

Fossil Species of *Clypeaster* from Japan*

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日本産ウニ *Clypeaster* の化石種について

森 下 晶

(要 旨)

瑞浪市日吉町菅沼の、瑞浪層群明世累層宿洞砂岩相からウニ化石 *Clypeaster* が採集された。検定の結果、現生種 *Clypeaster virescens* DOEDERLEIN の近縁種として記載した。この産出は重要で、宿洞相が沿岸～浅海の環境であることを支持する。また、瑞浪層群の化石ウニ群集への新しい追加であり、この結果、瑞浪層群産ウニ化石は次の10種となる。

Salenia nipponica MORISHITA, *Stomopneustes* sp., *Echinocyamus crispus* MAZZETTI, *Kewia minoensis* (MORISHITA), *Astriclypeus mannii ambigenus* NISIYAMA?, *A. mannii minoensis* MORISHITA, *Linthia nipponica* YOSHIWARA, *Schizaster* sp., *Brissopsis makiyamai* MORISHITA, *Clypeaster* cfr. *virescens* DOEDERLEIN

この機会に日本産 *Clypeaster* のチェック・リストを示した。

Introduction and Acknowledgment

Many years ago, several species of fossil *Clypeaster* from Taiwan had been reported by the author and Dr. I. HAYASAKA. But very little is known about the occurrence of fossil *Clypeaster* from Japan except Okinawa (Ryukyu limestone), although many fossil species of *Clypeaster* occur from the Tertiary formations of the world. It is, however, strange that there is no occurrence, especially from the Japanese Miocene.

Recently, one specimen of *Clypeaster* was found from the Mizunami Group of Mizunami City, Gifu Prefecture by Mr. Y. OKUMURA of Mizunami Fossil Museum. The preservation of this specimen is not necessarily perfect, but the characteristic feature of this genus is quite clear. So the author examined it and identified as the allied form of *Clypeaster virescens* DOEDERLEIN that is the Recent species.

In this paper, a meaning of the present occurrence is mentioned with the description of species from Mizunami and with the list of Japanese *Clypeaster*.

The author wishes to acknowledge his indebtedness to Dr. J. ITOIGAWA of Nagoya University and Mr. Y. OKUMURA of Mizunami Fossil Museum for their kind permission to examine this specimen.

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Description of species

Order Clypeasteroida A. AGASSIZ 1872

Suborder Clypeasteroidea A. AGASSIZ 1872

Family Clypeasteridae L. AGASSIZ 1835

Genus *Clypeaster* LAMARCK 1801

Test of medium to large size, pentagonal or subcircular in tumid marginal outline, angles rounded, highly variable, flattened to highly elevated apically; oral surface flat to concave, usually with well developed oral infundibulum; margin of test rounded to flattened and inflattened. Apical system central, madreporite usually star-shaped; small ocular plates at re-entering angles, pores small; genital plates fused; genital pores in median sutures of interradia, more or less remote. Petals variable, closed and rounded to wide open and sublyrate; outer pore of petals elongate, inner rounded, often connected by a well defined furrow. Periproct usually inframarginal, rarely marginal, small, situated at junction between third and fourth or fourth and fifth post-basicoronal interambulacral plates. Buccal membrane naked, with imbedded irregular spicules. Internal skeletal supports variable in abundance, consisting of thin laminae and pillars, most strongly developed in flattened species; wall of test sometimes double. Basicoronal (primordial) interambulacral plates usually much smaller than ambulacral plates, separated from post-basicoronal plates by one to three pairs of ambulacral plates; six to ten ambulacral and four to six interambulacral post-basicoronal plates on oral surface.

From the Eocene (Auversian) to Recent.

(after NISYAMA, 1968)

Clypeaster virescens DOEDERLEIN

Through the original description by DOEDERLEIN and the illustrations given by CLARK (1914) this species is fairly well known; a good number of specimens which I collected in Japanese waters in 1914 and at the Kei Islands in 1922 give me, however, the opportunity of adding something to our knowledge of it and also of supplying some new illustrations.

