

VALVE MORPHOLOGY OF THE MARINE DIATOM *NEOFRAGILARIA NICOBARICA* (BACILLARIOPHYCEAE: FRAGILARIACEAE)

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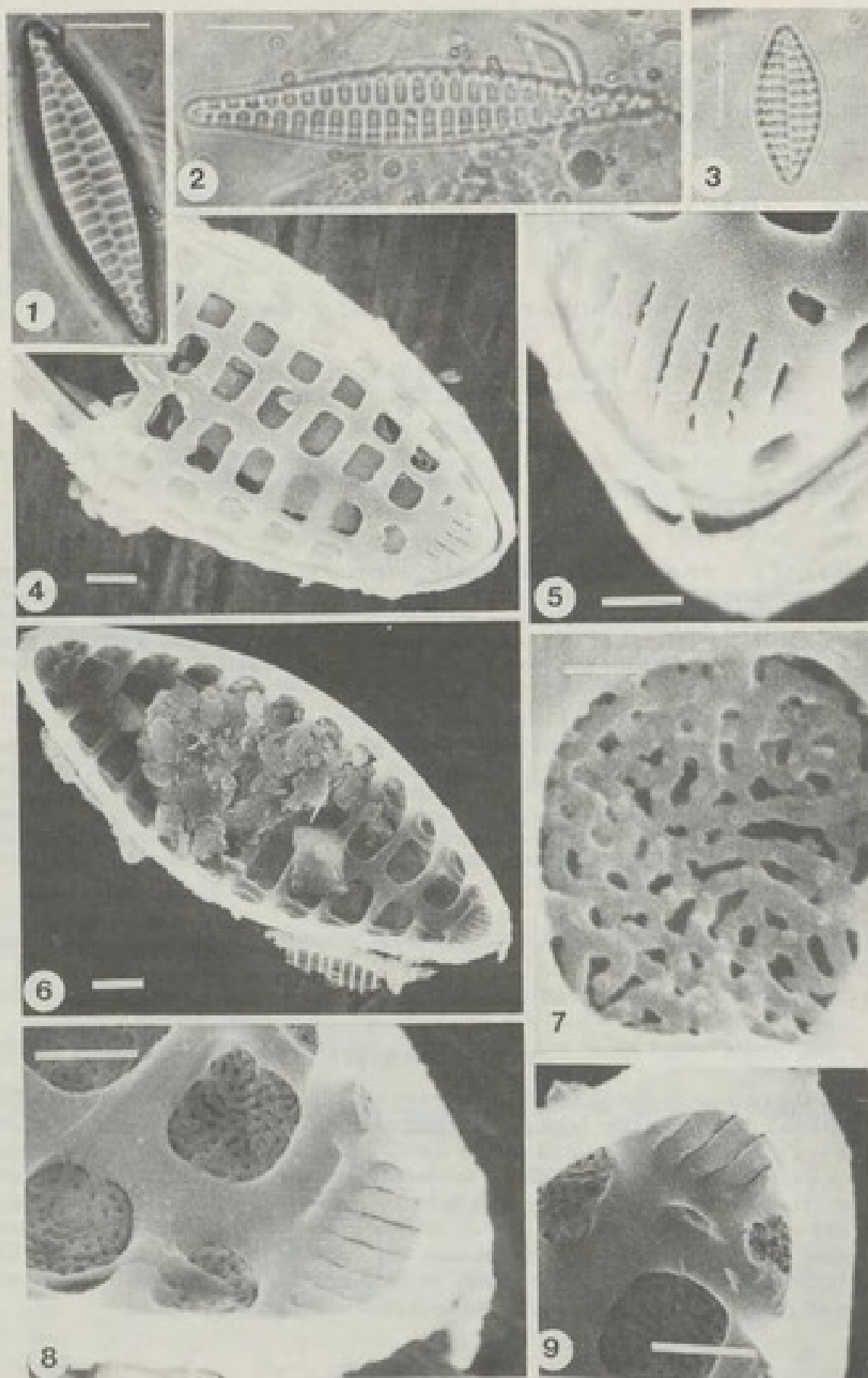
ABSTRACT - Valve morphology of *Neofragilaria nicobarica* Desik. et al. collected from the Andaman and Nicobar Island is studied with scanning electron microscope. The distinctive features of this diatom include the presence of apical slit fields, consisting of narrow slits separated by longitudinal bars of silica, rather than rows of pores, transverse striae with orderly rows of areolae that are not aligned across the sternum but alternate with each other, and the absence of rimoportulae. Its affinities are discussed.

RÉSUMÉ - La morphologie du frustule de *Neofragilaria nicobarica* Desik. et al. provenant des îles Andaman et Nicobar est étudiée au microscope électronique à balayage. Les caractères distinctifs de cette Diatomée comprennent: la présence d'une zone de fentes apicales formées d'étroites fentes séparées par des crêtes plutôt que par des rangées de pores; des stries transversales avec généralement des rangées d'aréoles non alignées de part et d'autre de l'area longitudinale mais alternes; l'absence de rimoportulae. Ses affinités sont discutées. (traduit par la rédaction).

