

INTERESTING OCCURRENCES OF FILAMENTOUS FRESHWATER ALGAE IN PORTO ALEGRE, RIO GRANDE DO SUL STATE, SOUTHERN BRAZIL

Iara Maria Franceschini^{1,3}
Gilberto Coelho^{2, 3}
Vagner Gularte Cortez³
Matheus Arduvino Reck⁴

ABSTRACT

New and interesting occurrences of filamentous green and red algae were observed in samples collected from two urban eutrophic ponds (Lago Moinhos de Vento and Lago Chinês) in Porto Alegre, Rio Grande do Sul State, Southern Brazil, namely *Pithophora oedogonia* (Montagne) Wittrock, *Spirogyra reinhardii* Chmielevski, and “*Audouinella macrospora*” (the ‘Chantransia’ stage of *Batrachospermum*). *Spirogyra reinhardii* is recorded for the first time for the city of Porto Alegre. *Pithophora oedogonia* is new to Brazil. Cellular measurements, illustrations, and biogeographical distribution of both species are given, as well as pictures of the ‘Chantransia’ stage of *Batrachospermum*.

Key words: *Pithophora*, *Spirogyra*, ‘Chantransia’ stage, eutrophic ponds, Brazilian subtropics.

RESUMO

Algumas ocorrências interessantes de algas filamentosas de água doce em Porto Alegre, Rio Grande do Sul, Brasil

Algumas ocorrências interessantes de algas filamentosas verdes e vermelha foram observadas em amostras coletadas em dois lagos artificiais (lago Moinhos de Vento e lago Chinês) de Porto Alegre, Rio Grande do Sul, a saber: *Pithophora oedogonia* (Montagne) Wittrock, *Spirogyra reinhardii* Chmielevski e “*Audouinella macrospora*” (fase ‘Chantransia’ de *Batrachospermum*). *Spirogyra reinhardii* é citada pela primeira vez para a cidade de Porto Alegre. *Pithophora oedogonia* é citação nova para o Brasil. Neste trabalho, são apresentadas medidas celulares, ilustrações e distribuição geográfica das duas espécies, bem como fotomicrografias da fase ‘Chantransia’ de *Batrachospermum*.

Palavras-chave: *Pithophora*, *Spirogyra*, fase ‘Chantransia’, citações novas.

INTRODUCTION

The first studies on the freshwater algae of Porto Alegre, Southern Brazil, were published by Bohlin (1897) and by Borge (1903a, 1903b) from samples collected by Dr. G. Malme, during the “Ersten Regnellschen Expedition”, which have reported 73 taxa of green algae in the region. Only many years later, Flores (1972) published a list with 27 genera of

green algae from a pond located in Parque Farroupilha. From 1972 until now, other authors have studied algal genera and species collected from different sampling sites in the city, and some papers were published (see Franceschini, 1992; Torgan et al., 1999, 2001, 2003).

In 1992, a study on planktonic and periphytic algae from the urban zone of Porto Alegre and environs was published by Franceschini. Ninety-six samples collected in six localities, from April 1986 to January

Recebido em: 01.08.2005; aceito em: 26.01.2006.

¹ Co-Professor. <iaramar@cpovo.net>.

² Universidade Federal de Santa Maria, Centro de Educação. <coelhogb@smail.ufsm.br>.

³ Universidade Federal do Rio Grande do Sul, Programa de Pós-Graduação em Botânica. <cortezvg@yahoo.com.br>.

⁴ Universidade Federal do Rio Grande do Sul, Bacharelado em Ciências Biológicas. <mateus_reck@yahoo.com.br>.

1987, revealed a rich algal flora: 378 taxa of cyanobacteria, red algae, euglenoids, dinoflagellates, green algae, and ochrophytes (excepting the diatoms) were identified; among them, green algae was the richest group, including 228 species, varieties, and formae.

Periodically, algal samples have been collected in some of these same sites by undergraduate and graduate students in courses on the algae and freshwater ecology, as well as by researchers and professionals in these fields.

In October 2004, we have observed new and interesting occurrences of filamentous green and red algae in two of these sampling sites, namely Lago Moinhos de Vento and Lago Chinês. In order to increase the knowledge on the algal composition in Brazilian subtropics, cellular measurements, illustrations and biogeographical distribution of two species of green algae, as well as pictures of a red alga from eutrophic ponds, are given in this paper.

