thickened annular ring (1.5~2.0 μm in diameter). Chloroplasts parietal discoid without pyrenoid (5~10 in number). Paramylon bodies oval to rod shaped (below 2 μm). Nucleus 4~7 μm in diameter. Flagellum one and half to twice to lorica length.

Occurrence and world distribution: CLB2, CLB3, CLB5, KN3, KN4, KN5. It is a rare species reported in USA by Palmer (1925). This is the second report in the world.

Remarks: *Trachelomonas flava* is distinguished by the spiny papillae on lorica. It is different from *T. lismorensis* in having relatively long spines. The ornaments are tiny and even nipple-shape.

9a. *Trachelomonas hexangulata* Swirenko var. *hexangulata* Swirenko (*Arch. Hydrobiol.* 9: p. 646. Pl. 2, Figs. 23-25, 1914) Figs. 47, 78

Synonym: *T. hexangulata* var. (Playfair) Deflandre 1926. *T. ampullula* Playfair 1915.

Lorica 26~31 μm long, 10~14 μm broad, hexangular ellipsoid, narrowed anteriorly, broadly rounded posteriorly, straight or parallel in lateral sides, smooth in surface. Flagellum aperture with straight and cylindrical collar (3~5 μm in height, 3~4 μm in diameter). Chloroplasts parietal discoid without pyrenoid (8~15 in number). Paramylon bodies oval to rod shaped (3~5 μm). Nucleus 4~6 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, KN1, KN3, KN4. It was previously recorded in Seoul (Skvortzov, 1932) and also reported as var. *major* in Kyeongnam (Chung and Kim, 1993). It is a cosmopolitan and common species. It was recorded in America (Argentina, USA), Asia (India, Japan, Soviet Union), Australia and Europe (France, Poland).

Remarks: *Trachelomonas hexangulata* is distinguished by the hexangular cell forms. Although this species was named as *T. ampullula* by Playfair (1915), Swirenko's publication has the priority, as is adopted by Deflandre (1926).

9b. *Trachelomonas hexangulata* Swirenko var. *repanda* Prescott (*Farlowia*. 1: 370. Pl. 4, Fig. 11. 1944) Figs. 45, 91

Lorica 37~44 μm long, 16~20 μm broad, hexangular ellipsoid, narrowed anteriorly, at backward narrowed and produced into blunt projection. This variety is distinguished by the shape and size (Prescott, 1944). The lateral margins of the lorica are more convex and the posterior lateral margins are more concave, so that a blunt apiculation is produced posteriorly. This variety has the raised ring-like thickening and narrow apical pore, while in *T. napiformis*, the lorica is thickened at midregion of collar.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB6, CLN4, KN1, KN3, KN4, KN5. It was previously recorded in Kyeongnam (Chung and Kim, 1993). It is a cosmopolitan, but not common variety. It was recorded in America (USA) and Asia (Japan).

10. **Trachelomonas hirta* Da Cunha var. *duplex* Deflandre (*Bull. Soc. Bot. France*. 74: 664. Fig. 6. 1927) Figs. 22, 73

Lorica 18~22 μm long, 12~16 μm broad, broadly ellipsoid with swelled lateral sides, broadly rounded at both end, porous and irregularly covered with short rod-like obtuse spines (below

2 μm long) in surface. Flagellum aperture with or without annular thickening and irregularly encircled with blunt spines (2~3 μm in diameter). Chloroplasts parietal discoid without pyrenoid (3~5 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus positioned in cell center (5~9 μm in diameter). Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB4, CN15, KN2, KN5. It is a rare variety recorded in France (Deflandre, 1927). This is the second report in the world.

Remarks: This variety is distinguished by the blunt spines on lorica. The short and stout spines of this variety are different from the sharply pointed spines of the type variety (Da Cunha, 1914). Although the obtuse spines are similar with those of *T. bacillifera* members, the typical ellipsoid form and chloroplast without pyrenoid of this varietal cell are diagnostic.

11a. *Trachelomonas hispida* (Perty) Stein emend. Deflandre var. *hispida* (Perty) Stein emend. Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours. p. 77-78. Figs. 202-203, 207-208, 227. 1926) Figs. 24, 80

Synonyms: *T. hispida* var. *rectangularis* Schroeder 1897. *T. hispida* var. *duplex* Deflandre 1926. *T. hispida* var. *papillata* Skvortzov, 1925b. *T. hispida* var. *punctata* Lemmermann 1906. *T. hispida* var. *australica* Playfair 1915. *T. hispida* var. *granulata* Playfair 1915.

Lorica 22~36 μm long, 20~25 μm broad, broadly ellipsoid with slightly swelled lateral sides, broadly rounded at both end, finely and densely porous, covered with short pointed spines (below 2 μm long) in surface. Flagellum aperture with or without annular thickening or sometimes encircled with spines at rim (4~6 μm in diameter). Chloroplasts parietal discoid with double sheathed pyrenoid (6~15 in number, 5~8 μm in diameter). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 10~14 μm in diameter. Flagellum one and half to two times to lorica length. Stigma present.

Occurrence and world distribution: CB3, CLB1, CLB2, CLB3, CLB5, CLB6, CLN2, CLN3, CLN4, CN1, CN2, CN4, CN6, CN10, CN11, CN13, CN14, CN15, CN16, CN18, KB1, KB4, KB6, KB7, KB8, KG1, KG2, KN1, KN3, KN4, KN6, KN7. It was previously recorded in Seoul (Skvortzov, 1932), Kyeongnam (Chung, 1970) and Cheon-

nam (Wui and Kim, 1987). It is a cosmopolitan and common species. It was recorded in America (Argentina, Brazil, USA, Venezuela), Asia (India, Japan, Soviet Union), Australia and Europe (England, France, Germany, Poland).

Remarks: *Trachelomonas hispida* is distinguished by the features of cell shape, flagellum aperture and lorica ornament. The diagnostic features delimiting infraspecific taxa in *T. hispida* are overlapped among them (West, 1977; West and Walne, 1980a; West *et al.*, 1980). The distributions of spines on lorica surface are extremely variable in Korean specimens.

11b. *Trachelomonas hispida* (Perty) Stein emend. Deflandre var. *coronata* Lemmermann (in Pascher (ed.), Süssw. F. 2: 150. 1913) Figs. 26, 82

Synonym: *T. hispida* var. *coronata-punctata* Skvortzov 1937.

Lorica 26~37 μm long, 19~26 μm broad. Flagellum aperture with distinct collar; collar crown-shaped by attached spines at base (4~6 μm in diameter, 2~3 μm in height). This variety is distinguished by a crown-like collar with the margin bearing a circle of sharp spines. The spines are uniformly beset with the margin and join at the base. That feature is also well agreed with those of previous studies (West and Walne, 1980b; Couté and Thérézien 1994). The chloroplasts of the starved cells are known to have a double sheathed pyrenoid (Pringsheim, 1953; Bourrelly, 1970; Philipose, 1988).

Occurrence and world distribution: CB3, CLB2, CLB3, CLB5, CLB6, CLN2, CN1, CN11, CN13, CN16, KB4, KB9, KG2, KN1, KN3. It was previously recorded in Kyeongnam (Chung, 1970). It is a cosmopolitan and common variety. It was recorded in America (Argentina, Brazil, USA), Asia (India, Japan, Soviet Union), Australia and Europe (England, France, Germany).

11c. **Trachelomonas hispida* (Perty) Stein emend. Deflandre var. *crenulatocollis* (Maskell) Lemmermann (In Krypto. der Mark Branden 3: 526. 1910) Figs. 25, 81

Synonyms: *T. crenulatocollis* Maskell 1886. *T. hispida* var. *coronata* f. *recta* Deflandre 1926. *T. hispida* var. *coronata* f. *patula* Deflandre 1926. *T. hispida* var. *coronata* f. *minor* Bourrelly 1952. *T. hispida* var. *crenulatocollis* f. *glabra* Philipose 1988.

Lorica 28~38 μm long, 19~28 μm broad. Flagellum aperture with distinct cylindrical collar; collar provided with slightly toothed margin at rim (4~6 μm in diameter, 2~3 μm in height). This variety is distinguished by a crenulate collar (Lemmermann, 1910). It is different from var. *coronata* in having short cylindrical collar with a coarsely toothed margin. Korean specimens varied from the extremes of sparse to dense in the distribution of spines.

Occurrence and world distribution: CB3, CLB2, CLB3, CLB5, CLB6, CN1, CN13, CN16, KB4, KG2, KN3, KN1, KN2. It is a cosmopolitan and common variety. It was recorded in America (Argentina, USA), Asia (India, Japan) and Europe (France, Germany).

12. **Trachelomonas janczewskii* Drezepolski var. *minor* Drezepolski (Kosmos **50**: 262. Fig. 16. 1925) Figs. 19, 59

Lorica 14~19 μm in diameter, globose, regularly beset with fine and sharp spines (2~4 μm long). Flagellum aperture surrounded by slightly thickened ring (2~3 μm in diameter). Chloroplasts parietal discoid without pyrenoid (below 10 in number). Paramylon bodies oval to rod shaped (below 2 μm). Nucleus 5~7 μm in diameter. Flagellum two to three times lorica length.

Occurrence and world distribution: CLB1, CLB2, KB6, KN3, KN4. It was originally reported in Poland and is rare variety. In Asia it was reported in Japan and Soviet Union.

Remarks: This variety is distinguished by the spherical cells with sharp spines and the small size (Drezepolski, 1925). Korean specimens are globose in the side view. This variety is different from *T. manchurica* Skvortzov in the number and length of spines.

13. **Trachelomonas kelloggii* (Skvortzov) Deflandre var. *nana* Balech (Anales Mus. Nac. Hist. Nat. Buenos Aires **41**: 221-305. Figs. 49-50, 179. 1944). Figs. 16, 65

Lorica 20~25 μm long, 18~22 μm broad, sub-spherical to broadly ellipsoid with swelled lateral sides, broadly rounded at both end, irregularly tuberculate in form of papillae. Flagellum aperture with or without annular thickening (2~3 μm in diameter). Chloroplasts parietal discoid with naked pyrenoid (3~5 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 5~9 μm in diameter. Flagellum same to

one and half times to lorica length.

Occurrence and world distribution: CLB5, CLN5, CN8, KB4, KG2, KN1, KN2. It is a rare variety recorded in Argentina (Balech, 1944). This is the second report in the world.

Remarks: This variety was distinguished by cell dimensions and lorica feature. The diameter of flagellum aperture is narrower than that of other taxa (Deflandre, 1926; Philipose, 1988). The tuberculated papilla is well arranged in our specimens compared to the irregular distribution.

14. *Trachelomonas klebsii* (Klebs) Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemo-urs. p. 79-80. Figs. 231-232. 1926) Figs. 44, 77

Synonym: *T. hispida* (Perty) Stein var. *cylindrica* Klebs 1883.

Lorica 26~30 μm long, 14~18 μm broad, cylindrical ellipsoid with nearly straight and parallel lateral sides, densely covered with short spines. Flagellum aperture surrounded by circle of spines (3~4 μm in diameter). Chloroplasts parietal discoid without pyrenoid (10~15 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 5~8 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB5, CLB6, CLN3, KG3, KN1, KN3. It was previously recorded in Cheonnam (Wui and Kim, 1987). It is a cosmopolitan and common species. It was recorded in America (Argentina, Venezuela), Asia (India, Soviet Union) and Europe (Belgium, France, Germany).

