

## Morphological Re-examination of Three *Goniodoma* Species in Korean Coastal Waters

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**Abstract** - A taxonomic survey of the dinoflagellate family, Triadiniaceae Dodge was conducted on 17 locations off the coast of Korea. Three species of *Goniodoma* collected from the coast of Korea : *Goniodoma orientale* Lindemann, *G. polyedricum* (Pouchet) Jørgensen, and *G. sphaericum* Murray et Whiting.

**Key words** : dinoflagellate, Triadiniaceae, *Goniodoma*, Korea

### INTRODUCTION

The dinoflagellate taxonomy was brought by Schiller (1933, 1937) in his comprehensive volumes on the Dinoflagellata, including all known marine and freshwater dinoflagellates. Other taxonomic works of significance have been published in Japan (Abe 1936, 1967, 1981), England (Dodge 1981, 1985), and most prolifically for the South Atlantic and Antarctic by Balech (1976, 1980).

For more than seventy years, investigations have been conducted on the distribution and abundance of marine phytoplankton along the Korean coast. Besides the regular series of collections, numerous short series have been taken since the Korean War in 1950. However, the taxonomic study of marine phytoplankton has been neglected somewhat in this country and its need has grown up for the scientist among oceanography, marine biology and fisheries (Shim 1994). Taxonomical studies on the dinoflagellates were carried out by Shim

*et al.* (1981) and Han (1981) for the first time in Korea. These researches were carried out with light microscopy. Later using scanning electron microscopy, several genera were identified by Lee (1987).

As a rule, morphological criteria are sufficient to classify the dinoflagellate species. From examinations of thousands of specimens, conservative versus variable morphological characters are known for dinoflagellates. In armoured dinoflagellates, the plate patterns provide useful characters for species determination (Taylor 1993).

Triadiniaceae, a family of order Gonyaulacales is characterized as three thecal plates around apex and three antapical plates in antapex and girdle equatorial (Stein, 1883). This family consists of only one genus. The genus *Goniodoma* Stein (1883) was replaced with *Triadinium* Dodge (1981) because it was already in use by a genus of butterfly. However, *Triadinium* was also in use by a genus of ciliate. If the view that a generic name should not have been used previously in any kingdom is adopted, then a further new generic name is required.

In this paper, we try to re-describe the characteristics of the dinoflagellate family Triadiniaceae observed in Korean coastal waters.

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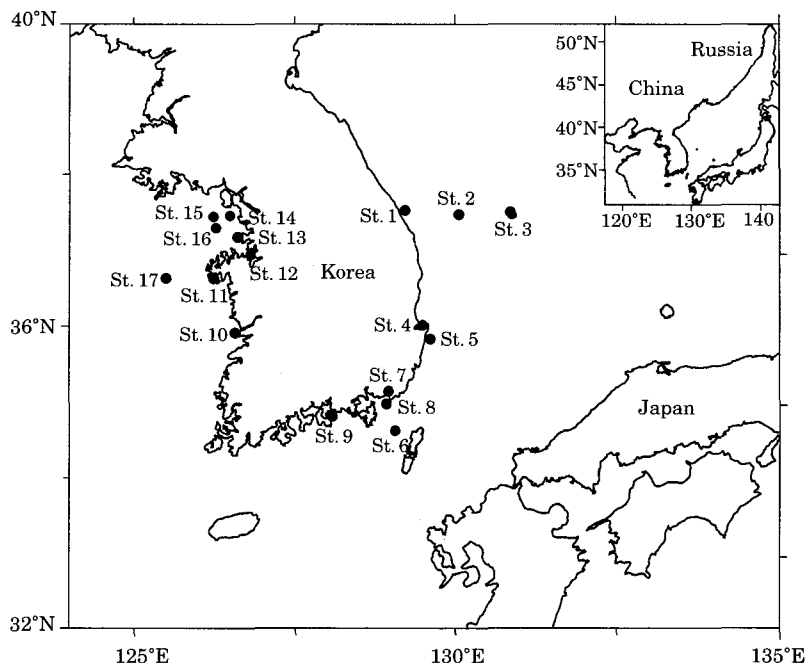


Fig. 1. A map showing the sampling locations in the coastal waters of Korea.