MATERIALS AND METHODS

Porto Alegre is the capital of Rio Grande do Sul State. It is located at 30°01'53" S and 51°13'19" W, in the south-eastern region of Brazil. The climate is subtropical humid (Cfa type, according to Köppen's classification), with annual mean temperature about 18°C. In summer, the mean temperature of the hottest month (January) is higher than 22°C. In winter, the mean temperature of the coldest month (July) is about 13°C. The annual average rainfall varies from 1250 to 1500 mm, with well distributed rains along the year (Livi, 1998; Nimer, 1990).

The sampling sites are situated in the urban zone, namely: Lago Moinhos de Vento (Fig. 1A; area 3300 m² and maximum depth about 1.5 m) and Lago Chinês (Fig. 1B; area 1000 m² and maximum depth about 0.50 m). Maps of the area and more details of the sampling stations are given by Franceschini (1992).

During the microscope analyses, we have observed a relative abundance of Sphaeroplales (e.g. *Coelastrum*, *Scenedesmus*, and *Pediastrum*) in the plankton of the alkaline waters of Lago Moinhos de Vento. Many macrophytes present in the slightly acidic waters of Lago Chinês have favoured the development of desmids (e.g. *Closterium*, *Cosmarium*, *Micrasterias*, and *Pleurotaenium*) in the metaphton of this pond.

Samples were taken in spring (14.X.2004). They were collected on the shores of the two localities

(see Fig. 1A, B). Submerged stems and leaves of macrophytes covered by an abundant algal mucilage, as well as filamentous algae were collected and put in glass bottles filled with water. The material was taken alive to the laboratory of the Department of Botany, Rio Grande do Sul University (UFRGS), and then preserved in 5% formalin.

In the field, water surface temperature and pH were measured with a Hanna HI 8314 combined electronic meter. In 15.XII.2004, we have returned to the sites for measuring the transparency with a Secchi disk 0.20 m diam., and the shore depth with a ruler.

Drawings and measurements of the algal species were made with a light microscope Wild M20 equipped with a camera lucida. Photomicrographs of the algae were made with a digital camera Canon A510.

All samples are kept at the Herbarium ICN of the Department of Botany, Rio Grande do Sul University.

RESULTS AND DISCUSSION

Table 1 summarises the measurements of water surface temperature, pH, transparency and depth on the shores of the two ponds, as well as the occurrence of the algae in each one.

Green algae

Class Ulvophyceae

Pithophora oedogonia (Montagne) Wittrock

(Fig. 2-17, 24, 25)

Vegetative cells 785-980 µm long, 60-70 µm width; apical akinetes 150-225 µm long, 70-90 µm width; intersperse akinetes 120-195 µm long, 75-90 µm width.

Remarks: This species was found in the slightly acidic waters of Lago Chinês (Tab. 1), forming free-floating mats on the shores.

Pithophora sumatrana is the only species mentioned by Schmidle (1901) to Brazil (see Bicudo & Menezes, 2005, p. 180). Rosa et al. (1974) have only mentioned the genus *Pithophora* in the results of a survey on algal genera from several ponds at Parque Farroupilha (where Lago Chinês is located) and Parque Paulo Gama, in Porto Alegre. Thus, *Pithophora oedogonia* is new to the country.

Biogeographical distribution: *Pithophora oedogonia* and the other species of the genus have been reported as very common in ponds from tropical regions and

during summer in temperate regions (Bourrelly, 1990; Bourrelly & Manguin, 1952; Graham & Wilcox, 2000; O'Neal et al., 1985).

Class Zygnematophyceae

Spirogyra reinhardii Chmielevski

(Fig. 18-23, 26, 27)

Vegetative cells 70-145 µm long, 110-120 µm width; zygospores ovoid (sometimes nearly globose) 110-150 µm long, 80-100 µm width, outer spore wall colourless and smooth, middle spore wall brown.

Remarks: Many filaments were observed forming mucilaginous masses on the shores of Lago Chinês (Tab. 1).