The test is in general distinctly longer than broad, as seen in the excellent figures Pl. 140, 1-2 of CLARK's work of 1914; more rarely it is almost pentagonal and the edge more concave in the interambulacra, as in one of my specimens which measures 95 mm in length, 93 mm in breadth, the greatest breadth being at the level of the anterolateral petals. The greatest size hitherto recorded is 112 mm length (CLARK, 1914); my largest specimen, from the Kei Islands, is 122 mm long, and a specimen from the Philippines ("Albatross") is 135 mm long. DOEDERLEIN gave a careful description of the internal structure of the test; I give a couple of figures to illustrate it.

Characteristic of this species is the small size of the petaloid area, only about half the test length, while in *Clypeaster japonicus* it is about 3/4 the test length. Another characteristic feature is that of the petals remaining distinctly open

distally, while in *japonicus* the paired petals are closed distally. The furrow connecting the pores is very shallow; there are in the adult specimens usually 3-4 primary tubercles on the ridges, but in younger specimens there are only two or one, or even none.

In regard to the apical system it is to be mentioned that genital pores have not yet appeared in a specimen 55 mm long; in a specimen of 68 mm length they are fully formed. There are long genital papillae.

The primary spines terminate (when well preserved) in a short hyaline thorn. Sections of the spines show a tendency to developing a meshwork in the axial cavity.

Pedicellariae. The tridentate pedicellariae, which occur both on the oral and the aboral side, reach a side of c. 1 mm length of head. The valves are rather narrow, somewhat compressed, meeting in the distal half or somewhat more. Small forms have the valves more spoon-shaped; some examples are intermediate in shape between the tridentate and the triphyllous pedicellariae. Typical triphyllous pedicellariae have quite short and broad valves, with only the side-edges of the valves finely serrate. The ophicephalous pedicellariae are of the usual shape, not specifically characteristic.

The colour of the live specimens is a yellowish-brown, but it turns a conspicuous greenish on preservation, as expressed in the name *virescens*. Gradually, however, the greenish colour usually (but not always) fades, particularly in young specimens. The denuded test, when thoroughly cleaned (by means of hypochlorite of sodium), is a uniform yellowish or whitish; when simply cleaned (in alcohol or water) the central part of the plates of the aboral side remain brown, the limit between the plates lighter, giving thus a very nice pattern.

Occurrence. This species is characteristic of the southern Japanese waters, being known from the Sagami Sea, from Kagoshima Bay and from the region off the Goto Islands; also from the Philippines and Indo-China. A related form is recorded by HAYASAKA & MORISHITA from the Miocene of Taiwan.

Bathymetrical distribution: c. 100-300 metres.

(after MORTENSEN, 1948)

Clypeaster cfr. *virescens* DOEDERLEIN

(Pl. 21, Figs. 1a, b, c)

- 1900 *Clypeaster virescens* DOEDERLEIN. S. YOSHIWARA, Japanese Echini, Zool. Mag., vol. 12. p. 389
- 1907 *Clypeaster virescens* DOEDERLEIN. S. TOKUNAGA (YOSHIWARA), Japanese Echini, vol. 19, pl. 14, figs. 9-10
- 1914 *Clypeaster virescens* DOEDERLEIN. H. L. CLARK, Hawaiian and other Pacific Echini, Clypeastrina, Mem. Mus. Comp. Zool., vol. 46, no. 1, p. 39, pl. 122, fig. 15; pl. 123, figs. 28-31; pl. 128, fig. 8. pl. 138, fig. 4; pl. 140, figs. 1-2
- 1925 *Clypeaster virescens* DOEDERLEIN. H. L. CLARK. A catalogue of the recent sea-urchins in the collection of the British Museum, p. 153

