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Morphological observations on *Mesoporos perforatus* (Dinophyceae)*

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Mesoporos perforatus (GRAN) LILLICK collected from Saroma Lake in Hokkaido was examined with light and scanning electron microscope (SEM). The surface of the valves is covered with minute spines similar to those of *Prorocentrum minimum* and *P. balticum*. The margin of each valve is ornamented with one row of trichocyst pores. A few trichocyst pores are located in the middle parts of the valves. The central pore of the valves is funnel-shaped. The tip of its pore extending toward the inner part of the valve is closed.

The taxonomical relationship of the present species with other species of the genus *Mesoporos* is discussed. This is the first report for the occurrence of the genus *Mesoporos* in Japan.

Key Index Words: Dinophyceae; *Mesoporos perforatus*; Morphology; SEM; Taxonomy.

Mesoporos perforatus was originally described by GRAN (1915) from the North Sea. At that time, this species was considered to be one species of the genus *Exuviaella* of the family Prorocentraceae and was designated as *E. perforata*.

In 1918, SCHILLER described a new species of *Exuviaella bisimpressa* from the Adrea Sea. LEBOUR (1922) also reported *E. perforata* from the English Channel. She observed the flagellar pores on the species which had not been noticed until then.

In 1928, SCHILLER established a new genus *Porella* for the species which have a central pore in the central part of each valve among the species of *Exuviaella*. Then he added two new species of *Porella*, *P. adriatica* and *P. globulus*.

SCHILLER (1933) reported a new species under the name of *Porella asymmetrica*. This new species had been reported to be *P. perforata* in 1928 by himself. The species separated from *P. perforata* for no other reason than that there are the differences in size and form between *P. perforata* and the new species. The generic name *Porella*, however, had already been used for lichens in the plant kingdom. Therefore, LILLICK (1937) made a new genus *Mesoporos* instead of the genus *Porella* according to the International Code of Botanical Nomenclature and four species which had been known as *Porella* were transferred to the new genus.

In 1945, BRAARUD cultivated *P. perforatus* in Allen medium and observed the variation of the form. SILVA (1953, 1960) reported *M. adriaticus* and *M. globulus* from the coastal waters of Portugal. WOOD (1958) reported *M. perforatus* from Australian waters.

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In 1966, SUBRAHMANYAN established a new species *M. parthasarathicus* from the Indian Ocean. Lately, RAMPI and BERNHARD (1980) reported five species, *M. adriaticus*, *M. asymmetricus*, *M. bisimpressus*, *M. globulus* and *M. perforatus* from the Mediterranean Sea.

Thus, six species of the genus *Mesoporos* are found in six areas, the Atlantic Ocean, Mediterranean Sea, Indian Ocean, Australian region, North Sea and Norwegian Sea. However, the species of the genus *Mesoporos* have not been reported from Japanese coastal waters.

Materials and Methods

The materials were collected by a plankton net from Saroma Lake, Hokkaido in 1977. The materials were fixed with 2% formalin and dehydrated in an ethyl alcohol series of 30-100%. For light microscope examinations, the specimens were mounted with Pleurax. For the observations under the SEM, the materials were dried at critical point in an aluminum box using liquid carbon dioxide. The dried materials were coated with gold. SEM micrographs were taken with a JSM-35.

Results and Discussion

Cells are composed of two valves, covered with small spines. Valves are almost circular in external form. Flagellar pores lie at the front of the valve, from which two flagellar arise. A central pore of each valve is funnel-shaped in cross section. An entrance of the pore gradually opens toward the surface of the valve. The form of the entrance is almost circular in the valve view. The opposite side of the entrance become more and more slender toward the inside of the valve and its terminal end is closed. About 15 trichocyst pores are found near the margin of the valve and several other pores are scattered in the middle part of the valve. Two or more yellow-brown chromatophores are present in the valves. Length and breadth are about 20 μm.

