

A new morphotype of chrysophycean stomatocyst from the pond of Peter the Great Botanical Garden (Saint Petersburg)

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Abstract. The paper deals with the problem of identifying chrysophycean stomatocysts. An historical essay of classification schemes for chrysophycean stomatocysts is presented. It is noted that the stomatocysts are widely used in palaeolimnological studies. A new 395/13 morphotype of a chrysophycean stomatocyst from the pond of Peter the Great Botanical Garden is described on the basis of plankton samples. The stomatocyst is spherical (5.3 μm diam.) and has a short cylindrical collar (1.8 μm diam., 0.2 μm high), with a conical pore (0.3 μm diam.). The entire stomatocyst surface is covered with rounded scabrae 0.1–0.2 μm in diameter. Morphology of the new stomatocyst morphotype was studied and its original micrograph was made with a scanning electron microscope.

Keywords: *Chrysophyta*, stomatocyst, electron-microscopic study.

Новый морфотип стоматоцисты золотистых водорослей из пруда Ботанического сада им. Петра Великого (Санкт-Петербург)

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Резюме. Рассматриваются некоторые проблемы идентификации стоматоцист золотистых водорослей. Представлен краткий исторический очерк схем, используемых для классификации стоматоцист. Отмечено широкое применение стоматоцист в палеолимнологических исследованиях. На основе изучения планктонных проб из прудов Ботанического сада им. Петра Великого описан новый для науки морфотип стоматоцисты хризофитовых 395/13. Стоматоциста округлая (5.3 мкм в диам.); воротничок короткий, цилиндрический (1.8 мкм в диам., 0.2 мкм выс.), с конической порой (диаметр 0.3 мкм). Вся поверхность стоматоцисты покрыта округлыми, равномерно расположенными гранулами 0.1–0.2 мкм в диам. Приведены данные о морфологии стоматоцисты и оригинальная микрофотография с использованием сканирующей электронной микроскопии.

Ключевые слова: *Chrysophyta*, стоматоцисты, электронно-микроскопическое исследование.

Stomatocysts are resting stages in the life cycle of *Chrysophyta*. They are hollow formations generally spherical (2–30 μm in diameter) in shape. The surface of mature stomatocysts is strongly silicified. The stomatocysts may be smooth-surfaced or ornamented with various structural elements such as spines, dots, granules, needles, and ridges. Species iden-

tification of stomatocysts is very difficult. To identify them, it is most reliable to study the full life cycle of individual species in culture. At present, stomatocyst taxonomy is problematic because very little information is available about their variability in size, shape and cell ultrastructure within a species. Some species can form stomatocysts with different ornamentation depending on temperature (Cronberg, 1986). Few morphotypes of stomatocysts have been ascribed to certain species (Duff *et al.*, 1995).

Several taxonomic schemes have been proposed to distinguish stomatocyst morphotypes whose biological affinity is unknown. The earliest schemes were constructed according to the binomial system of C. Linnaeus (Linnaeus, 1751; Deflandre, 1936). In 1956, G. Nygaard suggested using the term «cysta» for the title genus of an unidentified stomatocyst, which followed the name of the described morphotype (Nygaard, 1956). This system has been widely taken up by many experts (Leventhal, 1970; Sandgren, Carney, 1983; and others). In 1986, the International Statorspore Working Group (ISWG) declared inadmissible the existence of different taxa for two stages of the life cycle (vegetative cells and stomatocysts) of the same species. On behalf of the ISWG, G. Cronberg and C. D. Sandgren proposed a set of guidelines for description of stomatocysts (Cronberg, Sandgren, 1986). It was not intended to be a taxonomical code, but suggested appointing a «type» (a SEM negative number of one specimen, to be kept by the author), a «type locality» (where and how the material was obtained), and further ecological information and biological affinity in cases where it could be determined (Hansen, 2001). This system is currently taken as the standard for describing stomatocysts everywhere, including the handbooks of stomatocysts (Duff *et al.*, 1995; Wilkinson *et al.*, 2001).

An important goal is to determine the taxonomic affinities of the morphotypes. However, even if researchers only refer to numbered morphotypes at this stage, stomatocysts still can be used as powerful markers of environmental change, as well as in other scientific endeavours (Duff *et al.*, 1995). The stomatocysts of *Chrysophyta* are widely used in palaeolimnological studies as indicators of trophic levels of water bodies, climate changes, salinity and pH of water, because they are well preserved in bottom sediments (Nygaard, 1956; Cronberg, 1986; Duff *et al.*, 1995). Because of a highly seasonal nature of some chrysophyte taxa, layers of cysts in laminated lake sediments have been used to differentiate seasons (Duff *et al.*, 1995). Description of modern stomatocyst morphology is an important aspect of studying *Chrysophyta* and can serve as an additional criterion for assessing their diversity in water bodies.