KEY WORDS : Bacillariophyceae, Fragillariaceae, *Neofragilaria nicobarica*, morphology, Indian Ocean.

INTRODUCTION

In the course of our continuing efforts to classify the marine diatoms from the Andaman and Nicobar Islands, northern Indian Ocean (Desikachary *et al.* 1984, 1987; Desikachary & Ranjitha Devi, 1986), a number of small diatoms were encountered that were difficult to classify because we could not discern certain details of their morphology with light microscopy (LM). This problem raises the question of whether the use of electron microscopy is essential for determining taxonomic position. We believe that investigation of a species at the ultrastructural level in order to clarify its similarity to, or dissimilarity from accepted generic groupings will prove to be sound taxonomic practice.



A formal description and a latin diagnosis of *Neofragilaria nicobarica* collected from the Andaman and Nicobar Islands, Indian Ocean, were given in the recently published *Atlas of Diatoms*, dealing with Indian Ocean forms (Desikachary, 1987). Scanning electron microscopy (SEM) revealed additional information that helped us to determine its taxonomic position more accurately. The present paper deals with a detailed description of *Neofragilaria nicobarica* and its affinities.

MATERIALS AND METHODS

Material of *Neofragilaria nicobarica* was collected from sand samples obtained during a collecting trip to the Andaman and Nicobar Islands, Indian Ocean. Specimens for light microscopy were cleaned with concentrated sulphuric acid and washed repeatedly with distilled water. Cleaned samples were mounted in DPX mountant. Species for SEM were prepared as described by Prasad (1987). Terminology used in this paper follows that recommended by Ross *et al.* (1979), Cox & Ross (1981), and Williams & Round (1986).

RESULTS AND DISCUSSION

Neofragilaria Desikachary, Prasad et Prema

Valves linear elliptical or elliptical-lanceolate. Striae parallel, separated by ribs (virgae). Areolae cribrate internally, extending from valve face to mantle, in evenly spaced, uniseriate rows separated by conspicuous bars (vimines). Apical slit fields at edges of valve face consist of elongate pores, separated by siliceous bars. Rimoportulae and marginal spines lacking. Girdle of several open bands (incomplete).

Type species *Neofragilaria nicobarica* Desikachary *et al.*

This genus is characterized by the compound apical slit fields and by the absence of rimoportulae. Williams and Round (1987) used this generic epithet in a different sense, but there is a later homonym. The journal was issued in Feb. 1988 (Williams, pers. communication) while Desikachary *et al.* have published their new genus earlier (15th Dec. 1987).

Figs. 1-9: *Neofragilaria nicobarica* Desikachary *et al.* - Fig. 1-3: LM, scale = 10µm. 1: Nicobar Is. slide 1010. 2: Nicobar Is. slide 975 (1). 3: Andaman Is. slide 970. - Figs. 4-9: SEM of *Neofragilaria nicobarica*. 4: Exterior of the valve. Scale = 1µm. 5: Apical pore field with bars and slits. Scale = 0.5µm. 6: Interior of the valve. Note absence of rimoportula. Scale = 2µm. 7: Interior of the valve. A single areola with cribrum composed of pores and struts attached to areolar wall. Scale = 0.25µm. 8 and 9: Interior of the valve ends showing apical slit fields. Note the absence of rimoportula. Scale = 1µm.

Neofragilaria nicobarica Desikachary, Prasad et Prema, 1987, p. 8, pl. 306, fig. 9.

Type locality: Nicobar Islands, Indian Ocean.

Other locality: Andaman Islands, Indian Ocean.

Type slide : 975-1 deposited in the Philadelphia Academy of Natural Science; Syntype slides 975 (2-5), 967, 971, 740, 880, 1010, 970, 974, 966 are available in the senior author's collection at the University of Madras, Madras, India.

The detailed valve structure is extremely difficult to observe with LM, with the only visible feature the parallel rows of striae, which are often not aligned across the narrow sternum (Fig. 1-3). SEM, however, reveals complex valve structure (Fig. 4-9).

Valves linear-elliptical or elliptical lanceolate, tapering toward each pole; apices narrower and somewhat produced. Axial area (sternum *sensu* Williams, 1985) hyaline and narrow. Transverse rows of areolae not aligned across the axial area, in straight but alternating transverse rows. Apical axis 15-35 μm long and transapical axis 8-10 μm long; striae 6-7.10 μm . Sternum distinctive but narrow, interconnecting with parallel ribs or virgae (Cox & Ross, 1981). Virgae widely spaced; complex closing plates between virgae. Areolae more or less evenly spaced forming uniseriate rows.