A long time ago, Borge (1903b) reported *Spirogyra reinhardii* to an unknown locality in the physiographic region of Depressão Central, centre of Rio Grande do Sul State. This taxon is now being described for the first time to the city of Porto Alegre. We have no additional information on the occurrence of this species in another locality in Brazil.

Biogeographical distribution: *Spirogyra reinhardii* has been found in Africa, Europe and South America (Gauthier-Lièvre, 1965; Palamar-Mordvyntseva & Schyndanovina, 2000; Tell, 1985).

Red alga

Class Florideophyceae

'Chantransia' stage of *Batrachospermum*

(Fig. 28, 29)

Remarks: This alga was found on macrophytes (e.g. stems of Poaceae) inhabiting the shores of both ponds (Tab. 1).

According to Necchi et al. (1993a, 1993b) and Necchi & Zucchi (1995, 1997), the 'Chantransia' stage of members of *Batrachospermales* can be misinterpreted as species of *Audouinella*, which is an additional problem in identifying some taxa of freshwater red algae. By its morphological and morphometric characters, our material was first identified as *Audouinella macrospora* (Wood) Sheath et Burkholder. However, Necchi & Zucchi (1997) have demonstrated that *A. macrospora* is not a good species; instead, it is a complex involving the 'Chantransia' stage of several species of *Batrachospermum* and probably of other members of the *Batrachospermales* (e.g. *Lemanea*, *Paralemanea*, and *Thorea*).

Baptista & Saalfeld (1974) have collected the genus *Batrachospermum* in clean flowing waters from different localities of Rio Grande do Sul State, including Porto Alegre, but no indication of sampling sites were given. Data obtained from literature report *Batrachospermum* as a freshwater alga occurring in well-aerated, running streams, and also in spring-fed ponds, bogs or lakes around the world (Bourrelly, 1985; Graham & Wilcox, 2000; Lee, 1992; Necchi, 1990). Our specimens of 'Chantransia' were found in both ponds for the first time, so it is interesting to remark its occurrence in the eutrophic waters of Lago Moinhos de Vento and Lago Chinês.

Kristiansen (1996) has given an interesting review on the various methods for dispersal of freshwater algae, and has considered four main types, viz. airborne dispersal, by water, by organisms (e.g. beetles, dragonflies, birds, and mammals), and by man. As regards the human recent importance in algal dispersal, "even the energetic field naturalist may be unconsciously responsible for extending the range of a species, as he empties the residues of his collections of the day into some convenient puddle or stream" (Carpenter apud Talling, 1951). At present, we have no available information for any conclusive discussion on the occurrence of a red alga in an unusual habitat, such as eutrophic ponds from the urban zone of Porto Alegre. Much research is necessary to enlarge the knowledge on the ecological preferences of this alga.

CONCLUSIONS

Samples collected during spring from two urban eutrophic ponds in Porto Alegre, subtropical southeastern region of Brazil, revealed new and interesting occurrences of filamentous green and red algae.

Among the green algae, *Pithophora oedogonia*, a species found mainly in tropical regions, is new to Brazil; *Spirogyra reinhardii*, which has a scattered distribution, is being reported for the first time to the city of Porto Alegre, many years after it was first cited to an unknown locality of Rio Grande do Sul State.

"*Audouinella macrospora*", which is the 'Chantransia' stage of the red alga *Batrachospermum*, was found in both eutrophic ponds, that is, in an unusual habitat since *Batrachospermum* species occur preferably in clean running waters.

These finds incite us to much more work, including sampling during different seasons of several years, and analyses of environmental variables, to know better the ecological preferences of these algae.

ACKNOWLEDGEMENTS

The authors thank Dr. Rosa T. Guerrero and Dr. Albano Schwarzbold for their help, respectively, in laboratory and field analyses, Dr. Maria Luisa Lorscheitter, Dr. Lezilda Carvalho Torgan and Dilma Nascente for their help with the bibliography, Maewe de Assis Brasil and Jon Jeffrey Davison for revising the English.