Remarks: *Trachelomonas klebsii* is distinguished by the cell shape and lorica feature. Korean specimens are similar to description of Deflandre (1926). The shortly spines of lorica surface is different from the scrobiculated one of *T. abrupta* (Swirenko) Deflandre.

15. *Trachelomonas komarovii* Skvortzov var. *zuberi* (Koczwara) Skvortzov (Ber. d. deutsch. Bot. Ges. **43**: 308. Pl. 10, Fig. 4. 1925a) Figs. 8, 55

Lorica 20~26 μm in diameter, globose to sub-globose, smooth or minutely punctate in surface. Flagellum aperture 2~4 μm in diameter, concentrically surrounded by circumference collar; collar straight, low cylindrical (2~4 μm in height, 9~12 μm in diameter). Chloroplasts parietal

discoïd without pyrenoid (15~25 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 9~13 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB2, CLB3, KB1, KN3, KN4, KN5. It was previously recorded in Kyeongnam (Chung and Kim, 1993). It is a rarely known species and originally recorded in Soviet Union by Skvortzov (1925a).

Remarks: *Trachelomonas komarovii* is distinguished by the presence of circumference collar. This species is different from *T. coronetta* (Playfair) Deflandre by small flagellum aperture from the surrounding collar. In Korean specimens cell dimensions are large and the chloroplasts are numerous.

16. *Trachelomonas koreana* sp. nov.** Figs. 18, 87

Diagnosis: Lorica globosa (diameter: 26~34 μm), dense porosa, cum validis spinis (longitudo: 5~7 μm). Flagellaris porus cum cylindrato collo (diameter: 3~4 μm ; longitudo: 3~5 μm). 6~10 chloroplasti parietali, discoidales, sine pyrenoide. Paramyli grana ovalia ad bacilliformia (longitudo: 3~4 μm). Nucleus globosus (diameter: 9~15 μm). Flagellum 1~1.5 longior quam cellulae lorica. Stigma praesens. Cellula celeriter natans.

Holotypus: figura nostra 18.

Locus typicus: in magnopere nutritorio stagno Sajipo Changnyeong, Corea, et in aprime in naturalibus paludibus.

Lorica 26~34 μm in diameter, globose, densely porous and uniformly beset with stout and sharp pointed spines (5~7 μm long). Flagellum aperture with short cylindrical collar (3~5 μm in height, 3~4 μm in diameter). Chloroplasts parietal discoïd without pyrenoid (6~10 in number). Paramylon bodies oval to rod shaped (3~4 μm). Nucleus 9~15 μm in diameter. Flagellum one and half to two times to lorica length. Stigma present.

Holotype: Fig. 18.

Etymology: Latin *Koreana* means Korea first found.

Type locality: Sajipo Changnyeong (KN1), Korea. It was also collected in eutrophicated swamps, especially in natural wetland; CLB1, CLB3, CLB6, KN1, KN2, KN5.

Remarks: *Trachelomonas koreana* is distinguished by the globose cells with distinct spines. It belongs to the group *Rotundatae* in having

globose test form (Deflandre, 1926; Huber-Pestalozzi, 1955), but there are few members having the long and stout spines. The presence of distinct collar is different from that of other members.

17. **Trachelomonas lefevrei* Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours. p. 103. Figs. 509-511, 517-519. 1926) Figs. 31, 83

Lorica 25~37 μm long, 18~25 μm broad, ellipsoid to ovoid with slightly swelled at midregion, irregularly and densely punctate or porous in surface. Flagellum aperture with cylindrical collar; collar straight and denticulate at rim (2~3 μm in height, 4~6 μm in diameter). Chloroplasts parietal discoïd with double sheathed pyrenoid (4~10 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 8~10 μm in diameter. Flagellum two to three times to lorica length.

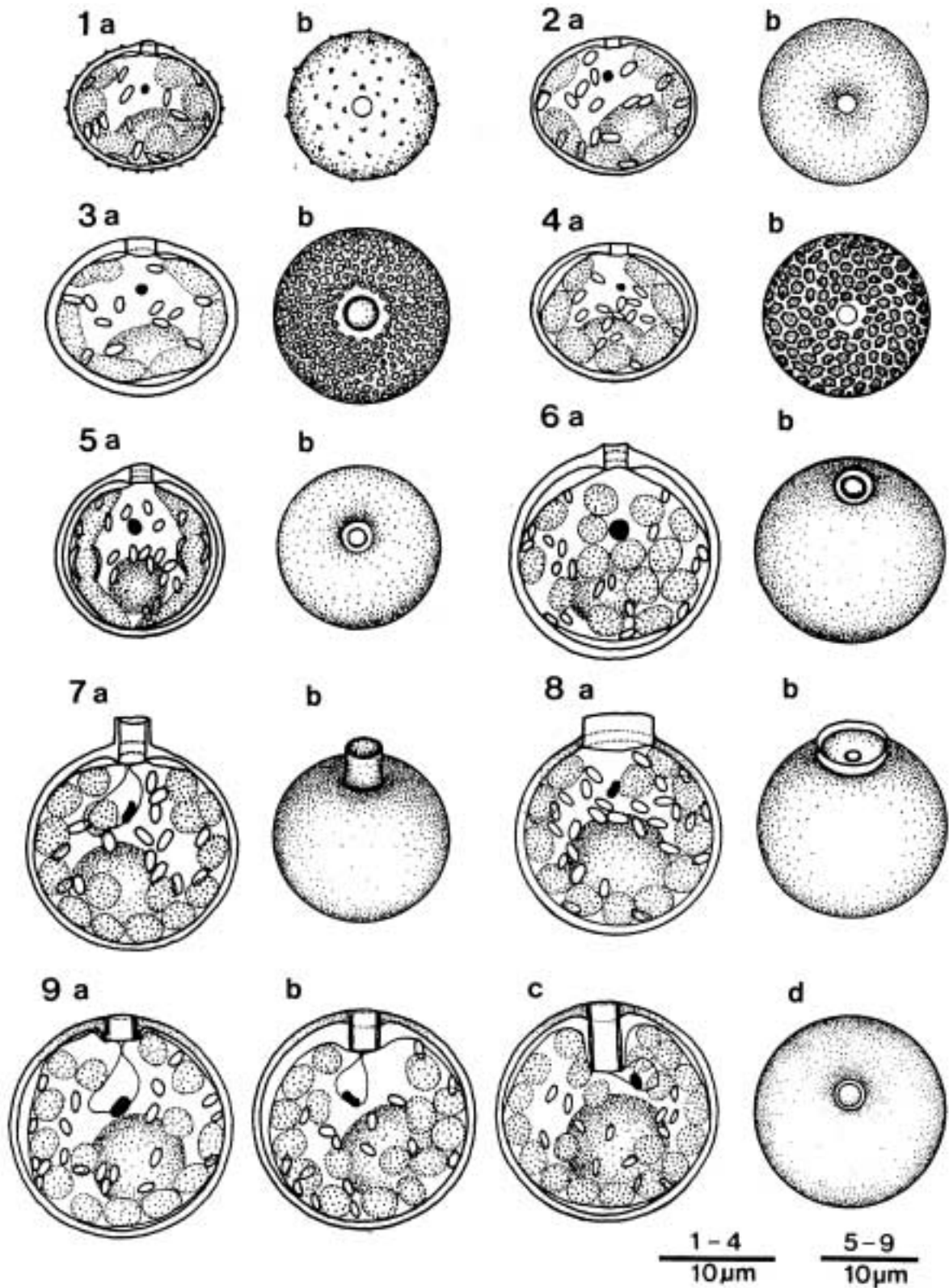
Occurrence and world distribution: CB1, CB2, CLB1, CLB2, CLB3, CLB5, CLB6, CLN4, CN1, CN6, CN8, CN13, CN18, KB1, KB8, KG2, KG3, KN1, KN4, KN6, KN11. It is a cosmopolitan and common species. It was recorded in America (Argentina, USA) and Europe (England, France).

Remarks: *Trachelomonas lefevrei* is identified by the features of cell shape and collar. The broadly ellipsoid shape of this species is different from that of *T. planctonica* Swirenko members having a subglobose form. The surface feature of lorica accords with the description of Dunlap *et al.* (1983) and Dunlap and Walne (1985). Korean specimens chloroplasts have the doubly sheathed pyrenoids.

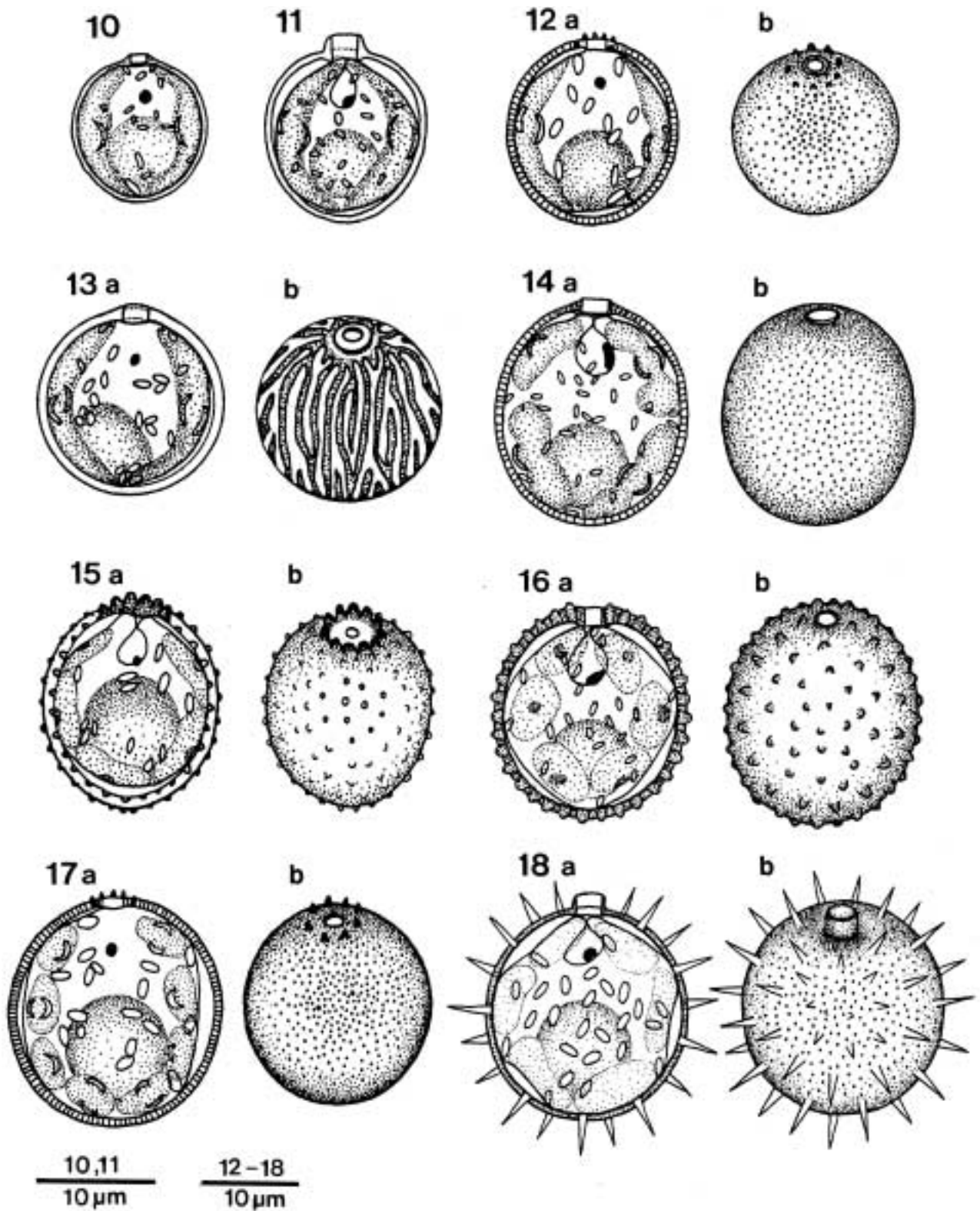
18. *Trachelomonas lotharingiae* de Pouques (Rev. Gen. Bot. 59 (700). p. 305. Fig. 2: 12-13. 1952) Figs. 35, 86

Lorica 25~32 μm long, 20~23 μm broad, oval to ovoid, densely pitted with minute pinhole and entirely beset with sharp spines (2~4 μm long) in surface. Flagellum aperture with straight and cylindrical collar; collar encircled with spines at rim (4~6 μm in height, 3~5 μm in diameter). Chloroplasts parietal discoïd without pyrenoid (10~15 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 8~11 μm in diameter. Flagellum one and half to twice times to lorica length.