St. 1 Donghae-Shi	St. 2 East Sea	St. 3 Ulrung-Do	St. 4 Pohang
St. 5 Wolsung	St. 6 Korea-Strait	St. 7 Masan	St. 8 Chinhae
St. 9 Samchunpo	St. 10 Mankyung	St. 11 Taean	St. 12 Ahsan
St. 13 Shiwha	St. 14 Incheon	St. 15 Youngjong-Do	St. 16 Youngheung-Do
St. 17 Yellow Sea			

## MATERIALS AND METHODS

Phytoplankton samples were collected from 17 locations near coastal areas of Korea from 1990 to 2002. Samples were vertically and horizontally obtained using a 63  $\mu\text{m}$  mesh plankton net, and fixed with 4% formalin or Lugol's solution. All samples are preserved at the Marine Plankton Laboratory in Seoul National University, except Lugol fixed samples collected from Chinhae and Masan Bay which are deposited at Coastal Ecosystem Research Laboratory in Korea Ocean Research and Development Institute (KORDI). The sampling locations are indicated in Fig. 1.

This monograph is the result of the microscopic analysis. Identification of dinoflagellates in water samples was usually done by using differential interference contrast (DIC), which revealed especially well lighted thecal structures. The microscope was equipped out on a Zeiss Axioskop microscope with a Mc 80 microphoto-system. For the apparent three-dimensional image,

scanning electron microscope (SEM) was used. For SEM analysis, an aliquot of sample material was pipetted onto a Nucleopore filter (pore diameter 1  $\mu\text{m}$ ) and filtered gently. The filter paper was rinsed with 100 mL of distilled water to remove salt crystals, air-dried, and then affixed to an aluminum stub. The stubs were sputter coated with gold and examined with a JEOL JSM-840A SEM.

The authors consulted for the species identification were Taylor (1976), Balech (1976, 1988) and Dodge (1981, 1982).

## RESULTS AND DISCUSSION

### Family Triadiniaceae Dodge 1982

Syn: Heteraulacaceae Loeblich 1965

Goniodomaceae Lindemann 1918

### Genus *Goniodoma* Stein 1883

Syn: *Heteroaulacus* Diesing 1850

*Triadinium* Dodge 1981

Polyhedral with a deep annulus; epitheca and hypotheca slightly unequal in size, composed of regularly arranged armored plates; chromatophores small brown platelets; chloroplasts present; fresh or salt water.

Cell polygonal or rounded with equatorial girdle which is slightly displaced. Girdle enclosed by conspicuous lists and ridges may be present along the junctions between the plates. Theca composed regularly punctate plates. There is a distinctive apical pore with a sigmoid aperture. The characteristic feature of this genus is the arrangement of three plates around the apical pore and at the antapex (Dodge 1982). These armored cells are similar to *Alexandrium*. But there are different in size, thickness of theca, surface markings, size and shape of plates, position of plates and the presence of strong cingular lists.

*Goniodoma orientale* Lindemann 1918

Syn: *Triadinium orientale* (Lindemann) Dodge 1981

Cell spherical with rounded profile, theca smooth but covered with rows of pores. Girdle slightly displaced about 0.5  $\mu\text{m}$  girdle widths in left-handed, with broad girdle lists. This species is easily confused with *Goniodoma sphericum*, because of the cell shape, cell size, and similar girdle displacement. But the shape and the plate pattern of sulcus are different.

