

A New Neustonic Genus and Species of Green Algae: *Chlorokremys scutella* (Tetrasporales)

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Abstract – A new genus and species of neustonic green algae, *Chlorokremys scutella*, a member of the Tetrasporales, is described. Each cell possesses a flat flotation disk composed of concentric rings which adheres the cell to the surface.

Tetrasporales / *Chlorokremys* / neuston

Résumé – Un nouveau genre neustonique d'algues vertes : *Chlorokremys scutella* gen. et sp. nov. (Tetrasporales). Un nouveau genre neustonique d'algues vertes, *Chlorokremys* (Tetrasporales) est décrit ainsi que son espèce type *C. scutella*. Chaque cellule possède un disque plat composé de cercles concentriques qui fixe la cellule à la surface de l'eau.

Tetrasporales / *Chlorokremys* / neustonique

INTRODUCTION

Neuston, a word first introduced by Naumann (1917), is composed of organisms associated with the water's surface (Marshall & Burchardt, 2005). They play a significant role in the dynamics of various ecosystems, both marine and freshwater. The neuston has been often divided into two categories: epineuston (organisms living on the surface of the air-water interface) and hyponeuston (organisms either attached to, or are directly below the surface film) (Geitler, 1942). Two other terms first used by Welch (1935), supraneuston and infraneuston, have not been universally adopted. Common components of the neuston are algae belonging to the Chlorophyta and Chrysophyta and to a lesser extent Euglenophyta and Tribophyta.

Previous investigations by Thompson and Wujek from Kansas and Michigan have revealed a diverse algal flora resulting in the descriptions of new genera and species and new records from Kansas, Michigan and/or the United States (Thompson, 1938a, b, 1950a, b, 1951, 1952, 1954, 1956, 1969, 1984; Wujek,

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1965, 2006; Wujek & Igoe, 1989; Thompson & Wujek, 1992, 1998; Wujek & Thompson, 2002; Wujek & Weis, 1984; Wujek *et al.*, 1980). The purpose of this paper is to describe a new genus and species of tetrasporalean alga first observed from a Douglas County, Kansas turnpike marsh. Additional observations were made from a Michigan collection.

MATERIALS AND METHODS

Phytoplankton samples containing *Chlorokremys* were collected with a 20 µm plankton net from an I-70 turnpike marsh, Douglas County, west of Lawrence, Kansas, July 1968. Additional samples containing *Chlorokremys scutella* were collected from Miller's Marsh, Charlevoix County, Michigan, July 1990. Stock cultures were transferred periodically to insure continuous vegetative reproduction. Observations with AO or Zeiss Photoscope II microscopes were made both from freshly collected material and from short term cultures grown in soil water extract or Bold's Basal Medium (Bold, 1967), with additional soil water extract. Attempts to maintain cultures for extended periods failed; cultures no longer survive.

Microscopic slides were prepared by gently touching a cover slip parallel to the surface of a sample or culture that had been allowed to stand for several hours in a stackable culture dish (115 × 50 mm).

RESULTS AND DISCUSSION

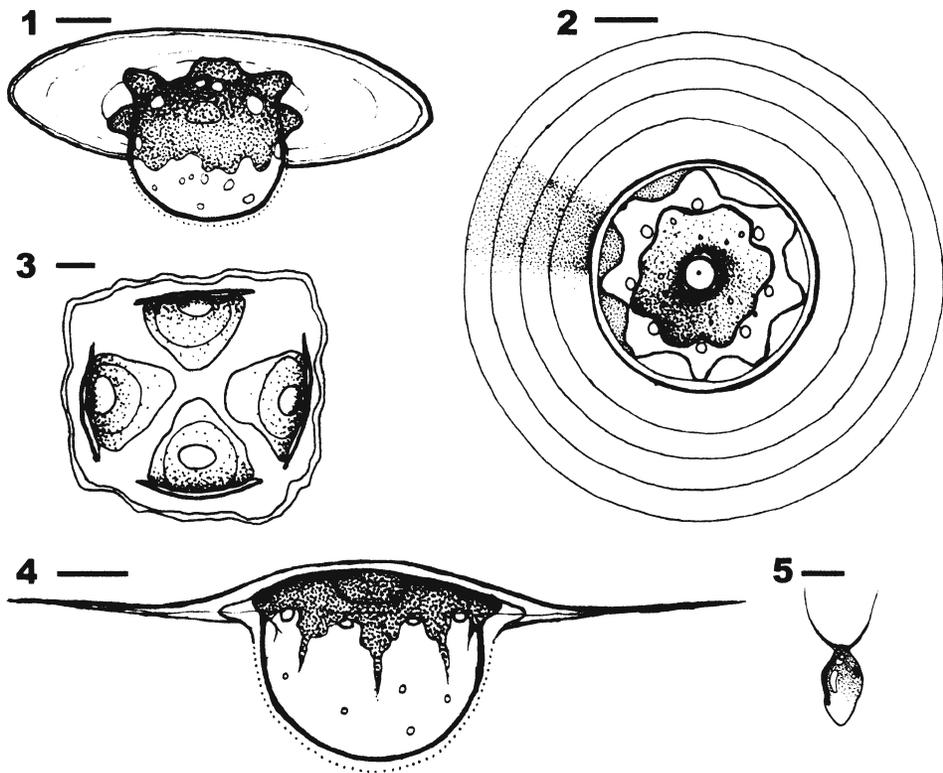
Chlorokremys scutella Wujek *et* Thompson, gen. et sp. nov. (Figs 1-5)