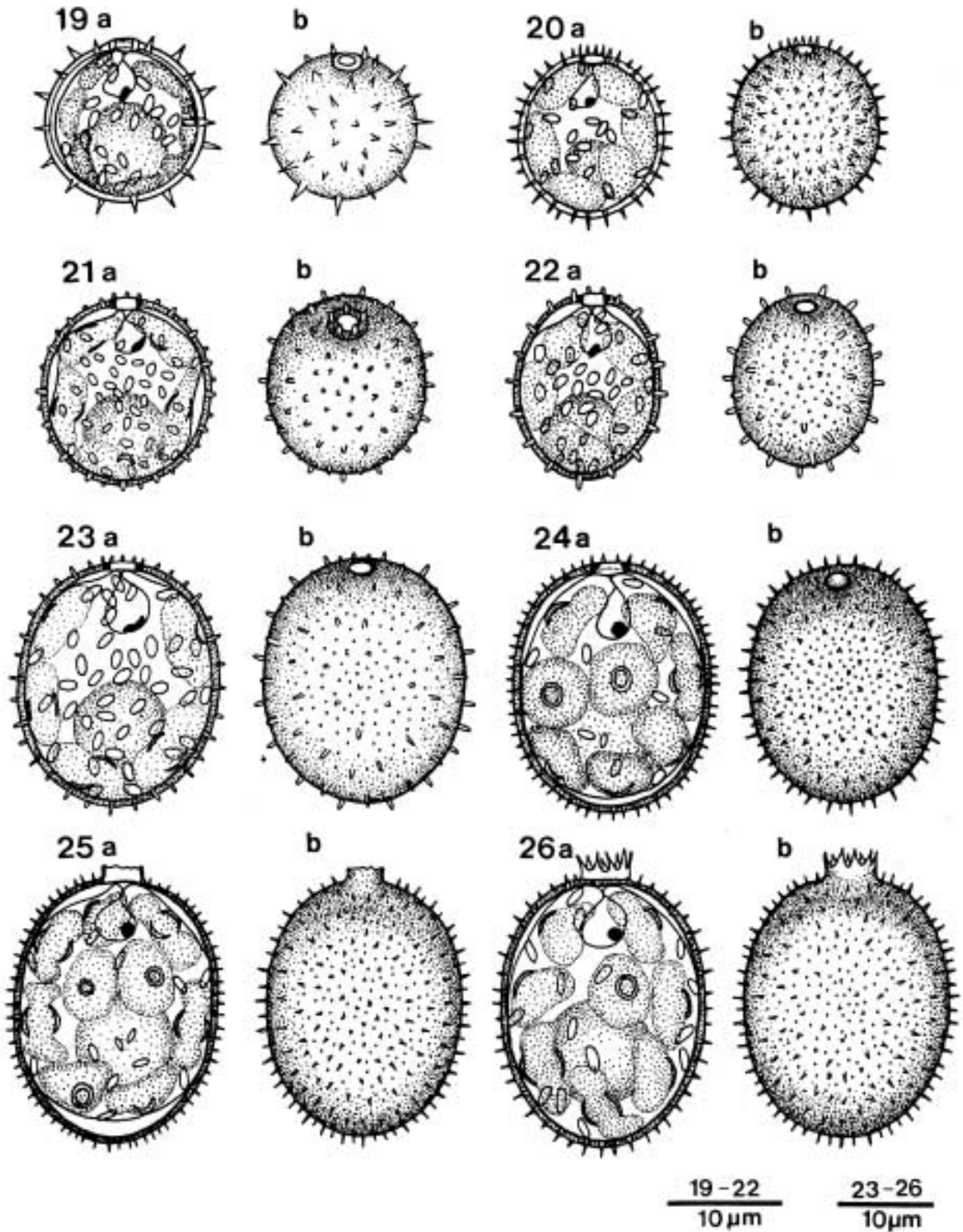
Occurrence and world distribution: CLB1,



Figs 1-9. 1. *Trachelomonas flava*. 2. *T. curta* var. *curta*. 3. *T. curta* var. *punctata*. 4. *T. curta* var. *reticulata*. 5. *T. volvocina*. 6. *T. volvocinopsis* var. *volvocinopsis*. 7. *T. volvocinopsis* var. *coronata*. 8. *T. komarovii* var. *zuberi*. 9. *T. varians*.



Figs 10–18. 10. *Trachelomonas oblonga* var. *oblonga*. 11. *T. oblonga* var. *australiana*. 12. *T. acanthostoma* var. *minor*. 13. *T. rugulosa*. 14. *T. zorensis*. 15. *T. tuberculata*. 16. *T. kelloggii* var. *nana*. 17. *T. acanthostoma* var. *acanthostoma*. 18. *T. koreana*.



Figs 19–26. 19. *Trachelomonas janczewskii* var. *minor*. 20. *T. spina*. 21. *T. bacillifera* var. *minima*. 22. *T. hirta* var. *duplex*. 23. *T. bacillifera* var. *bacillifera*. 24. *T. hispida* var. *hispida*. 25. *T. hispida* var. *crenulatocollis*. 26. *T. hispida* var. *coronata*.

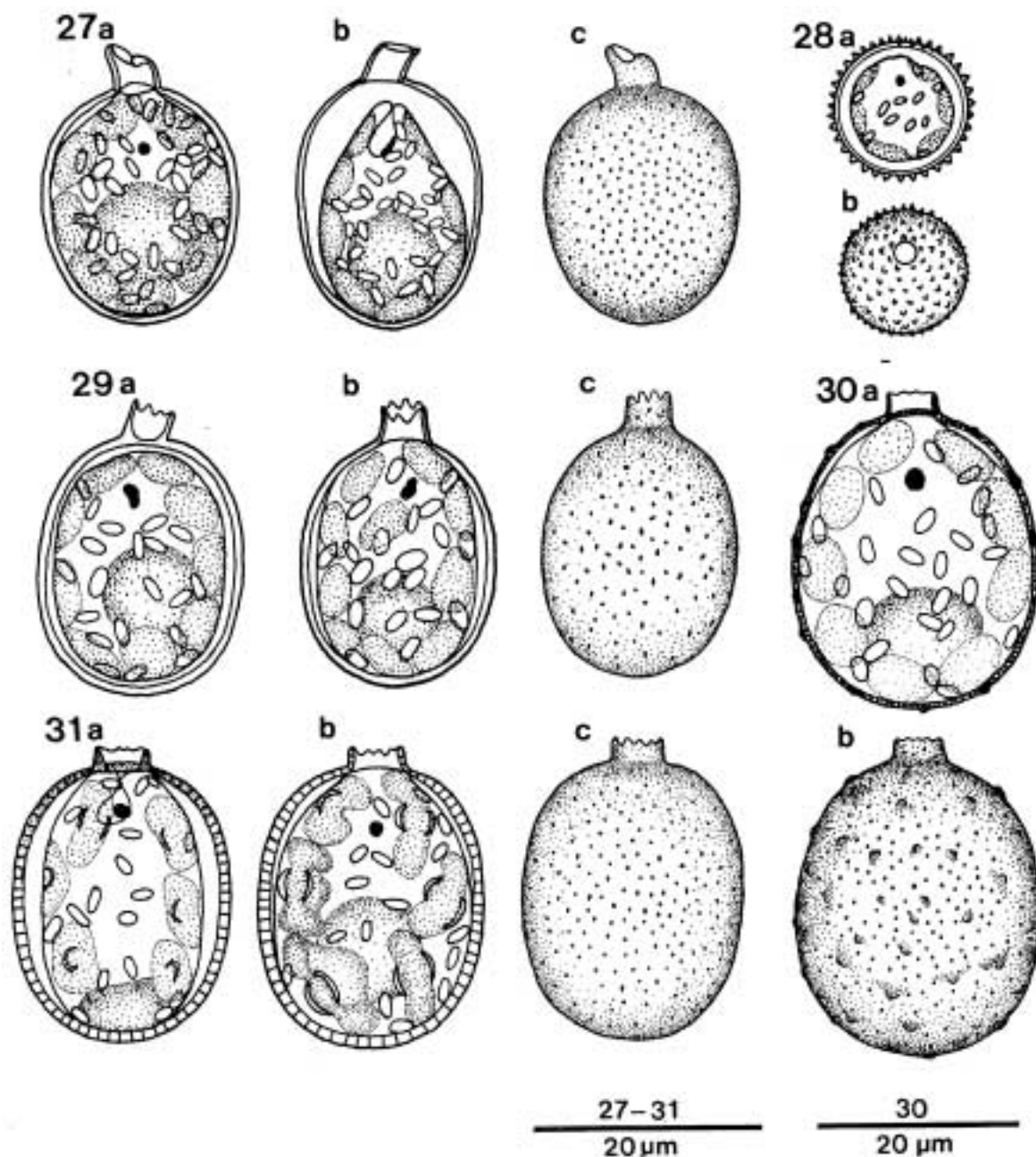
CLB2, CLB3, CLB6, KN3, KN4. It was previously recorded in Kyeongnam (Chung and Kim, 1993). It is a rarely known species recorded in France (de Poucques, 1952).

Remarks: *Trachelomonas lotharingiae* is distinguished by the oval cells ornamented with sharp spines. It is different from *T. hystrix* Teiling and *T. mirabilis* Swirenko on the basis of cell

shape and distribution of spine. The encircled spines at rim are also peculiar in this species.