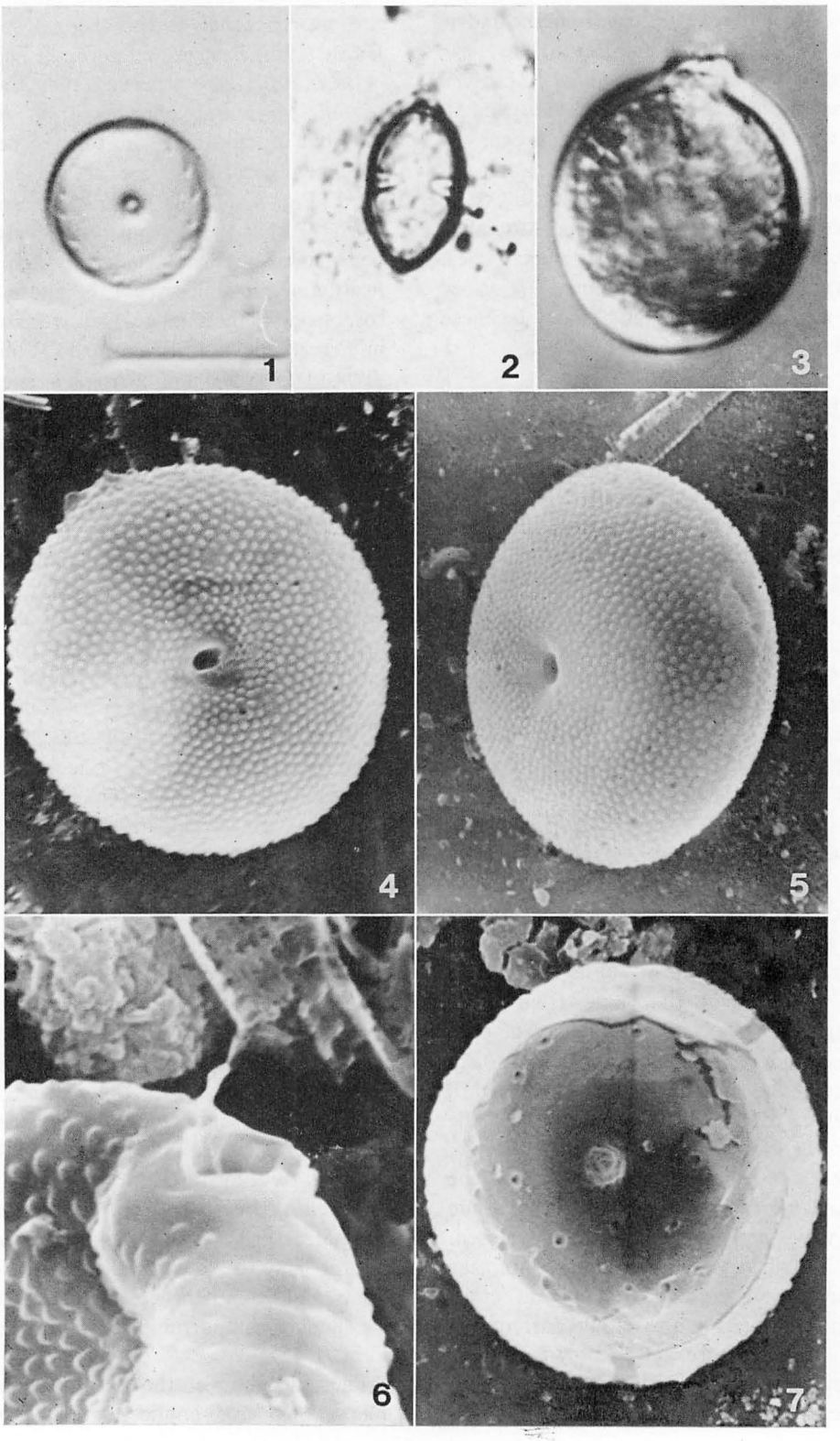
Specimens collected from Saroma Lake are nearly equal to the original species of GRAN (1915) in size and form. (Figs 1-3).

BRAARUD (1945) observed that the shape of *M. perforatus* changes from ovoid to ellipsoid in cultures. In this respect, the specimen described here resembles that of pl. 1, Fig. a, in his paper. Moreover, he observed that the margin of the valves was not smooth but wavy under a high magnification light microscope. These waves correspond to the spines which were observed in *Prorocentrum balticum* and *P. minimum* (TORIUMI, 1980) and Saroma's specimens. (Figs 4, 5). The number and arrangement of trichocyst pores of specimens from Saroma Lake slightly differ from the description of BRAARUD (1945). The number of trichocyst pores is ca. 20 on his specimens and they ring the margin of the valve. On the other hand, our specimens are distributed ca. 15 of trichocyst pores along the margin of the valve and a few pores scattered the central part of the valve (Fig. 7).

The present specimens are similar to *M. perforatus* reported by LEBOUR (1922, 1925) from the English Channel. She mentioned an interesting feature in the region of the flagellar pores. According to her, as though the two valves bite each other like two gears, they conjugate at the anterior end of the valves. But the region of the flagellar pores in our specimen looks as if it lacks such depression (Fig. 6).

Saroma specimens are more similar to *M. globulus* than the original species of GRAN in external form but differ from it in size. According to BRAARUD, the size of *M. perforatus* varies from 14 μm to 20 μm in cultures. This fact indicates that the size of *M. globulus* is within the limits of that of *M. perforatus*. However, considering from the original description of *M. globulus*, *M. perforatus* may be separated from it in size, form and some other features such as the number and arrangement of trichocyst pores.