**Distribution** : English Channel, Atlantic, China Sea, Caribbean, California

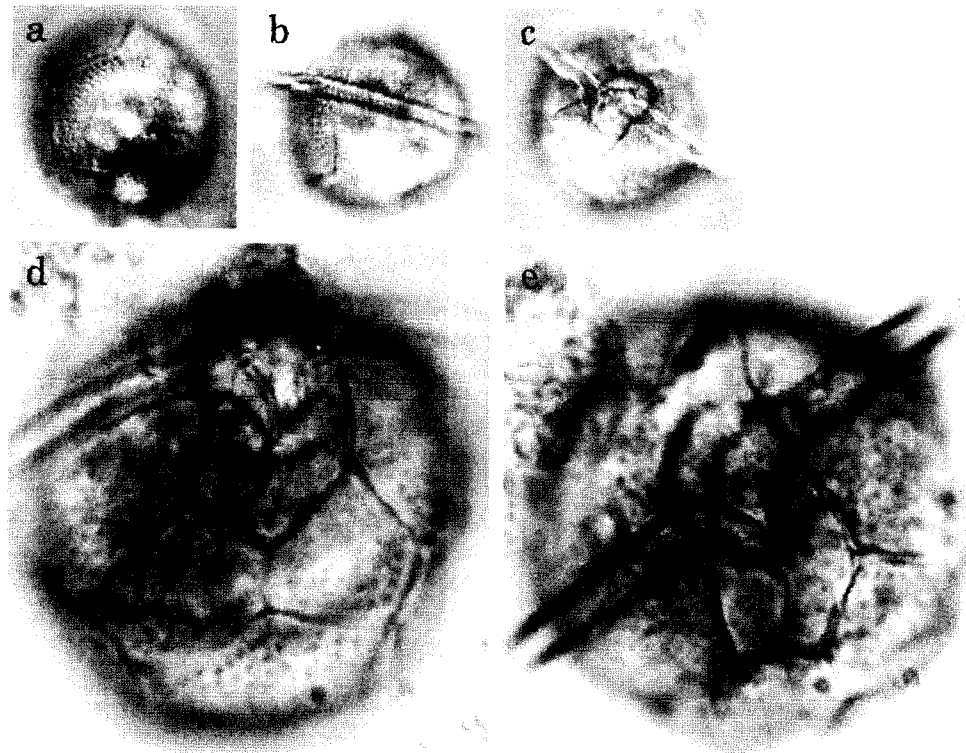
**Size** : 30~50  $\mu\text{m}$  (width)

**Distribution in Korea** : Chinhae Bay

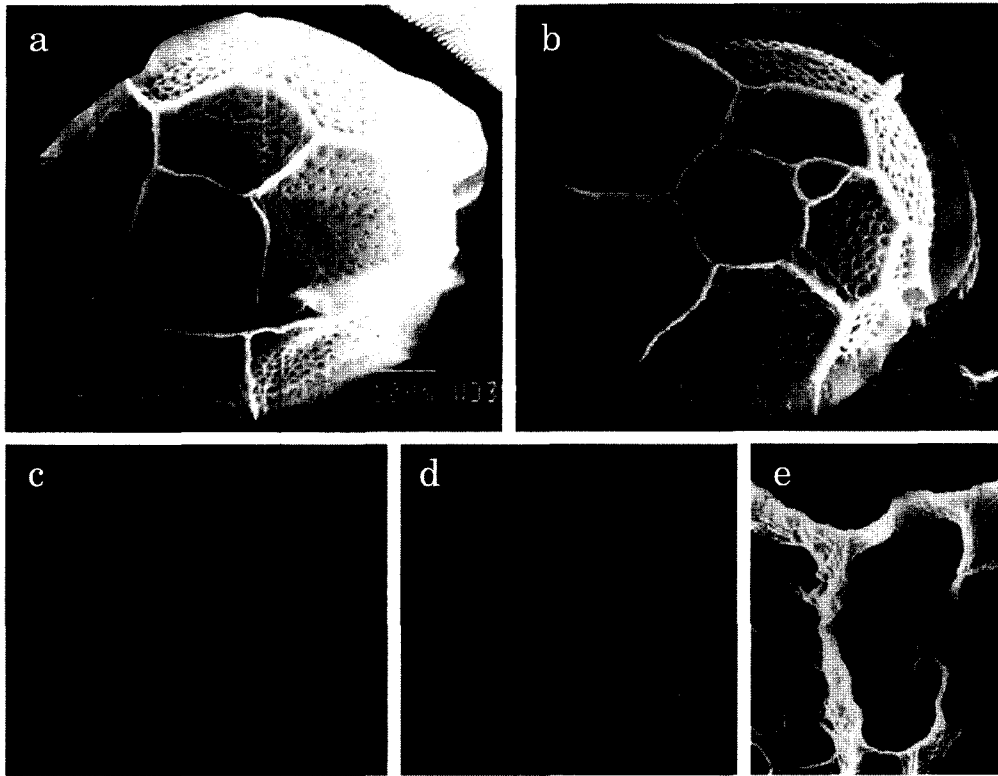
*Goniodoma polyedricum* (Pouchet) Jørgensen 1899