19a. *Trachelomonas oblonga* Lemmermann var. *oblonga* Lemmermann (Abh. Naturwiss. Vereine Bremen **16**(2): 335. 1899) Figs. 10, 58

Lorica 14~19 μm long, 12~16 μm broad, elon-



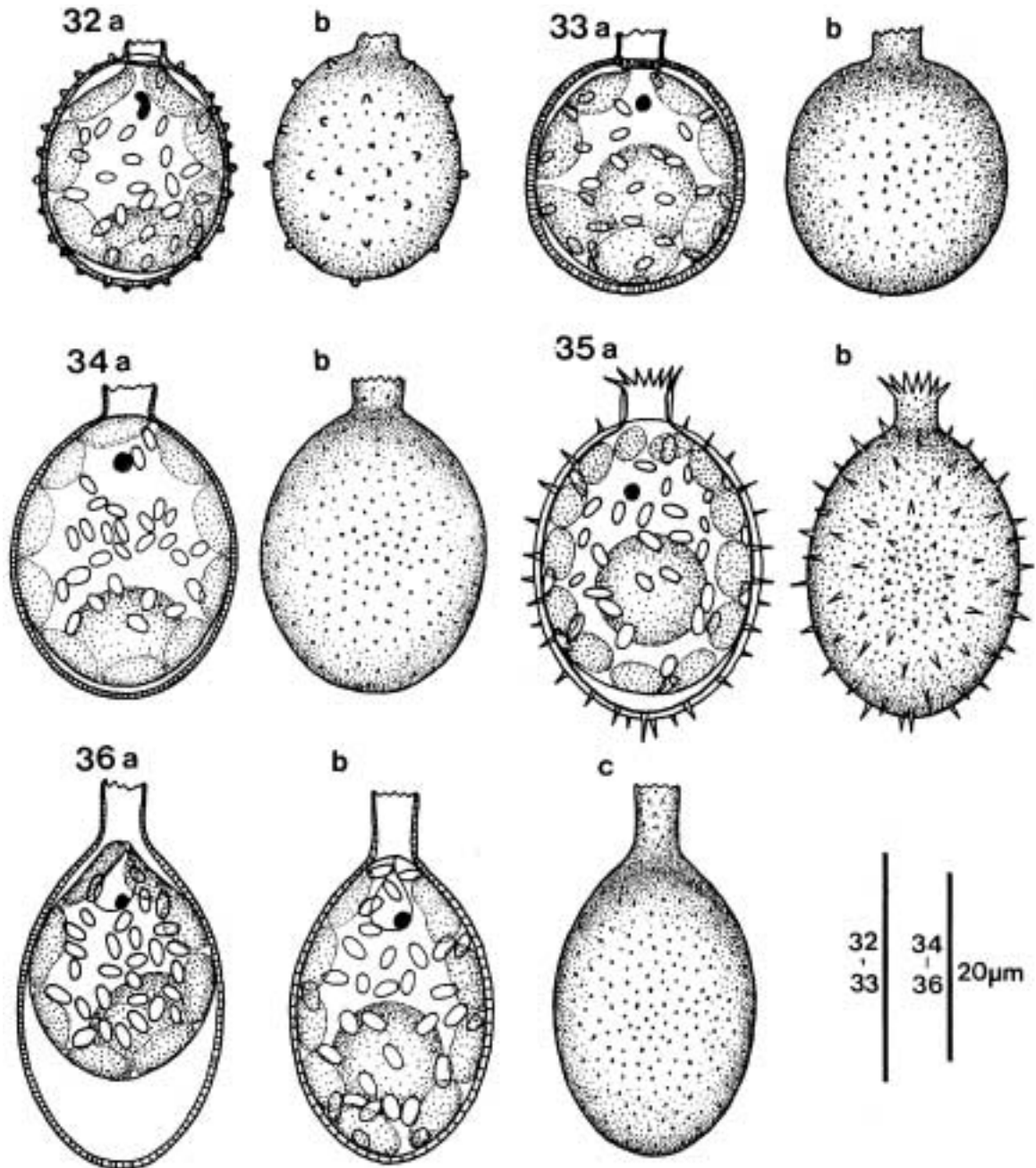
Figs 27-31. 27. *Trachelomonas playfairi*. 28. *T. woycickii*. 29. *T. similis*. 30. *T. planctonica* var. *vermiculosa*. 31. *T. lefevrei*.

gate ellipsoid with slightly swelled lateral sides, smooth in surface. Flagellum aperture surrounded by annular thickening ($2\sim 3\ \mu\text{m}$ in diameter). Chloroplasts two, discoid each with one double sheathed pyrenoid. Paramylon bodies oval to rod shaped (below $2\ \mu\text{m}$). Nucleus $4\sim 6\ \mu\text{m}$ in diameter. Flagellum two to three times to lorica length.

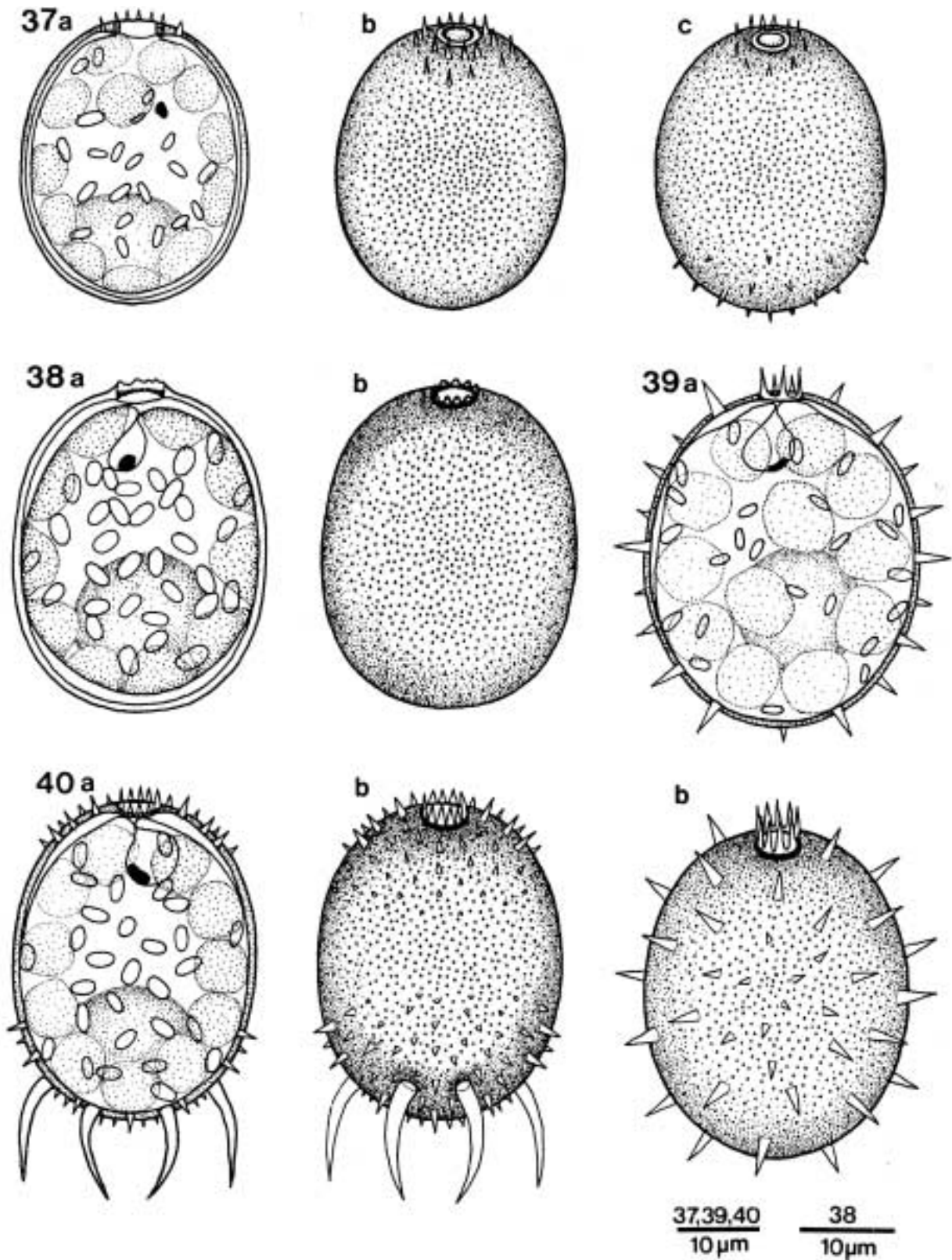
Occurrence: CLB1, CLB2, CLB3, CLB4, CLB5,

CLB6, CN8, CN18, KN3, KN4, KN5. It was previously recorded in Seoul (Skvortzov, 1932) and Cheonnam (Wui and Kim, 1987). World distribution: It is a cosmopolitan and common species. It was recorded in America (Argentina, Brazil), Asia (India), Australia and Europe (Germany).

Remarks: *Trachelomonas oblonga* is distin-



Figs 32–36. 32. *Trachelomonas planctonica* var. *papillosa*. 33. *T. planctonica* var. *planctonica*. 34. *T. pavlovskoensis* f. *pavlovskoensis*. 35. *T. lotharingiae*. 36. *T. pavlovskoensis* f. *ellipsoidea*.



Figs 37–40. 37. *Trachelomonas armata* var. *armata* f. *armata*. 38. *T. armata* var. *armata* f. *inevoluta*. 39. *T. superba*. 40. *T. armata* var. *steinii*.

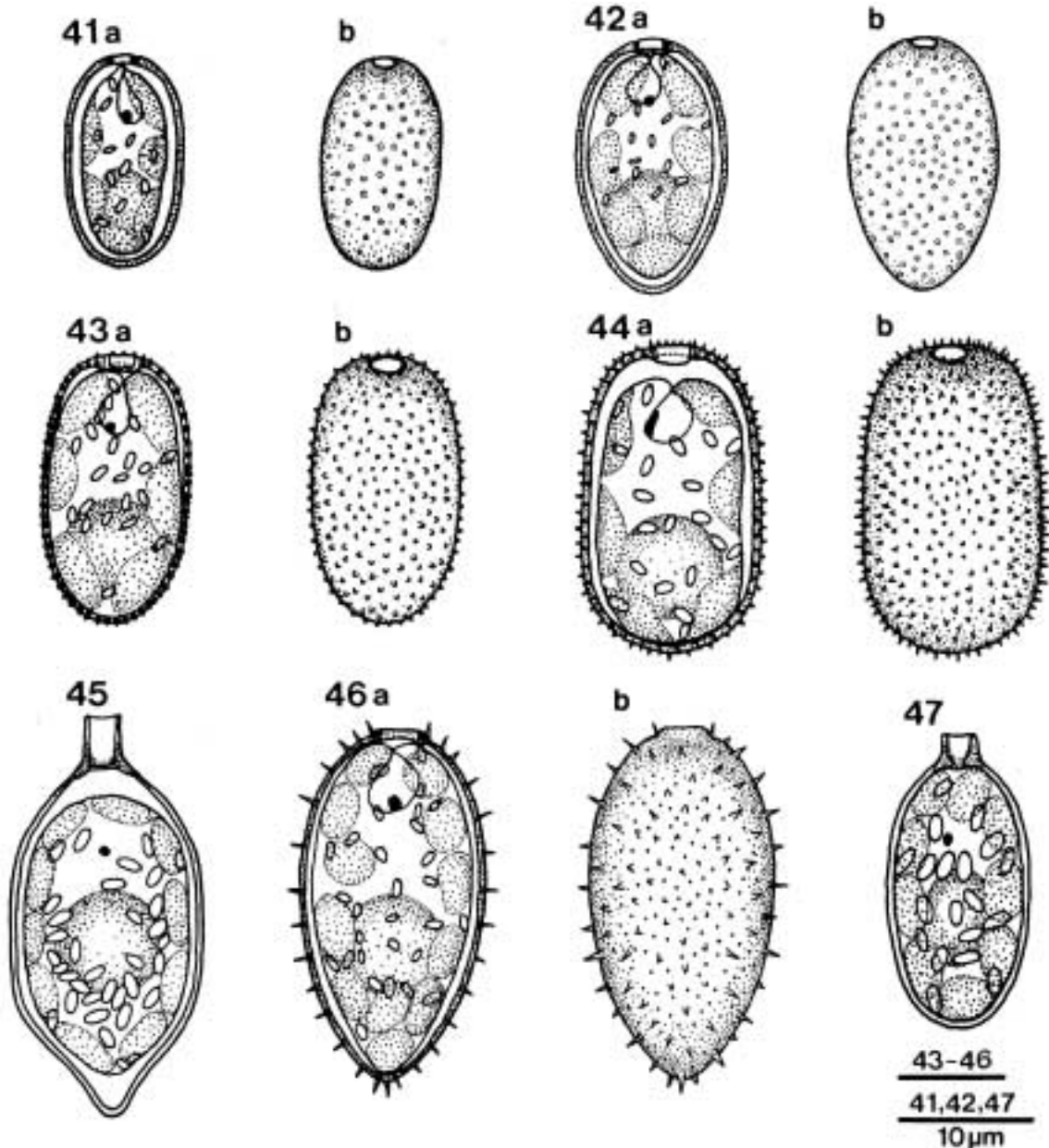
guished by the oval form of cells. The two chloroplasts with a double sheathed pyrenoid are similar to those of *T. volvocina* (Pringsheim, 1953; Philipose, 1988).