- 1947 *Clypeaster* cfr. *virescens* DOEDERLEIN. I. HAYASAKA and A. MORISHITA, Fossil species of *Clypeaster* from Taiwan, vol. 1, no. 1, p. 47, pl. 5, figs. 1a, b
- 1948 *Clypeaster virescens* DOEDERLEIN. Th. MORTENSEN, A monograph of the echinoidea, IV-2, *Clypeasteroidea*, p. 96. pl. 33, fig. 1; pl. 38, figs. 1-5; pl. 40, figs. 1, 10; pl. 67, figs. 5-7, 12-14, 20-21, 23; pl. 69, fig. 6, text-figs. 56, 57a, b
- 1949 *Clypeaster virescens* DOEDERLEIN. A. MORISHITA, Neogene Echinoids from Ishikawa and Toyama Prefectures, Jour. Geol. Soc., Japan, vol. 55, nos. 650-651, p. 258
- 1954 *Clypeaster virescens* DOEDERLEIN. H. UTINOMI, A check list of echinoids found in the Kii region, publ. Seto Mar. Biol. Lab., vol. 3, p. 352
- 1968 *Clypeaster virescens* DOEDERLEIN. S. NISIYAMA, The echinoid fauna from Japan and adjacent regions, part 2, Palaeont. Soc., Japan, Spec. Paper, no. 13, p. 36, pl. 12, figs. 1, 4; pl. 13, figs. 1-2, 7; pl. 14, fig. 1

Test roundly pentagonal; margin comparatively thin, anterior end rounded; large, about 87.0 mm in transverse diameter that may be a little shorter than longitudinal one; gradually rising to the apex with a gentle but convex slope. Apex central and low; height about 0.22 of transverse diameter. Oral surface almost flat, being slightly concave around the peristome, which may be central.

Petaloid area rather small, its length about 0.60 of radius of test; all petals rather short and wide, more or less open distally, their width usually half their length; posterior paired petals (I, V) 30.2 mm long and 15.6 mm wide at the widest point, make an angle of about 75° between median line of petal I and that of petal II; poriferous zone moderately wide, 7.4 mm for 15.6 mm of petal's width.

Apical system indistinct. Periproct inframarginal, its posterior border being 3 mm apart from the posterior margin of test. Oral ambulacral furrows simple, straight, and well defined, extending from the peristome to almost the margin.

Tuberculation is more distinct and larger on the oral surface than the aboral surface.

Observations: Only a single specimen of this species from the Mizunami Group is at the author's disposal. It is impossible to measure the longitudinal diameter exactly or to observe some features (apical system, ambulacral petals II, III, IV etc.) of the test detailedly, as the central portion of this specimen is broken. Nevertheless it is lucky to be possible to observe nearly the feature of the test, especially about ambulacral petals I, V and periproct.

This specimen looks closely allied to the fossil species *Clypeaster* cf. *virescens* DOEDERLEIN from the Miocene of Taiwan.

Locality: Suganuma, Hiyoshi-cho, Mizunami City, Gifu Prefecture.

Geological horizon: Mizunami Group (Shukunohora Facies). Middle Miocene.

Collector: Y. OKUMURA (Mizunami Fossil Museum).

Other occurrences: Ishikawa Prefecture (Omma sands. Pliocene); Okinawa Prefecture (Ryukyu limestone. Pleistocene); Taiwan (Upper Marine Fossil Bed. Miocene), (Byoritsu Bed, Pliocene).

The discovery of the genus *Clypeaster* from the Mizunami Group is quite important. It is not only support the littoral to neritic environment of the Mizunami

Group (Shukunohora Facies), but added one more species in the list of echinoid fauna of it, so the present fauna of fossil echinoids in the Mizunami Group is as follows; *Salenia nipponica* MORISHITA, *Stomopneustes* sp., *Echinocyamus crispus* MAZZETTI, *Kewia minoensis* (MORISHITA), *Astriclypeus mannii ambigenus* NISIYAMA?, *Astriclypeus minoensis* MORISHITA, *Linthia nipponica* YOSHIWARA, *Schizaster* sp., *Brissopsis makiyamai* MORISHITA and *Clypeaster* cf. *virescens* DOEDERLEIN.