Chlorokremys Wujek *et* Thompson, gen. nov.

Diagnosis: *Alga unicellularis, neustonica, operculo pateriformi tenui natanti. Cellulae globosae 5-14 µm diametro ab paginae visae, 3-8 ab laterali. Cellula subter visa rotunda ad ovoidea, interdum angularis si operculum replicatum ad marginem; visa similiter, chloroplastus viridis, circularis vel ovalis sed saepe margine irregulariter lobato cum pyrenoide centrali. Extra chloroplastum, lobi obtusi incolorati, forma, ordine et numero irregulariter distributi, globulis numerosis ad basim loborum, unus per vacuolam parvam. A latere visum, operculum natans ferrugineum, errigens leniter ab margine sustinente. A latere visa, cellula ipsa ellipsoidalis vel sphaerica ad segmentum curvatum affixa. Ex margine cellulae et contra operculum, lobi obtusi praesentes. Pars libera cellulae laevis, rotundata, vagina gelatinosa vice pariete celluloso manifesto. Chloroplastus parietalis contra curvaturam superficiale operculi, marginibus lobatis irregulariter sed cum lobis incoloratis prope basim alternantibus. Propagatio asexualis per zoosporas biflagellatas vel per aplanosporas. Propagatio sexualis non observata.*

Typus: die 28 July anni 1968 in palude iuxta viae I-70, Douglas County, Kansas, USA. Figuris 1 monstratus, in collectione Universitatis Michiganensis Centralis (17354), Mount Pleasant, Michigan. Holotypus: Fig. 1.

Alga is unicellular, neustonic with a thin saucer-shaped flotation cap (Fig. 1). Cells are globose, from 5-14 µm in diameter in surface view and from



Figs 1-5. *Chlorokremys scutella* gen. et sp. nov. **1.** Holotype. Cell from beneath. **2.** Top view. **3.** Aplanosporic reproduction. **4.** Side view. **5.** Zoospore. Scale = 1-4, 10 μm , 5, 5 μm .

3-8 μm in thickness in side view. From below, the cell appears to be round to oval, sometimes angular if the flange portion of the cap is folded back at several points (Figs 2, 4). In this same view the green plastid may be circular, oval, or more often with an irregularly lobate margin and with a central pyrenoid. External to the plastid, in this view, are blunt, colorless lobes in no regular number, order or form and these contain, at their base, numerous globules one each to a small vacuole. These stain immediately and deeply with methylene blue. The pyrenoid starch plates stain immediately and distinctly with IKI. Cells are uninucleate, the nucleus lying directly above the pyrenoid. Contractile vacuoles, while present, are not readily visible. In side view the flotation cap rises in a shallow curve from the supporting flange; the cap becomes brown with iron. The cell proper is attached to the curved portion and is ellipsoidal to nearly spherical in side view (Fig. 4). From the margin of the cell and against the cap are the colorless blunt lobes. The free portion of the cell is smooth and rounded and invested by a gelatinous sheath instead of a defined cellulose wall. The plastid is parietal and lies against the upper curvature toward the surface of the cap, and its margins are irregularly lobed corresponding to the colorless lobes at the base but alternate with them. Flotation disk and cell are more or less parallel with the water surface. Asexual reproduction by biflagellate zoospores or by aplanospores. Sexual reproduction not observed.