19b. *Trachelomonas oblonga* Lemmermann
var. ***australiana*** Playfair (Proc. Linn. Soc.
New South Wales. **40** (1): 12. Pl. 1, Figs.
17-21. 1915) Figs. 11, 60

Synonym: *T. oblonga* Lemmermann *sensu* Bo-

urrelly 1970.

Lorica 17~21 μm long, 16~19 μm broad. Flagellum aperture with straight and cylindrical collar; collar thickened like annular ring at base (3~4 μm in height, 2~3 μm in diameter). This variety is distinguished by the presence of collar. Korean specimens are slightly larger in dimension than the Playfair's type description, but the morphology is identical with that of the previous authors (Deflandre, 1926; Philipose, 1988). The



Figs 41-47. 41. *Trachelomonas cylindrica* var. *decollata*. 42. *T. obovata* var. *klebsiana*. 43. *T. abrupta* var. *arcuata*. 44. *T. klebsii*. 45. *T. hexangulata* var. *repanda*. 46. *T. anguste-ovata*. 47. *T. hexangulata* var. *hexangulata*.

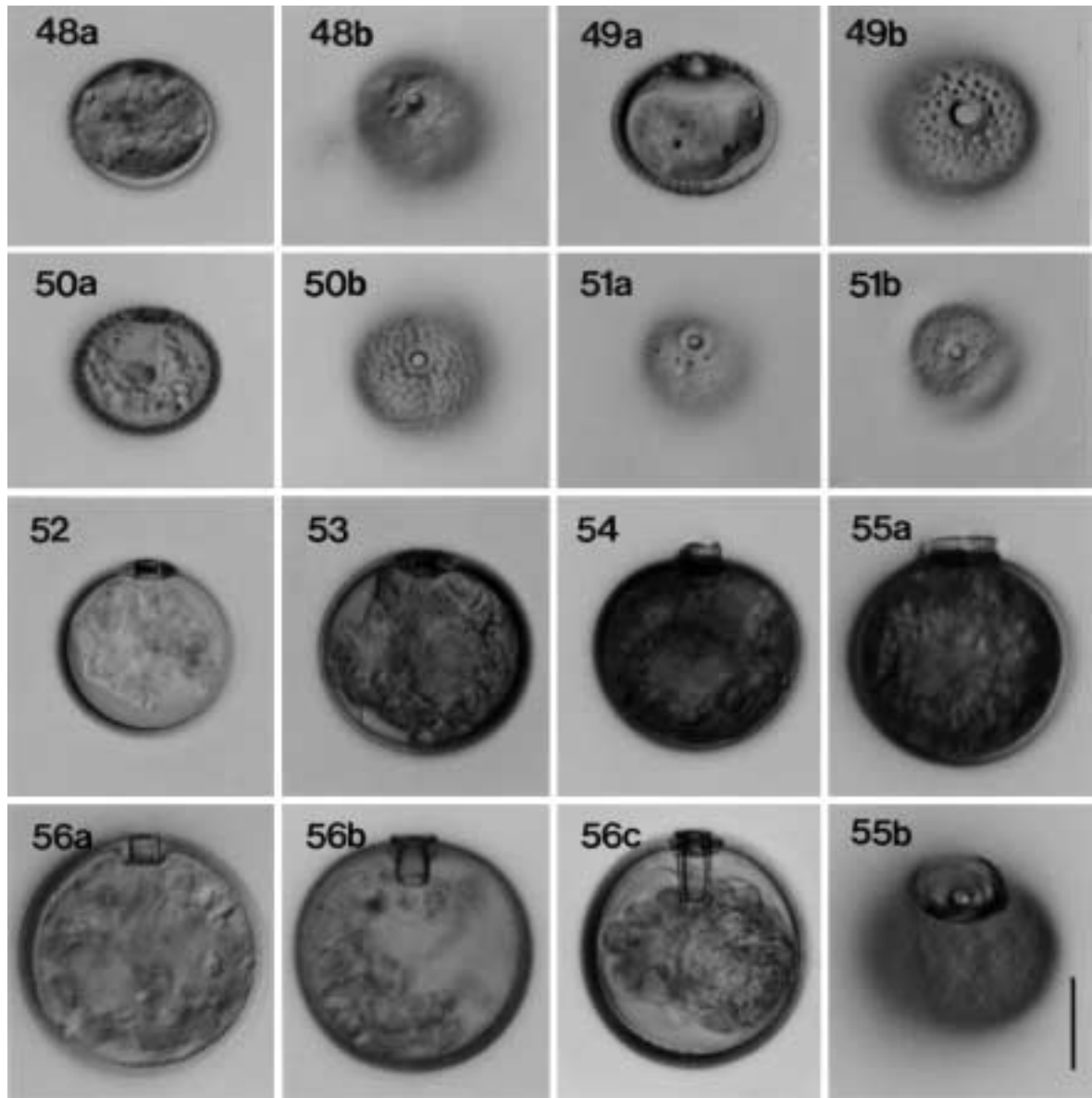
dimensions and shape of cells are different from that of *T. volvocina* var. *derephora* Conrad.

Occurrence and world distribution: CB3, CLB3, CLB5, CLN4, KB8, KN3, KN4. It was previously recorded in Jeju (Chung *et al.*, 1972) and Cheonnam (Wui and Kim, 1987). It is a cosmopolitan and common species. It was recorded in America (Argentina), Asia (India, Japan), Australia and Europe (France, Germany).

20. **Trachelomonas obovata* (Stokes) emend.

Deflandre var. ***klebsiana*** Deflandre (Mon. du genre *Trachelomonas* Ehr. Nemours. p. 96–97. Figs. 430–450. 1926) Figs. 42, 76

Lorica 22~29 μm long, 15~18 μm broad, obovoid with slightly swelled at midregion, rounded and flattened anteriorly, attenuated and conically rounded posteriorly, densely punctate in surface. Flagellum aperture with annularly thickened ring (3~4 μm in diameter). Chloroplasts parietal discoid without pyrenoid (6~10 in num-



Figs 48–56. 48. *Trachelomonas curta* var. *curta*. 49. *T. curta* var. *punctata*. 50. *T. curta* var. *reticulata*. 51. *T. flava*. 52. *T. volvocina*. 53. *T. volvocinopsis* var. *volvocinopsis*. 54. *T. volvocinopsis* var. *coronata*. 55. *T. komarovii* var. *zuberi*. 56. *T. varians*. Scale bar = 10 μm

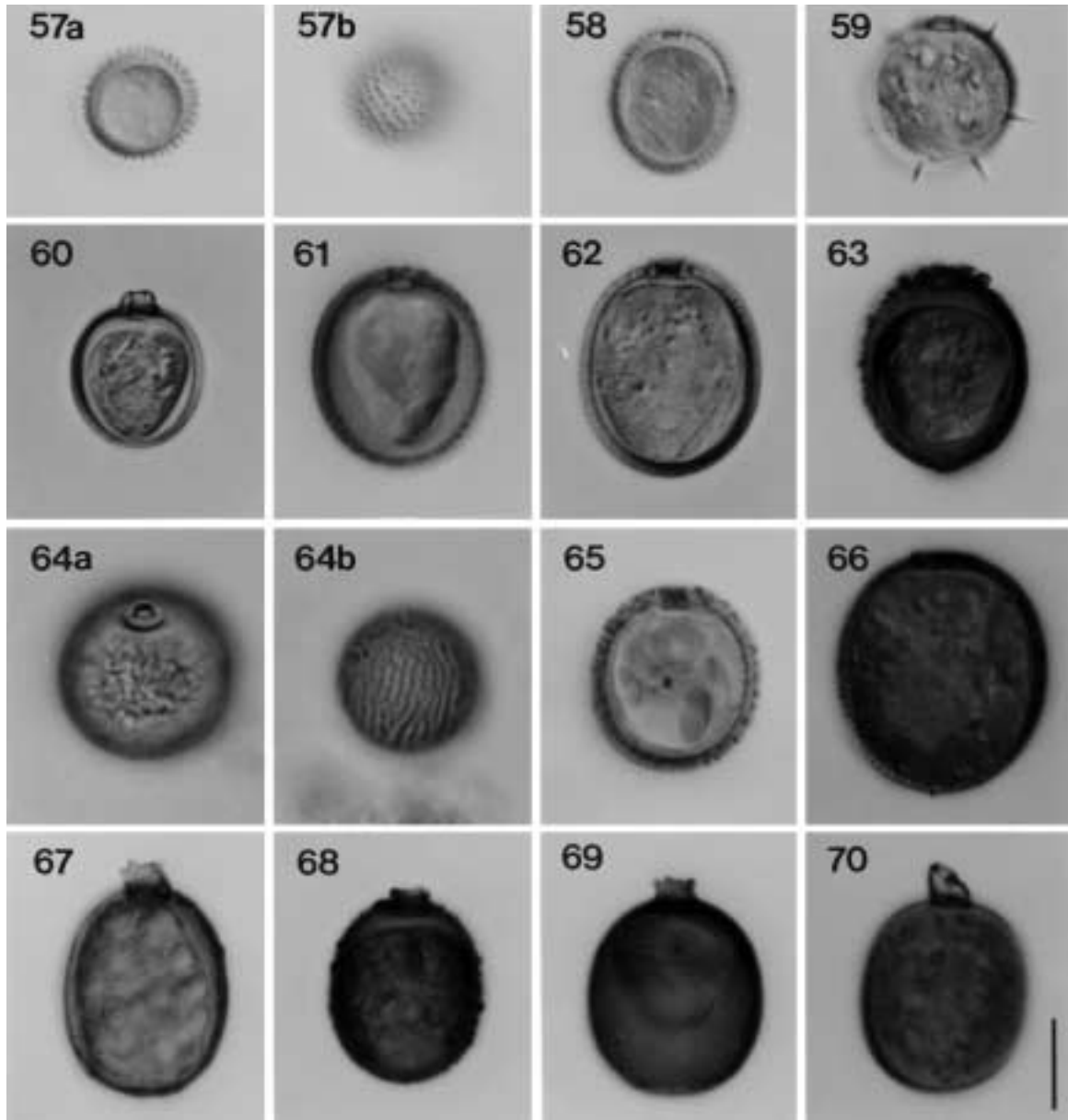
ber). Paramylon bodies oval to rod shaped (below $3\ \mu\text{m}$). Nucleus $5\sim 7\ \mu\text{m}$ in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB3, CLB5, CN11, CN13, CN15, KN1, KN2, KN3. It is a rare variety recorded in Europe (France).