Check List of *Clypeaster* in Japan

- *° *Clypeaster japonicus* DOEDERLEIN
- *° *Clypeaster virescens* DOEDERLEIN
- *° *Clypeaster reticulatus* (LINNAEUS)
 - ° *Clypeaster fervens hiradicus* MORTENSEN
 - ° *Clypeaster japonicus clypeus* DOEDERLEIN
 - ° *Clypeaster japonicus ogasawarensis* (YOSHIWARA)
 - ° *Clypeaster ohshimensis* IKEDA

(*fossil °recent)

Clypeaster japonicus DOEDERLEIN

YOSHIWARA, S., 1900 (p.388): YOSHIWARA (TOKUNAGA), S., 1907 (p1. 14, figs. 5-8): CLARK, H. L., 1914 (p.32, p1. 128, fig. 5; p1. 136, figs. 2-4; p1. 138, fig. 5): CLARK, H. L., 1925 (p.150): HAYASAKA, I. & MORISHITA, A., 1947 (p. 42, p1. 1, figs. 1a-b; p1. 2, figs. 1a-b): MORTENSEN, Th., 1948 (p. 99, p1. 31, fig. 1; p1. 34, fig. 6; p1. 35, fig. 2; p1. 42, fig. 3; p1. 67, figs. 1-2, 9-10): UTINOMI, H., 1954 (p. 352): COOKE, C. W., 1954 (p. 47, p1. 10, figs. 3-4). NISIYAMA, S., 1968 (p. 34, p1. 14, fig. 2)

Fossil localities: Tokunoshima, Taiwan

Geological horizon: Ryukyu limestone, Pleistocene

Distribution: the Japanese seas, from Sagami Sea to Kagoshima Gulf.

Clypeaster virescens DOEDERLEIN

(see p. 5)

Distribution: the Japanese Seas (Sagami Sea to Kagoshima Gulf) to Philippines, Indo-China and Australia?

Clypeaster reticulatus (LINNAEUS)

CLARK, H. L., 1914 (p. 34, p1. 124, figs. 3-6): CLARK, H. L., 1925 (p. 151): JEANNET, A. u. MARTIN, R., 1937 (p. 244, text-fig. 27): NISIYAMA, S., 1942 (p. 21): HAYASAKA, I. & MORISHITA, A., 1947 (p. 50, p1. 4, figs. 1a, b): MORTENSEN, Th., 1948 (p.71, p1. 18, figs.1-21; p1. 26, fig. 3; p1. 65, figs. 2, 13,16; text-figs. 8,47): UTINOMI, H., 1954 (p.352): DURHAM, J. W., 1955 (p. 95, 112, 120, 121; text-figs. 15b, 25e, 25a): NISIYAMA, S., 1968 (p. 41)

Fossil localities: Tokunoshima.

Geological horizon: Ryukyu limestone, Pleistocene.

Distribution: the Japanese Seas (Tanabe Bay to Ryukyu Islands) and Taiwan, and distributed over the Indo-West Pacific Oceans.

Clypeaster fervens hiradirus MORTENSEN

MORTENSEN, Th., 1948 (p. 86, pl. 22, figs. 8, 10, 11; pl. 65, fig. 12): NISIYAMA, S., 1968 (p. 366)

Distribution: Hirado Strait, Kyushu.

Clypeaster japonicus clypeus DOEDERLEIN

MORTENSEN, Th., 1948 (p. 101, pl. 34, figs. 4-7): NISIYAMA, S., 1968 (p. 368)

Distribution: Kagoshima Gulf.

Clypeaster japonicus ogasawarensis (YOSHIWARA)

YOSHIWARA, S., 1898: MORTENSEN, Th., 1948 (p. 102, pl. 69, fig. 7): NISIYAMA, S., 1968 (p. 368)

Distribution: Bonin Islands.

Clypeaster ohshimensis IKEDA

IKEDA, H., 1936 (p. 103, pl. 7): MORTENSEN, Th., 1948 (p. 131, pl. 34, figs. 1-3): NISIYAMA, S., 1968 (p. 368)

Distribution: Amami-Oshima.