Thus, deciding on the specific name of the genus *Mesoporos* implies several problems.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For solving these problems, it is considered that more detailed observations on many specimens collected from various localities are necessary.

Recently, DODGE (1981) concluded that the four species of *M. asymmetricus*, *M. adriaticus*, *M. bisimpressus* and *M. globulus* are all synonyms of *M. perforatus*. We agree with his opinion for the present. Therefore, the specimens collected from Saroma Lake are assigned to *M. perforatus*.

This is the first report of *Mesoporos* species from Japanese coastal waters.

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References

BRAARUD, T. 1945. Morphological observations on marine dinoflagellate cultures (*Porella perforata*, *Gonyaulax tamarensis*, *Prorocentrum reticulatum*). Avh. norske Vidensk. Akad. Oslo 11 : 1-18.

DODGE, J. D. 1981. Marine dinoflagellates of the British Isles. Her Majesty's Stationery Office, London, 1-303 pp.

GRAN, H. H. 1915. The plankton production in the North European Waters in the Spring of 1912. Bull. Planktonique 1912, 1-142 pp.

LEBOUR, M. V. 1922. Plymouth Peridinians II. *Exuviaella perforata* Gran from the English Channel. J. mar. biol. Ass. U. K. 12 : 812-817.

LEBOUR, M. V. 1925. The dinoflagellates of northern seas. 250 pp. J. mar. biol. Ass., Plymouth.

LILLICK, L. C. 1937. Seasonal studies of the phytoplankton off Woods Hole, Massachusetts. Biol. Bull. 73(3) : 488-503.

RAMPI, L. and BERNHARD, M. 1980. Chiave per la determinazione dell peridinee pelagiche mediterranee. Cnen-Rt Bio. 80(8) : 1-193.

SCHILLER, J. 1918. Über neue *Prorocentrum*-und *Exuviaella*-Arten. Arch. Protistenk. 38 : 250-262.

SCHILLER, J. 1928. Die planktishen Vegetationen des adriatichen Meeres. C. Dinoflagellata L. Teil Adniferidea, Dinophysidaceae System. Teil. Arch. Protistenk. 61 : 45-91.

SCHILLER, J. 1933. Dinoflagellate (Peridineae). 1-617 pp. *In* RABENHORST [ed.] Kryptogamenflora von Deutschland, Östrreich und der Schweiz, 10 (Flagellatae) Sect. 3(1). Reprint in 1971, New York, London.

SILVA, E. de S. 1953. "Red water" por *Exuviaella baltica* Lom. com simultanea mortandade de peixes nas agusa litorais de angola. An. Jta Invest. Ultramar 8(2) : 1-12.

SILVA, E. de S. 1960. O microplancton de superficie nos meses de Setembro e Outubro na estacáo de inhaca (Mozambique). Men. Jta Invest. Ultramar Segunda Serie 18 : 1-50.

SUBRAHMANYAN, R. 1966. New species of Dinophyceae from Indian waters. 1. The genera *Haplodinium* Klebs emend. Subrahmanyan and *Mesoporos* Lillick. Phykos 5 : 175-180.

TORIUMI, S. 1980. *Prorocentrum* species (Dinophyceae) causing red tide in Japanese coastal waters. Bull. Plankton Soc. Japan 27(2) : 105-112.

WOOD, E. J. F. 1958. Dinoflagellates in the Australian region. Aust. J. Mar. Freshw. Res. 5(2) : 171-351.

Fig. 1. Ventral view of *M. perforatus*, showing the central pore and the trichocyst pores of the margin of the valve (LM). ×1000

Fig. 2. Side view of *M. perforatus*, showing a funnel-shaped central pore (LM). ×1200

Fig. 3. Ventral view of *M. perforatus*, showing the depression of the flagellar pore region of the valve (LM). ×1800

Fig. 4. Ventral view of *M. perforatus*, showing the small spines of the valve (SEM). ×3500

Fig. 5. Oblique side view of *M. perforatus*, showing the suture of the valve (SEM). ×3500

Fig. 6. Flagellar pores of *M. perforatus*. ×9000

Fig. 7. Reverse side of *M. perforatus*, showing the distribution of trichocyst pores. The tip of the central pore is closed (SEM). ×4000

鳥海三郎*・根本敬久**: *Mesoporos perforatus* の形態観察

北海道のサロマ湖より得られた，*Mesoporos perforatus* を SEM で観察した。細胞は2枚の殻板で構成され，外形はほぼ円形で，細胞の前端に鞭毛孔が存在する。細胞の表面は小刺でおおわれ，それぞれの殻板の中央に中心孔を有する。本種の中心孔は細胞の内部に向って細くなる ロウト状であるが，その先端は閉じられている。細胞の周縁に沿って刺胞孔があるほかに，細胞の中央付近にも，それは散在する。