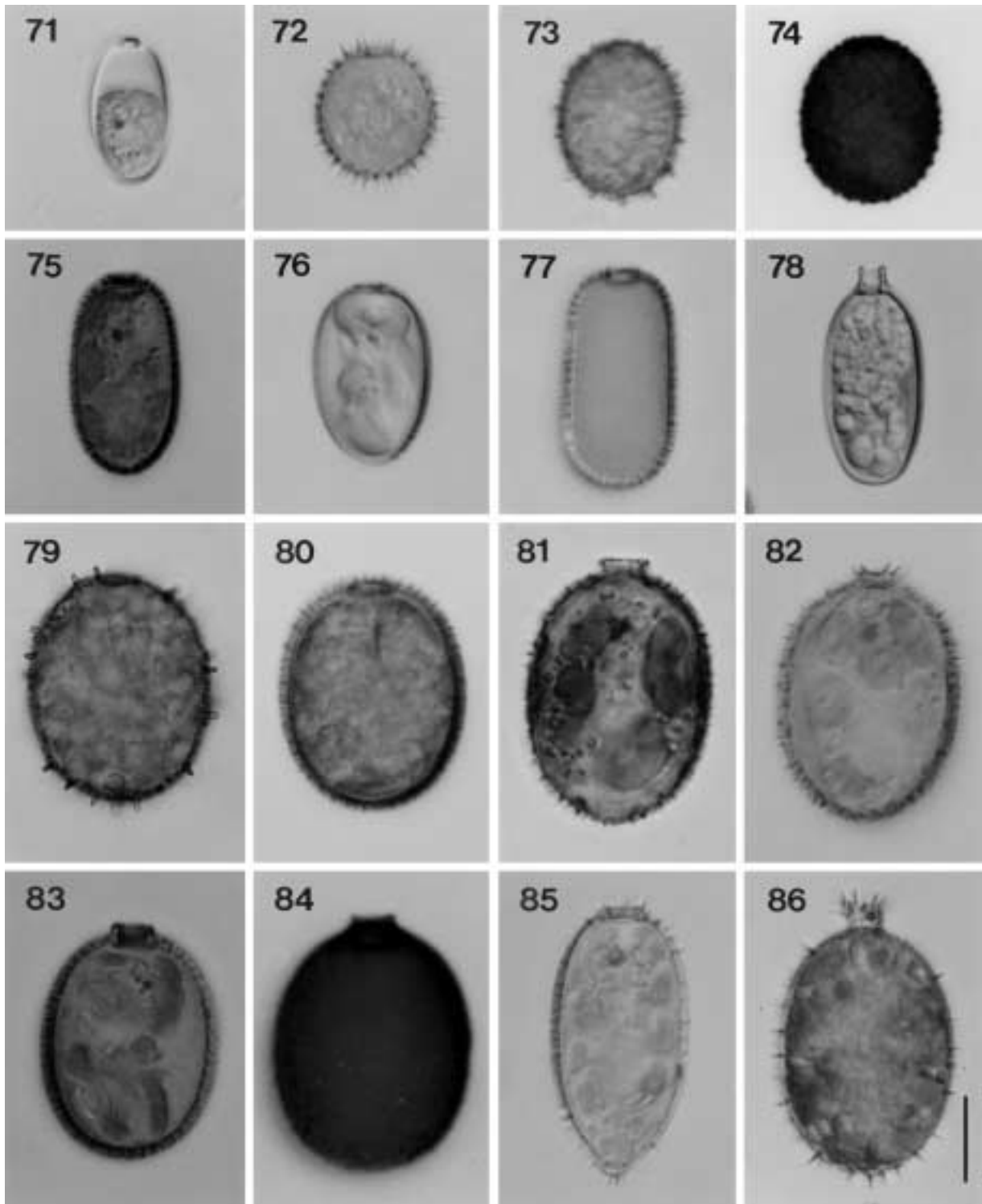
Remarks: *T. obovata* var. *klebsiana* is distinguished by the obovoid shape of the cells with the punctate surface of lorica (Deflandre, 1926).

The lorica surface of Korean specimens is minutely punctate without distinct spines. The morphology of Korean specimen accords with the original illustrations of Deflandre (1926), but the length to width ratios are variable.

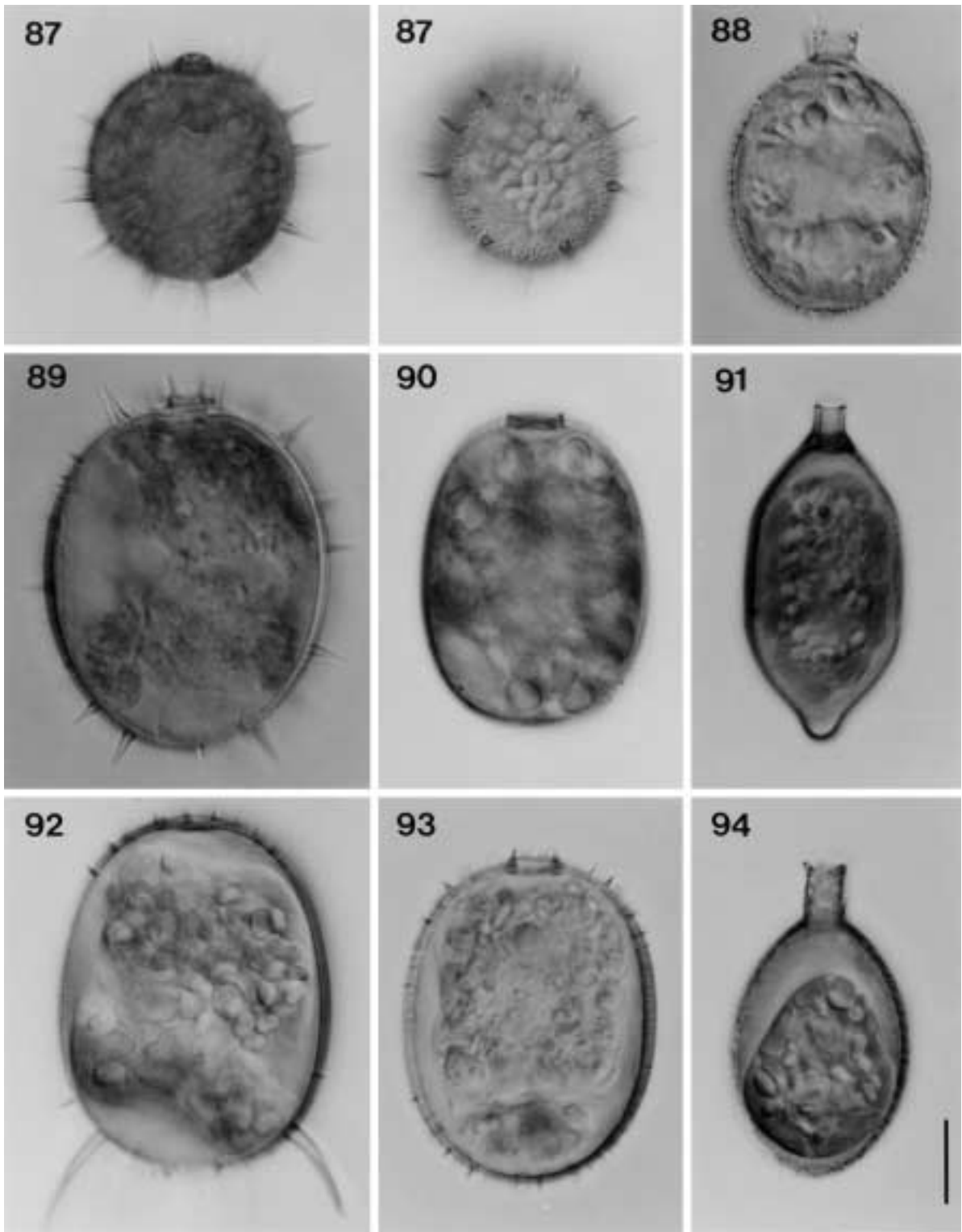
21a. **Trachelomonas pavlovskoensis* (Poljanski) Popova f. *pavlovskoensis* (Poljanski) Popova (Fl. Plant. Crypt. URSS. **8**: 173. Pl.



Figs 57–70. 57. *Trachelomonas woycickii*. 58. *T. oblonga* var. *oblonga*. 59. *T. janczewskii* var. *minor*. 60. *T. oblonga* var. *australiana*. 61. *T. acanthostoma* var. *minor*. 62. *T. zorensis*. 63. *T. tuberculata*. 64. *T. rugulosa*. 65. *T. kelloggii* var. *nana*. 66. *T. acanthostoma* var. *acanthostoma*. 67. *T. similis*. 68. *T. planctonica* var. *papillosa*. 69. *T. planctonica* var. *planctonica*. 70. *T. playfairi*. Scale bar = $10\ \mu\text{m}$



Figs 71–86. 71. *Trachelomonas cylindrica* var. *decollata*. 72. *T. spina*. 73. *T. hirta* var. *duplex*. 74. *T. bacillifera* var. *minima*. 75. *T. abrupta* var. *arcuata*. 76. *T. obovata* var. *klebsiana*. 77. *T. klebsii*. 78. *T. hexangulata* var. *hexangulata*. 79. *T. bacillifera* var. *bacillifera*. 80. *T. hispida* var. *hispida*. 81. *T. hispida* var. *crenulatocollis*. 82. *T. hispida* var. *coronata*. 83. *T. lefevrei*. 84. *T. planctonica* var. *vermiculosa*. 85. *T. anguste-ovata*. 86. *T. lotharingiae*. Scale bar = 10 μ m



Figs 87–94. 87. *Trachelomonas koreana*. 88. *T. pavlovskoensis* f. *pavlovskoensis*. 89. *T. superba*. 90. *T. armata* var. *armata* f. *inevoluta*. 91. *T. hexangulata* var. *repanda*. 92. *T. armata* var. *steinii*. 93. *T. armata* var. *armata* f. *armata*. 94. *T. pavlovskoensis* f. *ellipsoidea*. Scale bar = 10 μ m

15, Figs. 23–25. 1966) Figs. 34, 88

Lorica 29–36 μm long, 21–25 μm broad, broadly ellipsoid with swelled lateral sides, densely punctate in surface. Flagellum aperture with cylindrical collar; collar short cylindrical and slightly flared in apex (3–6 μm in height, 5–7 μm in diameter). Chloroplasts parietal discoid without pyrenoid (10–20 in number). Paramylon bodies oval to rod shaped (below 4 μm). Nucleus 10–13 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB5, CLN1, CN2, J1, KB8, KB9, KN1, KN2, KN4. It is a rare species reported in Asia (Japan, Soviet Union) and Europe (Poland).

Remarks: *Trachelomonas pavlovskoensis* is distinguished by the features of porous lorica. The morphology of Korean specimens agrees with those of Starmach (1983). The surface feature and relatively large cell size are different from those of *T. scabra* Playfair.

21b. **Trachelomonas pavlovskoensis* (Poljanski) Popova f. *ellipsoidea* Popova (Fl. Plant. Crypt. URSS. **8**: 174. Pl. 15, Figs. 26–28. 1966) Figs. 36, 94

Lorica 35–43 μm long, 20–25 μm broad, porous and sometimes covered with tiny papillae in surface. Collar long cylindrical and slightly flared in apex (5–8 μm in height, 4–6 μm in diameter). This forma is distinguished by cell shape and collar. Korean specimens are long, ellipsoid and have a relatively long cylindrical collar. The tiny papillae on lorica are also diagnostic.

Occurrence and world distribution: CLB1, CLB5, CLN3, CN13, KN3, KN4. It is a rare variety reported in Soviet Union, Asia (Japan) and Europe (Poland).