REFERENCES

- BAPTISTA, L. R. M.; SAALFELD, K. Nota sobre a ocorrência de algas vermelhas (Rhodophyta) continentais no Rio Grande do Sul. *Iheringia*, Série Botânica, Porto Alegre, n. 19, p. 49-52, 1974.
- BICUDO, C. E. M.; MENEZES, M. Chlorophyceae. In: BICUDO, C. E. M.; MENEZES, M. (Orgs.). **Gêneros de algas de águas continentais do Brasil**. Chave para identificação e descrições. São Carlos: RiMa, 2005. p. 115-215.
- BOHLIN, K. Die Algen der Ersten Regnellschen Expedition, I. Protococcoideen. **Bihang K. Svenska vetenskapsakademiens handlingar**, Stockholm, v. 23, n. 7, p. 1-47, 1897.
- BORGE, O. Die Algen der Ersten Regnellschen Expedition, II. Desmidiaceen. **Arkiv för Botanik**, Uppsala, v. 1, p. 71-138, 1903a.
- BORGE, O. Die Algen der Ersten Regnellschen Expedition, III. Zygnemaceen und Mesocarpaceen. **Arkiv för Botanik**, Uppsala, v. 1, p. 227-285, 1903b.
- BOURRELLY, P. **Les Algues d'eau douce. Initiation à la systématique**. Tome III: Les Algues bleues et rouges. Les Eugléniens, Peridiniens et Cryptomonadines. Réimpression revue et augmentée. Paris: Éd. Boubée, 1985. 606 p. (Collection Faunes et Flores actuelles).
- BOURRELLY, P. **Les Algues d'eau douce. Initiation à la systématique**. Tome I: Les Algues vertes. Réimpression revue et augmentée. Paris: Éd. Boubée, 1990. 572 p. (Collection Faunes et Flores actuelles).
- BOURRELLY, P.; MANGUIN, E. **Algues d'eau douce de la Guadeloupe et dépendances**. Paris: Sedes, 1952. 282 p.
- FLORES, F. E. V. Lista dos gêneros de Chlorophyta de um lago artificial de Porto Alegre, RS, Brasil. *Iheringia*, Série Botânica, Porto Alegre, n. 16, p. 9-14, 1972.
- FRANCESCHINI, I. M. Algues d'eau douce de Porto Alegre, Brésil (les Diatomophycées exclues). *Bibliotheca Phycologica*, Berlin, Stuttgart, v. 92, p. 1-127, 1992.
- GAUTHIER-LIÈVRE, L. Zygnemacées africaines. *Nova Hedwigia*, Weinheim, n. 20, p. 1-210, pl. 1-73, 1965.
- GRAHAM, L. E.; WILCOX, L. W. **Algae**. Upper Saddle River: Prentice Hall, 2000. 700 p.
- KRISTIANSEN, J. Dispersal of freshwater algae – a review. *Hidrobiologia*, Dordrecht, n. 336, p. 151-157, 1996.
- LEE, R. E. **Phycology**. 2. ed. Cambridge: Cambridge University Press, 1992. 645 p.
- LIVI, F. P. Elementos do clima: o contraste de tempos frios e quentes. In: MENEGAT, R. et al. (Coords.). **Atlas ambiental de Porto Alegre**. Porto Alegre: Ed. UFRGS, 1998. p. 73-78.
- NECCHI Jr, O. Revision of the genus *Batrachospermum* Roth (Rhodophyta, Batrachospermales) in Brazil. *Bibliotheca Phycologica*, Berlin, Stuttgart, v. 84, p. 1-201, 1990.