Areolae, rectangular or square, apparently loculate, with external foramina and internal veta. Velum as a cribrum plate on inner surface, suspended by up to 7 struts attached to areolar wall. Areolation continues down mantle with third areola continuing down valve mantle. Slit fields (*sensu* Takano, 1983) at both apices on valve face only and consisting of 5-7 longitudinal slits separated by bars. Central slits longer than marginal ones. Rimoportulae absent. Marginal spines non-functional or linking type absent. Complete girdle not observed; on basis of SEM, girdle bands splittings and edges of pars interior slightly frilled.

The marine diatom genus *Neofragilaria*, as herein defined, flourishes in the shallow-shelf marine environment around the Andaman and Nicobar Islands. Its paleoecologic record is presently unknown. This genus includes araphid diatoms of the subfamily Fragilarioideae that have several distinctive features: (1) the transverse striae with orderly rows of areolae are not aligned across the sternum but lie alternate to each other; (2) apical slit fields consist of narrow slits separated by longitudinal bars of silica rather than rows of porelli; (3) no rimoportulae are evident. These structures can only be resolved by SEM, although the presence or absence of rimoportulae can on occasions be vaguely ascertained under LM. These are the major features that differentiate *Neofragilaria* from other taxa in the Fragilarioideae. There appears to be some resemblance to certain species of *Raphoneis*, such as *R. fossile* (Grunow) Andrews (Andrews, 1978), whose areolae are not aligned across the narrow sternum. However, SEM observations have revealed the true structure of the valve, and the distinguishing features of this genus. *Neofragilaria* has apical slit fields. The apical pore fields of *Raphoneis* have rows of porelli. In addition, the latter has a single rimoportula at each pole, just below the pore field. The velum or sieve plate in *Neofragilaria* is simple with several struts. The vola type commonly seen in *Raphoneis* is absent from *Neofragilaria*.

Though distinct, *Raphoneis fossile* (Grunow) Andrews has some features similar to those seen in *Neofragilaria*, but needs further study before a final taxonomic conclusion is possible (see also Andrews, 1978).

The apical slit fields in *Neofragilaria* are somewhat analogous to those of *Neosynedra provincialis* (Grun.) W. et R. and *N. tortosa* (Grun.) W. et R. but differ from them in that the valves of *Neosynedra* are elongate with an expanded portion at the centre and slightly capitate to rounded poles. There is a single rimoportula and the areolae are occluded by cribra on the outer surface. In *Neofragilaria* the apical slit fields are on the valve face whereas in *Neosynedra* "apical pore fields" sensu Williams & Round (1986) occur on the valve mantle and part of the adjacent valve face. Although usually composed of a series of rows of horizontal bars and apertures, they are very occasionally interrupted by smaller cross members. The species cannot, therefore, be accommodated under *Neosynedra* despite the characters it shares with that genus. Characters such as the presence of simple apical pore fields, marginal linking spines allowing cells to form ribbon-shaped colonies, and the presence of one rimoportula in many species (see Poulin *et al.*, 1986; Lange-Bertalot, 1980) differentiate *Fragilaria* and *Neofragilaria*. The latter could easily be mistaken for a species of *Fragilaria* under light microscopy alone.

A somewhat analogous type of apical slit field occurs in *Protoraphis* Hustedt et Krasske (Gibson, 1979) and in *Cyclophora* (Navarro, 1982, Figs. 15, 17), but these genera differ in having rimoportulae and in the general valve architecture. SEM observations on *Neofragilaria* indicate quite clearly that it is not very closely related to any of the genera in the Fragilarioidae and shares only one or two characters with those genera.

Rivera *et al.* (1986, Figs. 7, 13) reported a series of elongated perforations at the ends of the valves in *Pseudohimantidium*. It appears that *Neofragilaria* is less similar to *Pseudohimantidium*, *Protoraphis*, and *Neosynedra* than these genera are one to one another.

Certain araphid pennate diatoms such as *Asterionella* and *Falcula media* possess apical pore fields that are similar to those of *Neofragilaria*. In *Asterionella glacialis* Castr. (Hasle, 1973, Figs. 22a, 23a, b, 25; Korner, 1970; Lewin & Norris 1970), the narrow stalk-like part as well as the broad basal part of the valve is furnished with narrow slits and lamellae. A symmetry of the valve and the presence of rimoportulae are important points of dissimilarity from *Neofragilaria*. Similarly transmission electron microscopy of *Falcula media* Voigt, a marine araphid pennate diatom, reveals that the apical pore field or "Endorgan" consists of apically orientated slits and lamellae (Geissler & Gerloff, 1963). Arcuate valves with transverse striae of contrasting structure and the presence of rimoportulae are sufficient to distinguish it from *Neofragilaria*.

Recently, Takano (1983) described a new genus, *Sceptronema*, from Japanese waters. This genus resembles *Neofragilaria* in having apical slit fields and no rimoportulae, but differs in having heteropolar valves with cribrate areolae.

Finally, the absence of any evidence of marginal spines on the valves suggest that *Neofragilaria nicobarica* does not form any ribbon-shaped colonies, as found in the genus *Fragilaria*. Further studies on live material should precede final judgement on colony formation.

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