22a. *Trachelomonas planctonica* Swirenko var. *planctonica* Swirenko (Arch. Hydrobiol. Planktonk. **9**(4): p. 633. Pl. 19, Fig. 6. 1914) Figs 33, 69

Synonym: *T. planctonica* var. *oblonga* Drezepolski 1925.

Lorica 20–26 μm long, 17–21 μm broad, subspherical to broadly ovoid with swelled lateral margin, densely punctate in surface. Flagellum aperture with collar; collar straightly cylindrical, crenulated or irregularly toothed at rim (2–4 μm in height, 3–4 μm in diameter). Chloroplasts

parietal discoid without pyrenoid (4–8 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 8–11 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB5, CLB6, CN16, KB8, KG2, KG3, KN3, KN5. It was previously recorded in Cheonnam (Wui and Kim, 1987) and also reported as var. *oblonga* in Ky-eongnam (Chung and Kim, 1993). It is cosmopolitan, but not common. It was recorded in Asia (Soviet Union), Australia and Europe (France, Poland).

Remarks: *Trachelomonas planctonica* is distinguished by the cell shape and lorica ornaments. According to Swirenko (1914) and Deflandre (1926), the subspherical cell shape and densely punctate surface of lorica are diagnostic.

22b. *Trachelomonas planctonica*** Swirenko var. *papillosa* var. nov. Figs. 32, 68

Diagnosis: a typo nova varietas lorica cum milliformibus papillis differt. Loricae longitudo: 19–25 μm ; latitudo: 15–19 μm .

Holotypus: figura nostra 32.

Locus typicus: in magnopere nutritorio vel poluto stagno Sajipo Changnyeong, Corea.

Lorica 19–25 μm long, 15–19 μm broad, minutely punctate and sparsely covered with nipple like papillae in surface. This variety is distinguished by the lorica ornamentation. The test is adorned with nipple-like papillae, while smooth to punctate in var. *planctonica*. The cell dimensions are surprisingly larger than in other taxa.

Holotype: Fig. 32.

Etymology: Latin papillosa possesses a papillate lorica.

Type locality: Sajipo Changnyeong (KN1), Korea. It was also collected in eutrophicated or polluted waters; CLB5, CLN5, J2, KG3, KN5.

22c. **Trachelomonas planctonica* Swirenko var. *vermiculosa* Balech (Anales Mus. Nac. Hist. Nat. Buenos Aires **41**: 279. Figs. 100–101, 209. 1944) Figs. 30, 84

Lorica 27–32 μm long, 19–22 μm broad, densely punctate and sparsely covered with blunt verrucosae in surface. This variety is distinguished by the verrucose ornamentation of lorica surface. It is similar to var. *planctonica* in having punctuations on lorica surface, but is peculiar by the presence of irregular or amorphous warts.

Occurrence and world distribution: CLB1, CLB6, KB1, KB8, KG3, KN1. It is a rare variety recorded in Argentina by Balech (1944). This is the second report in the world.

23. *Trachelomonas playfairi* Deflandre (Bull. Soc. Bot. France. **71**: 1125. Pl. 10, Fig. 14. 1924) Figs. 27, 70

Synonym: *T. flexicollis* Drezepolski 1925.

Lorica 20~26 μm long, 15~19 μm broad, broadly ellipsoid with slightly swelled at midregion, irregularly and minutely punctate in surface. Flagellum aperture with cylindrical collar; collar smooth at rim and undulated near apex (3~5 μm in height, 3~4 μm in diameter). Chloroplasts parietal discoid without pyrenoid (6~10 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 7~9 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CB1, CLB1, CLB3, CLB6, CLN4, CN3, CN11, KG2, KG3, KN1, KN2, KN3, KN4. It was previously recorded in Kyeongnam (Chung, 1970). It is a cosmopolitan, but not common species. It was recorded in Asia (Japan), Australia and Europe (France).

Remarks: *Trachelomonas playfairi* is distinguished by the curved cylindrical collar. The collar of this species is similar with that of *T. similis* Stokes, but the smooth and undulated rim is diagnostic. The morphology of Korean specimens accords with that of Deflandre (1926) and Huber-Pestalozzi (1955) except for the punctate surface of lorica.

24. * *Trachelomonas rugulosa* (Stein) Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours, p. 62. Figs. 81-83, 85, 89. 1926) Figs. 13, 64

Synonym: *T. stokesiana* Palmer 1902.

Lorica 16~24 μm in diameter, globose, longitudinally or spirally rugose in surface. Flagellum aperture surrounded by thickened annular ring and sometimes slightly depressed (2~4 μm in diameter). Chloroplasts two discoids with double sheathed pyrenoid. Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 6~8 μm in diameter. Flagellum two to three times to lorica length.

Occurrence and world distribution: CLB1, CLN2, CLN5, CN11, KG2, KN7. It is a cosmopolitan and common species. It was recorded in Africa (Congo), America (Argentina, USA, Venezuela) and Europe (Belgium, France).

Remarks: *Trachelomonas rugulosa* is distinguished by the rugose surface on lorica. Deflandre (1926) observed longitudinal or spiral, and continuous or discontinuous lorica, so he synonymized *T. stokesiana* Palmer to *T. rugulosa*. Korean specimens also show the diverse forms of lorica (Conrad and Van Meel, 1952; Huber-Pestalozzi, 1955; Tell and Domitrovic, 1985). The chloroplast is similar to that of *T. volvocina* Ehrenberg.

25. *Trachelomonas similis* Stokes (Proc. Amer. Philos. Soc. **28**: 76. Fig. 12. 1887) Figs. 29, 67

Lorica 23~29 μm long, 14~19 μm broad, ellipsoid to ovoid with slightly swelled at midregion, irregularly and minutely porous in surface. Flagellum aperture with cylindrical collar; collar curved and denticulate in apex (3~5 μm in height, 3~4 μm in diameter). Chloroplasts parietal discoid without pyrenoid (7~10 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 7~8 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB4, CLB5, CN11, KN1, KN3, KN4. It was previously recorded in Kyeongnam (Chung and Kim, 1993). It is a cosmopolitan and common species. It was recorded in America (Argentina, USA, Venezuela), Asia (Burma, India, Japan, Soviet Union) and Europe (France).

Remarks: *Trachelomonas similis* is distinguished by the curved cylindrical collar. This species is similar to *T. playfairi*, but different in the flared or denticulate collar (Deflandre, 1926; Huber-Pestalozzi, 1955). Although, in the previous reports, the chloroplasts are two to four, discoid and with pyrenoid (Pringsheim, 1953), about ten discoid without the pyrenoid are observed in Korean specimens.

26. ** *Trachelomonas spina* sp. nov. Figs. 20, 72

Diagnosis: Lorica ovalis ad late elliptica (longitudo: 16~21 μm ; latitudo: 14~17 μm), cum tumidis lateribus. Lorica cum validis et acutis spinis (longitudo: 2~4 μm) uniformiter ornata. Flagellaris porus (diameter 2~3 μm) cum spinis cinctus. 5~9 chloroplasti parietali discoiales, sine pyrenoide. Paramyli grana ovalia ad bacilliformia (longitudo: 2~3 μm). Nucleus globosus (diameter: 8~10 μm). Flagellum 2~3 longior quam cellulae lorica. Stigma praesens. Cellula celeriter

natans.

Holotypus: figura nostra 20.

Locus typicus: in magnopere nutritorio stagno Jiral Hamahn, Corea, et in aprime naturalibus paludibus.

Lorica 16~21 μm long, 14~17 μm broad, oval to ellipsoid with swelled lateral sides, uniformly beset with stout and sharp pointed spines (2~4 μm long) in surface. Flagellum aperture encircled by spines (2~3 μm in diameter). Chloroplasts parietal discoid without pyrenoid (5~9 in number). Paramylon bodies oval to rod shaped (2~3 μm). Nucleus 8~10 μm in diameter. Flagellum two or three times to lorica length.

Holotype: Fig. 20.

Etymology: Latin *spina* means spines equipped on lorica.

Type locality: Jiral Hamahn (KN5), Korea. It was also collected in eutrophicated swamps, especially in natural wetland; CLB1, CLB3, KB5, KG3, KN4.

Remarks: This species is distinguished by cell shape and surface features. The elliptical cells are different from *T. woycickii* Koczwara and *T. janczewskii* in globose form. The surface feature is also similar with *T. robusta* (Swirenko) Deflandre and *T. superba*, but the size range and spine feature are fairly different. The uniform and sharp spines of Korean specimens are also different from *T. hirta* having the uneven length and *T. bacillifera* having the bluntly pointed spines.

27. *Trachelomonas superba* (Swirenko) Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours. p. 84. Figs. 261-262, 264-269, 273. 1926) Figs. 39, 89

Lorica 38~46 μm long, 31~37 μm broad, broadly ovoid with swelled lateral sides, densely porous and covered with stout spines (4~7 μm long). Flagellum aperture surrounded by circles of spines at rim (4~6 μm in diameter). Chloroplasts parietal discoid without pyrenoid (12~22 in number, 5~8 μm in diameter). Paramylon bodies oval to rod shaped (3~6 μm). Nucleus 14~19 μm in diameter. Flagellum same to one and half to lorica length.

Occurrence and world distribution: CLB3, KB8, KG1, KG2, KN1, KN3. It was previously recorded in Cheonnam (Chung, 1975) and Ky-eongnam (Chung and Kim, 1993). It is a cosmopolitan and common species. It was recorded in America (Argentina, USA, Venezuela), Asia

(Burma, Japan, Soviet Union) and Europe (Denmark, France, Holland, Poland).

Remarks: *Trachelomonas superba* is distinguished by the large sized cell dimension. The short and stout spines uniformly besetting on lorica surface are diagnostic.

28. **Trachelomonas tuberculata* Middelhoek (Hydrobiol. 1(1): 87. Pl. 1, Figs. 7-10. 1948) Figs. 15, 63

Synonym: *T. tuberculata* var. *nevadensis* Sánchez Castillo et de la Rosa Alamos 1993.

Lorica 16~22 μm long, 15~19 μm broad, subspherical to broadly ellipsoid, tuberculated with blunt warts. Flagellum aperture encircled with warts (3~4 μm in diameter); warts joined at base. Chloroplasts parietal discoid (4~7 in number) with naked pyrenoid. Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 8~11 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CB2, CLB1, CN11, CN15, KG2, KN2. It is a cosmopolitan, but not common species. It has been recorded in America (Argentina) and Europe (France).

Remarks: *Trachelomonas tuberculata* is distinguished by the tuberculated lorica. In Korean specimens, the ornament surrounding the flagellum aperture joins each other at the base and the warts are larger than that of lorica surface. In these features, this species is different from *T. subverrucosa* Deflandre and *T. pseudofelix* Deflandre.

29. *Trachelomonas varians* Deflandre (Bull. Soc. Bot. France. 71: 1124. Pl. 10, Figs. 6-7. 1924) Figs. 9, 56

Synonyms: *T. volvocina* var. *subglobosa* Lemmermann 1913. *T. varians* var. *globosa* Deflandre 1926.

Lorica 23~30 μm in diameter, globose to subglobose, smooth or minutely punctate in surface. Flagellum aperture surrounded by depressed collar; collar cylindrical tube, extended inwardly into lorica cavity (3~5 μm in diameter, 3~10 μm in depth). Chloroplasts parietal discoid without pyrenoid (20~30 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 11~15 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, KG2, KN1, KN3, KN4. It was

previously reported as var. *globosa* by Chung and Kim (1993) in Kyeongnam. It is a cosmopolitan and common species. It was recorded in America (Argentina, USA), Asia (India, Japan) and Europe (France, Germany).