- NECCHI Jr, O.; SHEATH, R. G.; COLE, K. M. Systematics of freshwater *Audouinella* (Acrochaetiaceae, Rhodophyta) in North America. 1. The reddish species. *Algological Studies*, Stuttgart, n. 70, p. 11-28, 1993a.
- NECCHI Jr, O.; SHEATH, R. G.; COLE, K. M. Systematics of freshwater *Audouinella* (Acrochaetiaceae, Rhodophyta) in North America. 2. The bluish species. *Algological Studies*, Stuttgart, n. 71, p. 13-21, 1993b.
- NECCHI Jr, O.; ZUCCHI, M. R. Systematics and distribution of freshwater *Audouinella* (Acrochaetiaceae, Rhodophyta) in Brazil. *European Journal of Phycology*, Cambridge, v. 30, n. 3, p. 209-218, 1995.
- NECCHI Jr, O.; ZUCCHI, M. R. *Audouinella macrospora* (Acrochaetiaceae, Rhodophyta) is the Chantransia stage of *Batrachospermum* (Batrachospermales). *Phycologia*, Oxford, v. 36, n. 3, p. 220-224, 1997.
- NIMER, E. Clima. In: IBGE (Ed.). **Geografia do Brasil**. v. 2. Região Sul. Rio de Janeiro: IBGE, 1990. p. 151-187.
- O'NEAL, S. W.; LEMBI, C. A.; SPENCER, D. F. Productivity of the filamentous alga *Pithophora oedogonia* (Chlorophyta) in Surrey Lake, Indiana. *Journal of Phycology*, Lawrence, n. 21, p. 562-569, 1985.
- PALAMAR-MORDVYNTSEVA, G. M.; SCHYNDANOVINA, I. P. New for the Chernigiv Polissia flora species of the genus *Spirogyra* Link. (Zygnematales, Chlorophyta). *Ukrayins'kyi Botanichnyi Zhurnal*, Kyiv, v. 57, n. 1, p. 77-79, 2000.
- ROSA, Z. M.; AGUIAR, L. W.; CÔRTE-REAL, M. Nota sobre gêneros de algas continentais do município de Porto Alegre, Rio Grande do Sul, Brasil. *Iheringia*, Série Botânica, Porto Alegre, n. 19, p. 53-62, 1974.
- SCHMIDLE, W. Algen aus Brasilien. *Hedwigia*, v. 40, n. 1, p. 45-54, 1901.
- TALLING, J. F. The element of chance in pond populations. *The Naturalist*, n. 1951, p. 157-170, 1951.
- TELL, G. Catalogo de las Algas de Agua Dulce de la Republica Argentina. *Bibliotheca Phycologica*, Vaduz, v. 70, p. 1-283, 1985.
- TORGAN, L. C.; BARREDA, K. A.; FORTES, D. F. Catálogo das algas Chlorophyta de águas continentais e marinhas do estado do Rio Grande do Sul, Brasil. *Iheringia*, Série Botânica, Porto Alegre, n. 56, p. 147-183, 2001.
- TORGAN, L. C.; BARREDA, K. A.; SANTOS, C. B. Catálogo das algas Cryptophyta, Heterokontophyta, Dinophyta, Haptophyta e Rhodophyta de águas continentais e costeiras do Rio Grande do Sul, Brasil. *Iheringia*, Série Botânica, Porto Alegre, v. 58, n. 2, p. 227-250, 2003.
- TORGAN, L. C.; BECKER, V.; PRATES, H. M. Checklist das diatomáceas (Bacillariophyceae) de ambientes de águas continentais e costeiras do estado do Rio Grande do Sul, Brasil. *Iheringia*, Série Botânica, Porto Alegre, n. 52, p. 89-144, 1999.