References

- CLARK, H. L. (1914), Hawaiian and other Pacific echini. *Mem. Mus. Comp. Zool.*, **46**.
 ——— (1925), A catalogue of the recent sea-urchins in the collection of the British Museum. *British Museum (Nat. Hist.)*, England.
 COOKE, C. W. (1954), Pliocene Echinoids from Okinawa. *U. S. Geol. Surv., Prof. Paper*, **246-C**.
 DURHAM, J. W. (1955), Classification of Clypeasteroid echinoids. *Univ. California Publ. Geol. Sci.*, **31**.
 HAYASAKA, I. and MORISHITA, A. (1947), Fossil Species of *Clypeaster* from Taiwan. *Acta Geol. Taiwanica*, **1**.
 IKEDA, H. (1936), A new *Clypeaster* from Japan. *Annot. Zool. Japon.*, **16**.
 JEANNET, A. u. MARTIN, R. (1937), Ueber Neozoische Echinoidea aus dem Niederlandisch Archipel. *Leid. Geol. Mededl.*, **8**.
 MORISHITA, A. (1949), Neogene echinoids from Ishikawa and Toyama Prefectures. *Jour. Geol. Soc., Japan*, **55**.
 ——— (1960), Biostratigraphical studies of Japanese Tertiary echinoids. *Jour. Earth Sciences, Nagoya Univ.*, **8**.
 ——— (1974), Fossil echinoids from Mizunami District. *Bull. Mizunami Fossil Mus.*, no. 1.
 MORTENSEN, Th. (1948), A monograph of the echinoidea, IV-2. Copenhagen.
 NISIYAMA, S. (1942), Cenozoic echinoids of North Japan. *Jour. Geol. Soc., Japan*, **49**.

- (1968), The echinoids fauna from Japan and adjacent regions, part 2. *Palaeont. Soc. Japan, Spec. Paper*, no. 13.
- UTINOMI, H. (1954), A check list of echinoids found in the Kii region. *Publ. Seto Mar. Biol. Lab.*, 3.
- YOSHIWARA, S. (1898), Preliminary notice of new Japanese echinoids. *Annot. Zool. Japon.*, 2.
- (1900), Japanese echini. *Zool. Mag.*, 12.
- [TOKUNAGA] (1907), Japanese echini. *op. cit.*, 19.

Plate 21

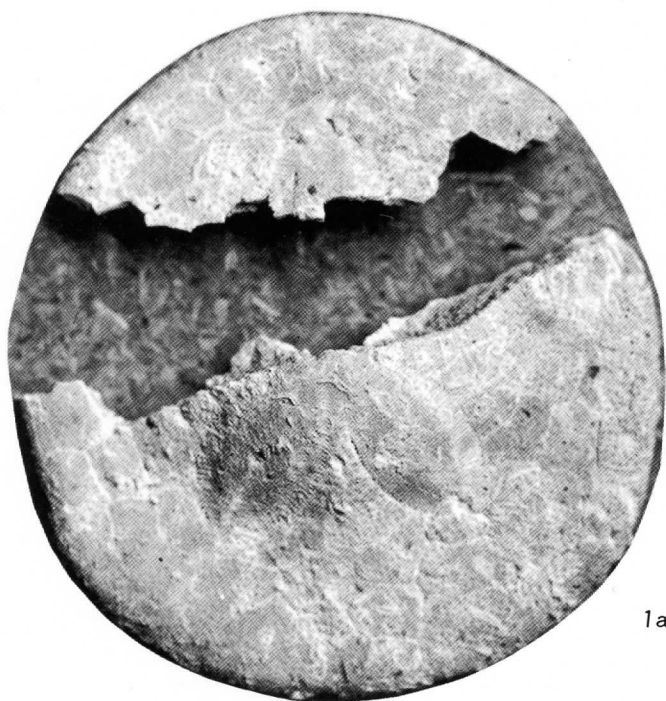
Figs. 1a-c. *Clypeaster* cfr. *virescens* DÖDERLEIN ×1 Mizunami Group. Mid. Miocene.