Type: collected 28 July 1968 in a I-70 turnpike marsh, Douglas County, Kansas. Holotypus: Fig. 1. Material observed from Michigan is in the CMC herbarium as aqueous sample, accession number 17354.

Etymology: The epithet “*Chlorokremys*” is derived from the Greek “chloro” meaning green and “kremys” meaning to hang.

***Chlorokremys scutella* Wujek et Thompson, sp. nov.**

Diagnosis: *Characteres generis: Cellulae laxe aggregatae ab coalescentibuss cellulis propinquis aut fortasse ab divisione cellulae et motu laterali cellulae filialis unae, operculum suum secernentis. Cellulae saepe quaternae, juvenalissimas includentes, ergo ab divisione cellulae originatae aut fortasse ab quatuor zoosporis non liberatis effectae. Numerosae cellulae solitariae juvenalissimae indicunt ut per zoosporas productae. Unum operculum vetum vacuum observatum foramine magno in pariete submerso. Zoosporae ellipsoidales (5-9 μ m) duabus flagellis aequilongis. Stigma praesens.*

Typus: die 28 July anni 1968 in palude iuxta viae I-70, Douglas County, Kansas. Figuris 1 monstratus, in collectione Universitatis Michiganensis Centralis, Mount Pleasant, Michigan. Holotypus: Fig. 1.

Etymology: The epithet “*scutella*” refers to the saucer-shaped flotation cap.

Characteristics as for the genus. Loose aggregates of cells occur by coalescence of adjacent cells or perhaps by division of the cell and a lateral movement of one daughter cell which then secretes its own cap.

Rafts of four cells only are frequent and groups of four very young cells suggest that these have originated by cell division but the same situation could develop from four unreleased zoospores (Fig. 3). Numerous very young solitary cells suggest that zoospores are produced and one old empty cap was observed in which there was a large hole in the submerged wall. Zoospores are ellipsoidal ($5 \times 9 \mu$ m), with two equal flagella (Fig. 5). A stigma is present.

Additional observations of the organism were made from samples collected in July 1990 from Miller’s Marsh, Beaver Island, Charlevoix County, Michigan (CMC accession number 17354).

It is the unique pattern of the cap which separates this taxon from other species. The cells approach *Nautococcus emersus* Geitler (1942) in appearance, but *C. scutella*’s pyrenoid lacks the stellate appearance observed in pyrenoids of older cells of *N. emersus*. Neustonic *Nautococcus* taxa also lack the characteristic caps present on *Chlorokremys* cells. Its overall morphology closely resembles Pascher’s (1942) chrysophycean genus *Kremastochrysis*. However, the cells of *Chlorokremys* possess chloroplasts and the zoospores have equal biflagellate flagella. In that regards it approaches Pascher’s (1942) green algal genus *Kremastochloris*. *Kremastochloris* cells, with zoospores similar to *Chlorokremys*, though, lack the extensive flat disc with concentric zones which adheres *Chlorokremys* to the surface. A portion of each *Kremastochloris* cell is highly elevated above the surface of the water, while in *Chlorokremys*, the cell is more or less parallel with the water’s surface.

However, in its overall morphology, our organism most closely resembles *Nautocapsa neustophila* (Czosnowski) Ettl et Ettl, a genus described by Ettl & Ettl (1959). It is based on a *Carteria* species, *C. neustophila* (Czosnowski, 1952), which also possesses a flotation cap. However, the cell of *N. neustophila* is completely enveloped in a gelatinous sac and its flotation cap does not contain concentric rings, characters lacking in our taxon. Additionally, zoospores of *N. neustophila* are quadriflagellate whereas the zoospores of *C. scutella* are biflagellate.

In summary, based on the morphology of the above newly described organism, it is best placed in the order Tetrasporales, family Nautococcaceae as delineated in Fott (1972).