Remarks: *Trachelomonas varians* is distinguished by the depressed collar surrounding the flagellum aperture (Deflandre 1926; Conrad and Van Meel, 1952; Philipose, 1988; Tell and Domitrovic, 1985; Tell and Conforti, 1986). In Korean specimens, lorica range from one sixth to one third of the length. It is different from *T. cerviculr* Stokes by smooth and parallel lorica. The chloroplasts without pyrenoid are different from that of *T. volvocina* Ehrenberg members.

30. *Trachelomonas volvocina* Ehrenberg (Die Infus. als. vollk. Org. Berlin und Leipzig. p. 48-49. Pl. 2, Fig. 29. 1838) Figs. 5, 52

Lorica 13~22 μm in diameter, globose, smooth in surface. Flagellum aperture surrounded by thickened annular ring and sometimes depressed (2~3 μm in diameter). Chloroplasts two discoids with double sheathed pyrenoid. Paramylon bodies oval to rod shaped (below 3 μm).

Nucleus 4~7 μm in diameter. Flagellum two or three times to lorica length.

Occurrence and world distribution: CB2, CB3, CLB1, CLB2, CLB3, CLB4, CLB5, CLB6, CLN1, CLN2, CLN4, CN2, CN3, CN5, CN8, CN9, CN11, CN13, CN14, CN15, CN16, CN17, J1, KB2, KB4, KB6, KB7, KB8, KB9, KG2, KG3, KN2, KN4, KN6, KN7, KW1, KW2. It was previously reported in Seoul (Skvortzov, 1932), Kyeongbook (Chung, 1970) and Cheonnam (Wui and Kim, 1987). It is a cosmopolitan and ubiquitous species. It is recorded in America (Argentina, USA), Asia (Burma, India, Japan), Australia and Europe (Czechoslovakia, France, Germany).

Remarks: *Trachelomonas volvocina* is distinguished by the spherical cell form. Many infra-specific taxa have been described on the basis of the lorica surface and flagellum aperture (Playfair, 1915, 1921; Deflandre, 1926; Wilson, 1929; Huber-Pestalozzi, 1955; Conforti and Joo, 1994). Korean specimens have minute ornaments such as very tiny pinhole or papillae on the lorica surface. The flagellum aperture is thickened like a ring without a distinct collar. The chloroplasts are discoid in the surface view while short-banded in the side view.

31a. *Trachelomonas volvocinopsis* Swirenko var. *volvocinopsis* Swirenko (Arch. Hydrobiol. u. Plankton **9**(4): p. 633. Pl. 19, Figs. 1-2. 1915) Figs. 6, 53

Synonym: *T. indica* Skvortzov 1937.

Lorica 14~25 μm in diameter, globose to subglobose, smooth or minutely punctate in surface. Flagellum aperture surrounded by thickened annular ring and sometimes slightly depressed (2~4 μm in diameter). Chloroplasts parietal discoid without pyrenoid (15~25 in number). Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 10~13 μm in diameter. Flagellum one and half to two times to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB5, CN1, CN2, KB1, KB6, KG3, KN3, KN4. It was previously recorded in Seoul (Skvortzov, 1932). It is a cosmopolitan and common species. It was recorded in America (Argentina, Venezuela), Asia (Burma, India, Soviet Union) and Europe (France, Germany, Holland).

Remarks: *Trachelomonas volvocinopsis* is distinguished by the numerous disc-like chloroplasts. Korean specimens accord with the description of Deflandre (1926), Bourrelly (1970), Tell and Domitrovic (1985). The absence of pyrenoid in each chloroplast is contrast to the naked pyrenoid of Pringsheim (1953).

31b. **Trachelomonas volvocinopsis* Swirenko var. *coronata* (Skvortzov) Bourrelly (S.E.D. E.S. p. 186. Paris. 1952) Figs 7, 54

Synonym: *T. indica* var. *coronata* Skvortzov 1937.

Lorica 18~24 μm in diameter. Flagellum aperture with straight and cylindrical collar (3~4 μm in diameter, 3~6 μm long). This variety is distinguished by the cylindrical collar and the numerous chloroplasts. Korean specimens are larger in lorica or collar dimensions than those of Bourrelly's description.

Occurrence and world distribution: CLB1, CLB3, CLB4, CLN4, CLN5, KN3, KN4. This is a rarely known variety and reported in Asia (Burma, India) and Europe (France).

32. *Trachelomonas woycickii* Koczwara (Kosmos **40**: 231-275. Pl. 1, Fig. 10. 1915) Figs. 28, 57

Synonyms: *T. woycickii* var. *pusilla* Drezepolski 1925. *T. sparsesetulosa* Huber-Pestalozzi

1955.

Lorica 11 ~ 16 μm in diameter, globose, densely and regularly beset with fine spines (1 ~ 2 μm long). Flagellum aperture narrow and slightly thickened (2 ~ 3 μm in diameter). Chloroplasts parietal discoid without pyrenoid (below 10 in number). Paramylon bodies oval to rod shaped (below 2 μm). Nucleus 4 ~ 5 μm in diameter. Flagellum two to three times to lorica length.

Occurrence and world distribution: CLB1, CLB2, CLB3, CLB5, CN3, KN3, KN4. It was previously recorded in Kyeongnam (Chung and Kim, 1993). It is a cosmopolitan, but not common species. It was recorded in America (Argentina), Asia (India) and Europe (France, Germany, Poland).

Remarks: *Trachelomonas woycickii* is distinguished by the spiny ornaments besetting lorica. Cell dimensions are known to be very variable in the previous reports (Tell and Domitrovic, 1985; Wolowski, 1992; Conforti and Joo, 1994).

33. **Trachelomonas zorensis* Deflandre (Mono. du genre *Trachelomonas* Ehr. Nemours. p. 92. Figs. 391–395. 1926) Figs. 14, 62

Lorica 18 ~ 23 μm long, 15 ~ 19 μm broad, broadly ellipsoid with slightly swelled and arched lateral sides, broadly rounded at both end, densely punctate with pits or scrobiculae in surface. Flagellum aperture with or without annular thickening (2 ~ 3 μm in diameter). Chloroplasts parietal discoid (3 ~ 5 in number) with double sheathed pyrenoid. Paramylon bodies oval to rod shaped (below 3 μm). Nucleus 5 ~ 9 μm in diameter. Flagellum one and half times to lorica length.

Occurrence and world distribution: CB1, CLB5, CLB6, CLN1, CLN5, CN1, CN2, CN9, CN11, CN13, KB4, KG1, KG2, KG3, KN1, KN2, KN3, KN4, KN5, KN6. It is a well-known species in Europe (Belgium, England, France, Germany). In Asia it was recorded in India by Philipose (1988).

Remarks: *Trachelomonas zorensis* is distinguished by the features of lorica surface. According to (Philipose, 1988), the ornaments on lorica are provided by some pits or scrobiculae. The chloroplasts are sheathed by paramylon caps in Korean specimens and the number is two to four, as is reported before (Deflandre, 1926; Middelhoek, 1950, 1951; Pringsheim, 1953; Hortobagyi, 1969).

List of Other Taxa Previously Recorded in Korea

- T. abrupta* (Swirenko) Deflandre (Chung, 1970, 1975)
T. allia (Drezepolski) Deflandre (Skvortzov, 1932)
T. bernaardinensis (Vischer) Deflandre (Chung and Kim, 1993)
T. cervicula Stokes (Skvortzov, 1932)
T. charkoviensis (Swirenko) Deflandre (Chung, 1975)
T. citrifomis Drezepolski var. *aspera* Skvortzov (Skvortzov, 1932)
T. derephora (Conrad) Van Oye (Chung and Kim, 1993)
T. dubia Swirenko (Skvortzov, 1932; Chung, 1975; Chung and Kim, 1993)
T. dybowski Drezepolski (Chung et al. 1972; Wui and Kim, 1987)
T. globularis (Awerinzoff) Lemmermann (Chung and Kim, 1993)
T. granulosa Playfair (Chung, 1975; Wui and Kim, 1987)
T. intermedia Dangeard (Skvortzov, 1932; Wui and Kim, 1987)
T. khannae Skvortzov (Chung and Kim, 1993)
T. lacustris Drezepolski (Chung, 1970)
T. mangini Deflandre (Chung and Kim, 1993)
T. mucosa Swirenko var. *depressa* Skvortzov (Skvortzov, 1932)
T. nexilis Palmer (Chung and Kim, 1993)
T. pulcherrima Playfair (Chung, 1975)
T. pusilla Playfair (Chung, 1975)
T. raciborskii Woloszynska (Wui and Kim 1987; Chung and Kim, 1993)
T. robusta (Swirenko) Deflandre (Chung, 1970; Wui and Kim, 1987)
T. volzii Lemmermann var. *cylindracea* Playfair (Chung and Kim, 1993)
T. wislouchii (Skvortzov) Deflandre (Chung and Kim, 1993)

GENERAL CONCLUSION

A total of 47 taxa of the genus *Trachelomonas* are described and illustrated here. Of these, 4 taxa of *T. curta* var. *reticulata*, *T. koreana*, *T. planctonica* var. *papillosa* and *T. spina* are newly described for the world flora and 14 taxa are newly added to the Korean *Trachelomonas* flora. Most of the taxa are commonly reported in worldwide (Pringsheim, 1953; Huber-Pestalozzi, 1955; Popova, 1966; Philipose, 1988; Sanchez Castillo

and Rosa Alamos, 1993).

Korean *Trachelomonas* species numbered a total 52 taxa (Skvortzov, 1932; Chung 1970; Chung *et al.*, 1972; Chung, 1975; Wui and Kim, 1987; Chung and Kim, 1993). Of these 29 taxa are redescribed or synonymized, but the rest 23 taxa have not been collected here. Therefore, a total of 70 taxa are listed to the Korean *Trachelomonas* flora here.

Trachelomonas species are abundant and diverse in old or stagnant swamps or ponds, where other euglenoids grow well. Especially, the old or natural wetlands provide a rich flora, as is reported in the previous studies (Munawar, 1972; Rojo and Alvarez Cobelas, 1993). These waters include a lot of aquatic plants, which in turn provide rich organic carbons, proteins, lipids and even inorganic salts. The fishery ponds also show a diversity of the species. Three *Trachelomonas* species, *T. bacillifera*, *T. hispida*, and *T. volvocina* formed blooming in the natural swamps or fishery farms in spring and summer. Therefore, old swamps and fishery ponds appear good places to show the biodiversity of Korean *Trachelomonas* species. However, most of *Trachelomonas* species are scarcely common in urban waters polluted by human or industrial activities.

ABSTRACT

This paper deals with floristic and taxonomic accounts of 47 taxa of the genus *Trachelomonas* collected from 58 waters in Korea. Of these, 19 taxa are added to the Korean *Trachelomonas* flora, and 4 taxa, *T. curta* var. *reticulata*, *T. koraeana*, *T. planctonica* var. *papillosa*, and *T. spina* are newly recorded in the world flora of the euglenoids. Detailed description and illustrations are given for each species. Since 23 taxa are previously reported in the Korean freshwaters, a total of 70 taxa are listed up in the Korean *Trachelomonas* flora. *Trachelomonas* species are abundant and diverse in old or stagnant swamps or ponds, where is enriched with organic matters and nutrient salts. *T. bacillifera*, *T. hispida*, and *T. volvocina* formed water blooming in the natural swamps or fishery ponds in spring and summer.

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