Suganuma, Hiyoshi-cho, Mizunami City, Gifu Prefecture.

a : aboral surface

b : oral surface

c : profile



1a



1b



1c

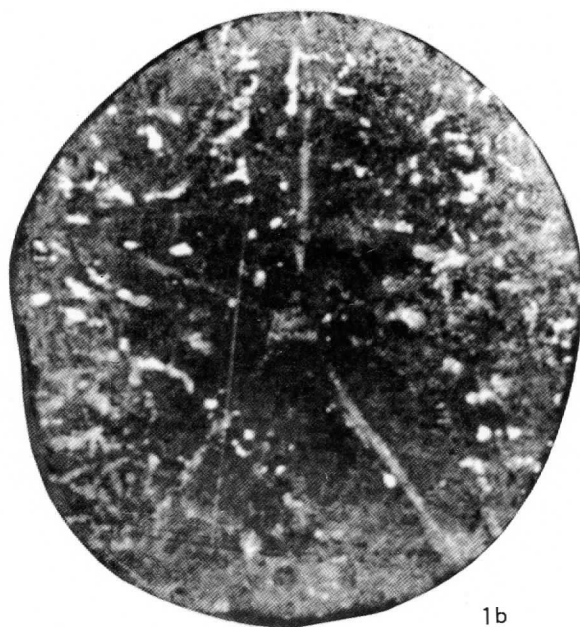
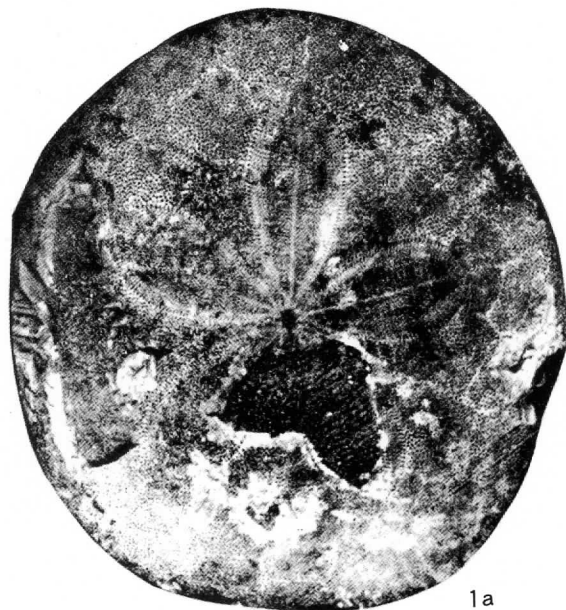
Figs. 1a-c. *Clypeaster* cfr. *virescens* DÖDERLEIN $\times 0.7$ Upper Marine Fossil Beds.

Mid. Miocene, Taiwan.

a : aboral surface

b : oral surface

(After HAYASAKA & MORISHITA 1947)

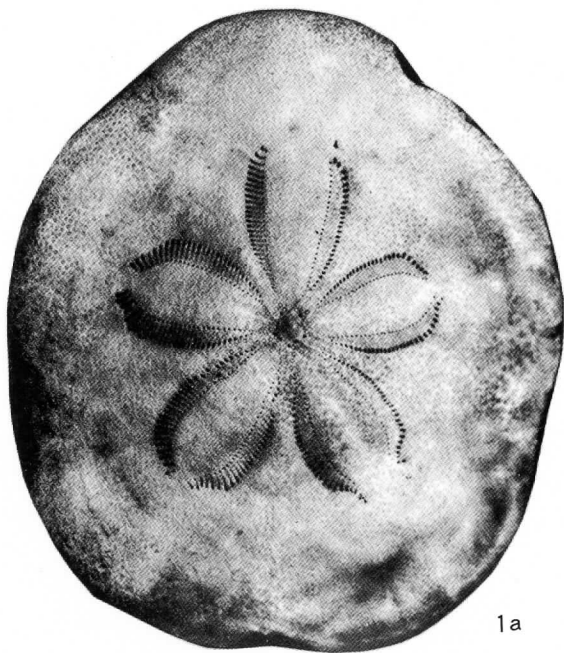


Figs. 1a-c. *Clypeaster virescens* DÖDERLEIN Recent.

a : aboral surface $\times 0.8$

b : oral surface $\times 0.8$

c : profile $\times 1.2$ (After MORTENSEN 1948)



1a



1b



1c