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REFERENCES

- BOLD H.C., 1967 — *A Laboratory Manual for Plant Morphology*. New York, Harper & Row, 123 p.
- CZOSNOWSKI J., 1952 — Nowy gatunek neustonowy *Carteria neustophila* n. sp. (A new neustonic species - *Carteria neustophila* n. sp.). *Acta societatis botanicorum Poloniae* 21: 329-333.
- ETTL H. & Ettl O., 1959 — Zur Kenntnis der Klasse Volvophyceae. II. *Archiv für Protistenkunde* 104: 51-112.
- FOTT B., 1972 — Chlorophyceae (Grünalgen), Ordnung: Tetrasporales. In: *Das Phytoplankton des Süßwassers*. Band XVI, 6. Teil. Stuttgart, E. Schweizerbart'sche Verlagsbuchhandlung, 116 p.
- GEITLER L., 1942 — Zur Kenntnis der Bewohner des Oberflächenhäutchens einheimischer Gewässer. *Biologia generalis* 16: 450-475.
- MARSHALL H.G. & BURCHARDT L., 2005 — Neuston: Its definition with a historical review regarding its concept and community structure. *Archiv für Hydrobiologie* 164: 429-448.
- NAUMANN E., 1917 — Beiträge zur Kenntnis des Teichnannoplanktons. II. Über das Neuston des Süßwassers. *Biologisches Zentralblatt* 37: 98-106.
- PASCHER A., 1942 — Über einige mit Schwimmschirmchen versehene Organismen der Wasseroberfläche. *Beihefte zum Botanischen Centralblatt* 61: 462-487.
- THOMPSON R.H., 1938a — A preliminary survey of the fresh-water algae of Eastern Kansas. *University of Kansas science bulletin* 25: 5-83.
- THOMPSON R.H., 1938b — *Coronastrum*: a new genus of algae in the family Scenedesmaeaceae. *American journal of botany* 25: 692-694.
- THOMPSON R.H., 1950a — A new genus and new records of fresh-water Pyrrophyta in the Desmokiatae and Dinophyceae. *Lloydia* 13: 277-299.
- THOMPSON R.H., 1950b — A new species of *Coronastrum*. *American journal of botany* 37: 371-373.
- THOMPSON R.H., 1951 — *Schizodictyon*, a new genus in the Palmellaceae. *American journal of botany* 38: 780-783.
- THOMPSON R.H., 1952 — A new genus and records of algae in the Chlorococcales. *American journal of botany* 39: 365-367.
- THOMPSON R.H., 1954 — Studies in the Volvocales. I. Sexual reproduction of *Pandorina charkowiensis* and observations on *Volvulina steinii*. *American journal of botany* 42: 142-145.
- THOMPSON R.H., 1956 — *Schizochlamys gelatinosa* and *Placosphaera opaca*. *American journal of botany* 43: 665-672.
- THOMPSON R.H., 1969 — Sexual reproduction in *Chaetosphaeridium globosum* (Nordst.) Klebahn (Chlorophyceae) and description of a species new to science. *Journal of phycology* 5: 285-290.
- THOMPSON R.H., 1984 — *Chlorohippotes tenax* gen. et sp. nov. (Chlorophyceae). *Transactions of the Kansas academy of science* 87: 36-40.
- THOMPSON R.H. & WUJEK D.E., 1992 — *Printzina* gen. nov. (Trentepohliaceae), including a description of a new species. *Journal of phycology* 28: 232-237.
- THOMPSON R.H. & WUJEK D.E., 1998 — *Chrysocapsopsis rupicola*: a new genus and species in the Chrysophyceae. *Phycological research* 46: 165-168.
- WELCH P.S., 1935 — *Limnology*. 1st Ed. New York, McGraw-Hill Book Co., 538 p.
- WUJEK D.E., 1965 — A contribution to the diatom flora of Kansas. *Southwestern naturalist* 10: 39-41.
- WUJEK D.E., 2006 — The first occurrence of the chrysophyte alga *Amphirhiza epizootica* from North America. *The Michigan botanist* 45: 197-200.
- WUJEK D.E. & WEIS M.M., 1984 — Mallomonadaceae from Kansas. *Transactions of the Kansas Academy of Science* 87: 26-31.
- WUJEK D.E. & IGOE M.J., 1989 — Studies on Michigan Chrysophyceae. VII. *Beihefte zur Nova Hedwigia* 95: 269-280.
- WUJEK D.E. & THOMPSON R.H., 2002 — The genera *Uroglena*, *Uroglenopsis*, and *Eusphaerella* (Chrysophyceae). *Phycologia* 41: 293-305.
- WUJEK D.E., CHAPO M.S. & REINKE D.C., 1980 — New records and distributional notes on diatoms from western Kansas. *Technical bulletin of the state biological survey of Kansas* 9: 90-109.