TABLE 1 – Water variables and algae occurrence at the sampling sites.

Water variable Locality	Water T (°C)	pH	Transp. (m)	Depth (m)	Algae
Lago Moinhos de Vento	26.7	8.40	0.29 0.32 0.28	0.38 0.45 0.54	'Chantransia' stage of <i>Batrachospermum</i>
Lago Chinês	25.0-26.0	6.48	0.30 ^(b) 0.32 ^(b)	0.30 0.32	<i>Pithophora oedogonia</i> , <i>Spirogyra reinhardii</i> , and 'Chantransia' stage of <i>Batrachospermum</i>

^(b) means that Secchi disk touched the bottom, so water transparency was higher than indicated by the values.

Fig. 1A, B. View across the shores of the sampling sites. **A:** Lago Moinhos de Vento. **B:** Lago Chinês.



Fig. 2-17. *Pithophora oedogonia*: 2-9. Intersperse akinetes. 10-15. Apical akinetes. 16, 17. Germination of akinetes (16. protrusion of germination tube [arrow]; 17. initial elongation of the germination tubes). Scale bar: 100 μ m.

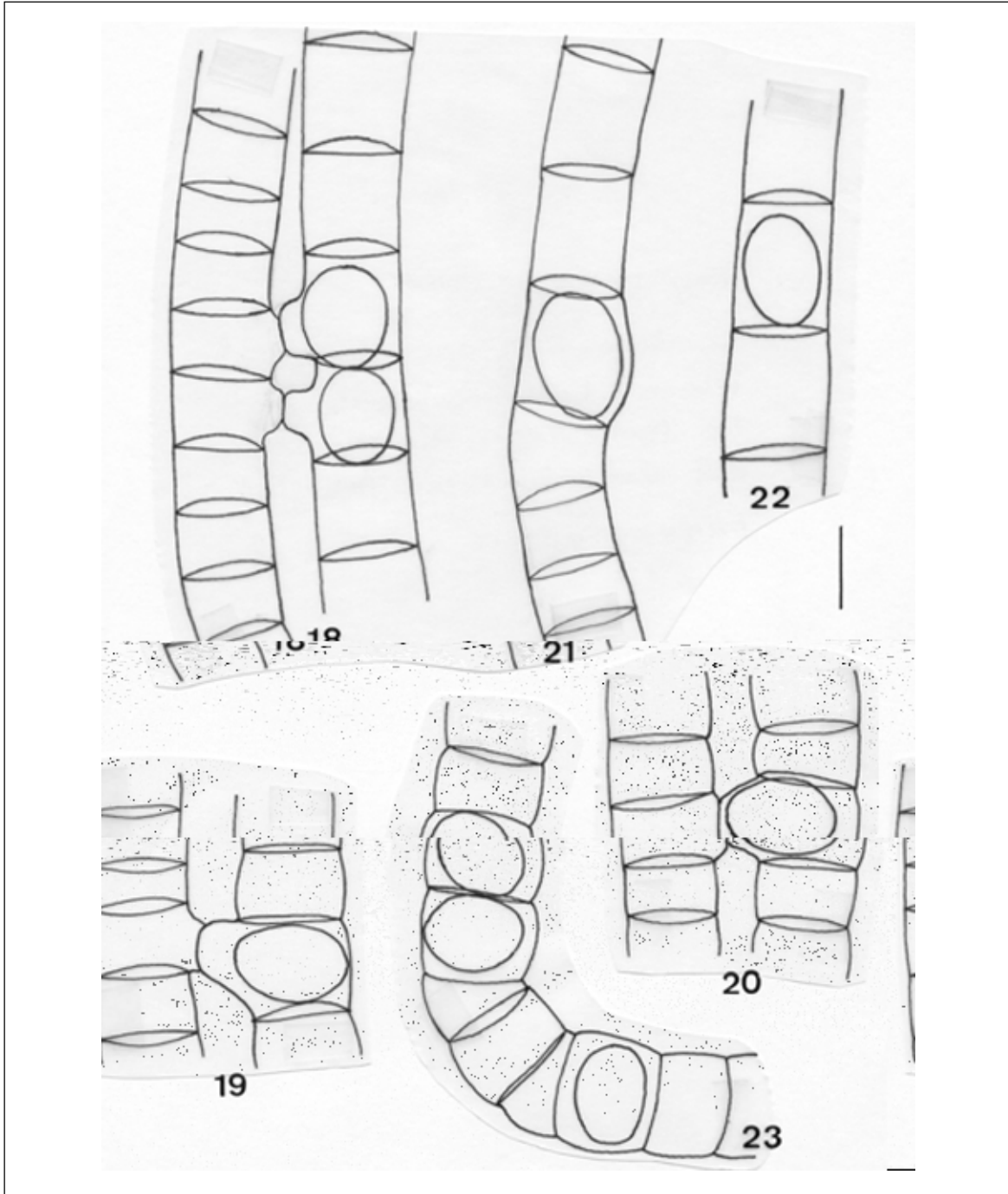


Fig. 18-23. *Spirogyra reinhardii*: 18-20. Conjugating filaments showing conjugation tubes formed by both gametangia, and zygospores. 21-23. Zygospores formed within gametangial cells. Scale bar: 100 μ m.

Fig. 24-29. **24, 25.** *Pithophora oedogonia*: **24.** Germination tube of an intersperse akinete during elongation. **25.** Two apical akinetes. **26, 27.** *Spirogyra reinhardii*: **26.** Conjugating filaments with zygospores. **27.** Zygospore within a gametangial cell. **28, 29.** 'Chantransia' stage of *Batrachospermum*: **28.** Erect filaments with monosporangial branches. **29.** Monosporangial branch with monosporangium. Scale bar: μm .