When studying plankton samples with scanning electron microscopy (SEM) it was found that our chrysophycean stomatocyst morphotype does not match any of the known morphotypes. Methods of sampling, processing and examination with SEM are described in Safronova (2014). Samples were taken on 17 May 2013 from the Figurnyi Pond located in the Peter the Great Botanical Garden, Saint-Petersburg, Russia. From pond samples taken earlier, four chrysophycean stomatocysts were identified, two of which were determined to species (Safronova, 2014). The description of a new stomatocyst morphotype is presented below.

Stomatocyst 395/13 Safronova, **nov.** (Plate I).

Biological affinity: unknown.

Negative: 395.

Number of samples: 8.

Locality: Figurnyi Pond, Peter the Great Botanical Garden, Saint-Petersburg, Russia (59°58.209' N; 30°19.688' E). 17.05.2013, water t° = 19 °C; pH 7.5; specific conductivity 250 $\mu\text{S cm}^{-1}$.

SEM description: The stomatocyst is spherical (5.3 μm in diam.), having a short cylindrical collar (1.8 μm in diam., 0.2 μm high), with a conical pore (0.3 μm in diam.). The inner collar margin with a planar annulus has a radial annular ring. The entire stomatocyst surface is covered with rounded scabrae 0.1–0.2 μm in diam. arranged equidistantly in a regular pattern, with a distance of 0.2 μm between scabrae.

The shape, size and surface morphology of stomatocyst 395/13 resemble those of stomatocyst 117 (Zeeb *et al.*, 1990) but differ in collar morphology. Stomatocyst 117 has a cylindrical to slightly obconical collar (0.3–0.5 μm high); the basal part of the collar is covered with rounded scabrae arranged equidistantly in a regular pattern (as the entire surface of the stomatocyst). The collar of stomatocyst 395/13 is shorter (0.2 μm high) than the collar of stomatocyst 117 and is not ornamented with rounded scabrae. The inner collar margin of stomatocyst 395/13 with a planar annulus has a radial annular ring that is absent in stomatocyst 117.

The study was carried out using the equipment of BIN RAS SEM Department, within the BIN RAS Laboratory of Algology project «Regional taxonomic and floristic studies of algae of marine and continental waters» (N 0120125605).

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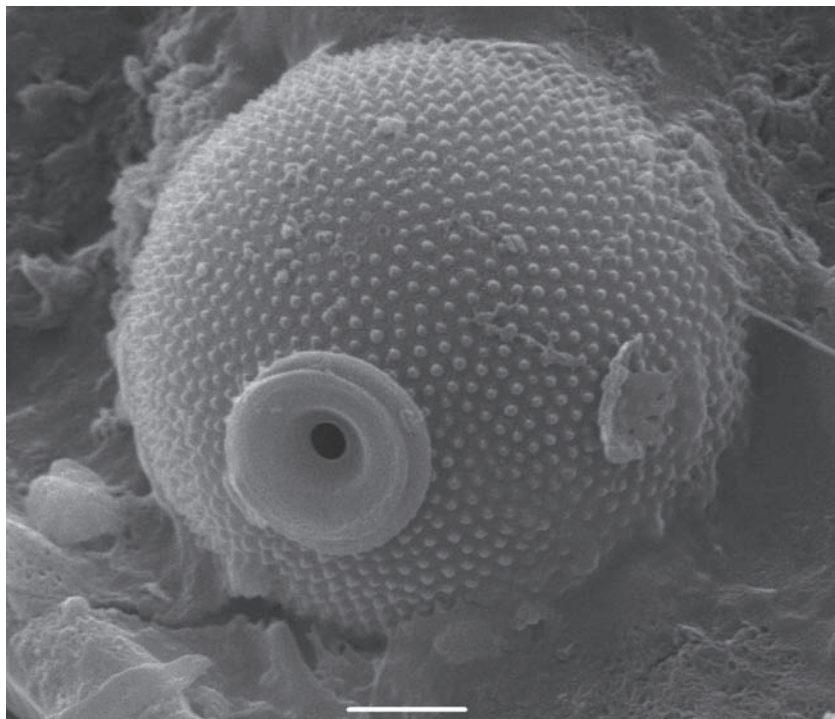


Plate I. Stomatocyst 395/13 Safronova. Scale bar: 1 μm .
Стоматоциста 395/13 Safronova. Масштабная линейка: 1 μm .