Syn. : *Heteraulacus polyedricus* (Stein) Drugg & Loeblich 1967

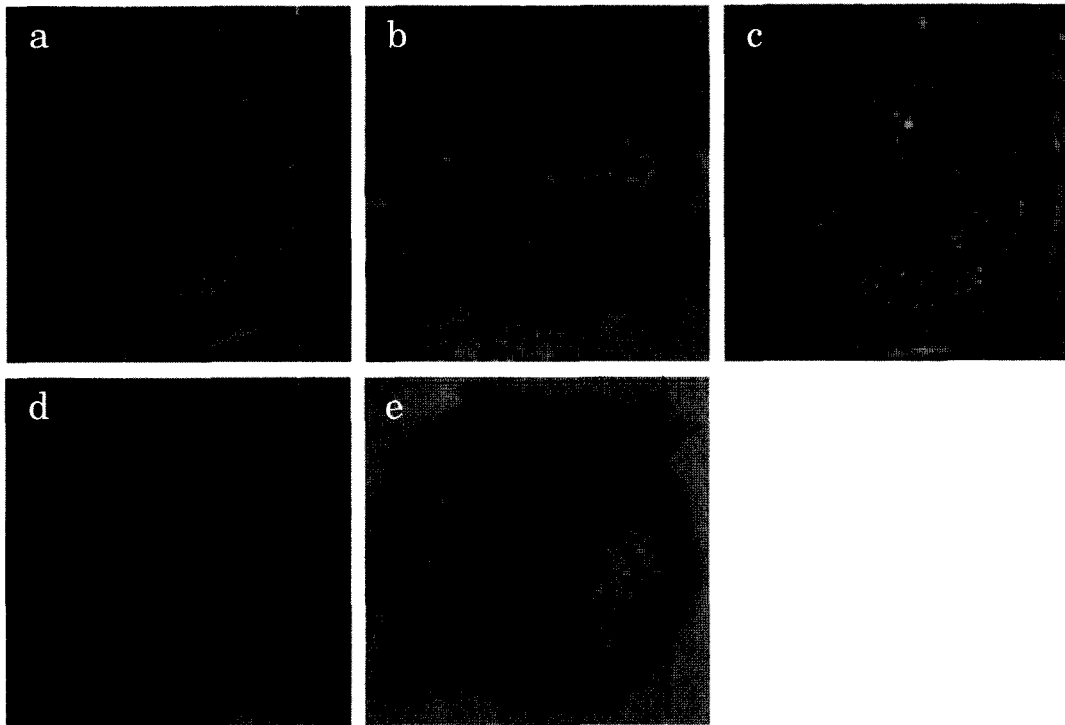
Cell with very characteristic polyhedral shape, seven-sided in ventral view. Epitheca with 3 apical plates and no anterior intercalary plate and 7 precingular plates, hypotheca with 6 postcingular plates and one posterior intercalary plate and one antapical plate.



**Fig. 2.** Photomicrographs of *Goniodoma orientale*. a-e are the same specimen. a-c are at 400 $\times$  magnification. a is an antipical, b is a lateral and c is a ventral view. d and e are at 1,000 $\times$  magnification. e is a ventral view.



**Fig. 3.** Photomicrographs of *Goniiodoma polyedricum*. a, b, and e are the scanning electron micrographs. e is apical pore complex of the cell. c and d are the same specimen at 1,000 $\times$  magnification.



**Fig. 4.** Photomicrographs of *Goniiodoma sphaericum* at 1,000 $\times$  magnification.

Transverse section nearly circular, girdle equatorial, left-handed, with strong lists supported by spines. Theca strongly sculptured with pores. Cell contents yellowish brown.

**Distribution** : Sub-tropical, rare in Gulf Stream, Red Sea, Adriatic, Indian Ocean, English Channel, California

**Size** : 48~60  $\mu\text{m}$  (long)

**Distribution in Korea** : East Sea (Wolsung).

***Goniodoma sphaericum* Murray & Whiting 1899**

Syn. : *Triadinium sphaericum* (Murray & Whiting)

Dodge 1982

*Heteraulacus sphaericus* Loeblich 1965

Cell spherical with rounded profile, theca smooth but covered with rows of pores. Girdle slightly displaced about 0.5  $\mu\text{m}$  girdle widths in left-handed, with broad girdle lists. This species is easily confused with *Goniodoma orientale*, due to the cell shape and size, and poroid of similar theca and different sulcal plate and sulcal shape.

**Distribution** : English Channel, Atlantic, China Sea, Caribbean, California

**Size** : 30~50  $\mu\text{m}$  (width)

**Distribution in Korea** : Samchunpo

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