この属に含まれる種は現在までに，北海や地中海などの6海域より6種が知られているが，これらの種を 確定するには，それぞれの海域より採集される種について，鞭毛孔の構造などの詳細な観察が必要と考えられる。

この報告は，日本沿岸域より得られた，*Mesoporos* 属についての最初の報告である。

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新 刊 紹 介

SPECTOR, D. L. (ed.) **Dinoflagellates** 545 pp. Academic Press, Orland, U. S. A. 1984. 邦貨約25,500円

渦鞭毛藻類について，最近の研究成果を第一線で活躍する16名の研究者が概説したもので，その内容は広く生物学全般にわたっており（生態学的な記述は少ないが），いわば“渦鞭毛藻の生物学”といった内容の成書である。

各章はそれぞれの研究分野の 歴史的背景を紹介した後に，最新の研究成果を概説するレビュー形式となっている。章の題目と内容は次のようである（カッコ内は執筆者名）。1) 渦鞭毛藻：その概要（D. L. SPECTOR）。2) 渦鞭毛藻の分類（J. D. DODGE）。題は分類であるが，分類群毎の詳しい各論はなく，分類基準に用いられる幾つかの形質の記述が行なわれ，続いて章の終りに，代表的な属の分類表と科，目の特徴が簡単に記される。3) 細胞外被（H. NETZEL & G. DÜRR）渦鞭毛藻は他の藻群に比べ複雑な細胞外被を有し，その構造は重要な分類形質の一つとなっている。この章では細胞外被の構造変異，発生様式などが解説される。4) 渦鞭毛藻核（D.L. SPECTOR）。渦鞭毛藻核と呼ばれる特殊な核について，その特徴，染色体の微細構造，DNA や RNA に関する生化学的解析結果が総説される。5) 細胞周期と有糸分裂（R. E. TRIEMER & L. FRITZ）。細胞周期と DNA 複製のタイミング，核分裂の際の染色体，微小管等の挙動の微細構造などが述べられる。9) 有性生殖（L. A. PFIESTER）。比較的良く調べられている種類の有性生殖過程の要約と解説。なお渦鞭毛藻では，現生種約 2000 のうちで有性生殖が知られているのはわずかに23種に過ぎない。7) 海産有毒渦鞭毛藻（K. A. STEIDINGER & D. G. BADEN）。有毒な渦鞭毛藻の 分類・生活様式・産生する 毒成分やアッセイ法・毒の作用機作などの解説。8) 渦鞭毛藻の 遺伝学（C. A. BEAM & M. HIMES）。遺伝的解析の最も進んでいる種類 *Crypthecodinium cohnii* の研究結果を中心に表現型の分離の様式・同胞種（交配群）の存在が詳述され，ついで GC 含量・種間のアイソザイム比較など分子レベルでのアプローチも簡単に紹介される。9) 渦鞭毛藻の生理・生化学（A. R. LOEBLICH III）。最近の研究を中心に生理学的研究と生化学的研究とに分けてその概要が紹介される。10) 渦鞭毛藻の概日リズム（B. M. SWEENEY）。概日リズム（サーカディアンリズム）は生物界に広く見られる現象であるが，渦鞭毛藻では，光合成活性や生体発光にも概日リズムが見られるという。11) 特殊な細胞含有物（D. L. SPECTOR）。主として電子顕微鏡で観察できる種々の特徴的な細胞小器官，貯蔵物質やウィルス様物質などについての総説。12) 渦鞭毛藻の培養（R. R. L. GUILLARD & M. D. KELLER）。培養技術の発達史，渦鞭毛藻の栄養摂取様式の解説，培養の具体的な方法の論述。13) 渦鞭毛藻のシスト（A. R. LOEBLICH III & L. A. LOEBLICH）。研究の歴史とシストの一般的性質の解説。14) 渦鞭毛藻の進化（A. R. LOEBLICH III）。主に細胞学的な証拠に基づき，渦鞭毛藻のグループ内での進化，特化した生物群である渦鞭毛藻の進化的位置に関する推論の提唱が行われている。ここでは *Oxyrrhis* という属が最も原始的な性質をもつ渦鞭毛藻であるとして，それをもとに進化のシェーマが展開される。

各章の執筆者が異なる為に重複する部分も少なくないが，気になる程ではない。スペースの関係と本書が研究成果の総説であることから実際のデーターや図表が充分でなく，理解しにくい点もあるが，これらは引用文献を参照することで解決されよう。各章の引用文献は充実しており，最新の研究までよくカバーしている。渦鞭毛藻に関する生物学全般にわたる研究成果を総説した本書は，この生物群の研究の現状を知る上で有用であり，時宜を得た出版物というべきである。

(筑波大学生物科学系 堀口健雄)