786. ECHINODIDS FROM THE CRETACEOUS HAIDATEYAMA GROUP,
EASTERN KYUSHU*

KEISAKU TANAKA

Geological Survey of Japan, Ibaraki 305

MASAYUKI NODA

Minamioita Junior High School, Oita 870

and

HITOSHI TANAKA

Institute of Geology and Mineralogy, Hiroshima University, Hiroshima 730

Abstract. In this paper four species of spatangoid echinoids are described which came from the Upper Formation of the Haidateyama Group in Oita Prefecture. They are three species of *Heteraster*, of which one is new, and one species assigned to *Pseudowashitaster*. For the description of a new species, material from the Lower Cretaceous Arita Formation in Wakayama Prefecture is also complementarily dealt with here. Three of the echinoid species occur in common in the Lower Barremian of several areas in the Chichibu Terrane, Southwest Japan. Therefore, this combined with already reported ammonites strongly suggests an Early Barremian age for the Upper Formation of the Haidateyama Group.

Introduction

The Lower Cretaceous Haidateyama Group in the Chichibu Terrane of eastern Kyushu has hitherto been investigated from the standpoint of stratigraphy by Fujii (1954), Teraoka (1970), Tanaka and Ohta (1980) and Tashiro et al. (1983). Nevertheless, palaeontological works have not yet been completed, except for the description of an ammonite species by Noda (1977) and that of trigonian species by Tashiro and Matsuda (1983).

Recently, numerous specimens of fossil echinoids have been obtained from the Haidateyama Group, some of which have been preliminarily reported by Noda (1977) without palaeontological descriptions. This is a useful piece of information about the Lower Cretaceous echinoid faunas of Japan which are very inferior to the molluscan faunas. The echinoid specimens available for the present study were collected by Seiji Kohi, a former pupil of one of us (M. N.) and by another of us (H. T.), but their specific identification has been done by the senior author (K. T.) in cooperation with M. N. Thus, four species belonging to two genera have been distinguished; two of them are identified with

*Received August 15, 1983
hitherto known species and another is new. In this paper the four echinoid species are described and their biostratigraphic implications are discussed. Furthermore, the specimens from the Barremian Arida Formation of the Yuasa area, Wakayama Prefecture are also dealt with here as complementary material for a new species.

The specimens described here are kept at the Geological Survey of Japan, Tsukuba (GSJ) and the Institute of Geology and Mineralogy, Hiroshima University, Hiroshima (IGH), with their respective abbreviations in parentheses.

Before going further, we wish to express our sincere gratitude to Professor Emeritus Tatsuro Matsumoto of Kyushu University for his valuable suggestions and kindness in critical reading of the first draft. We also thank Mr. Seiji Kohi for supplying the material for this study, and Mr. Yoshio Masai of the Geological Survey of Japan for photographing some of the specimens.

Text-fig. 1. Localities of echinoid specimens from the Haidateyama Group. Inset is a map of Kyushu, showing location of the studied area (solid circle).
noid specimens examined came, consists chiefly of thickly alternating beds of sandstone and mudstone and is about 200 m thick. It yields abundant shallow marine molluscain fossils.

The echinoid specimens for the present study were obtained from locs. HK-204, H-105, H-106, Su-102 and Su-104 of the Upper Formation (Lower Barremian) of the Haidateyama Group (Text-fig. 1). Of these localities, Noda’s locality is indicated by prefix HK and H. Tanaka’s ones by H and Su.

Locs. HK-204, H-105 (much the same as the preceding one) and H-106 are situated at Honjo-mura, Minamiamabe-gun, Oita Prefecture. Loc. HK-204 is occupied by siltstone with subsidiary mudstone, and locs. H-105 and H-106 by siltstone to fine sandy siltstone. Locs. Su-102 and Su-104 are situated at Notsu-machi, Ono-gun, Oita Prefecture. The former is occupied by fine sandy siltstone and the latter by siltstone. Especially locs. HK-204, H-105 and H-106 yield a number of echinodin fossils.

At all the echinoid localities various molluscain species also occur abundantly. The occurrence of Ancyloceras (Ancyloceras) sp. aff. A. (A.) vandenheckii Astier at loc. HK-204 (Noda, 1977) and Crioceratites (Crioceratites) sp. aff. C. (C.) koechlini (Astier) at loc. H-105 (Matsumoto et al., 1982), among others, is worthy of mention.

Systematic Descriptions
(by Keisaku Tanaka and Masayuki Noda)

Order Spatangoidea Claus, 1876
Suborder Toxasterina Fischer, 1966
Family Toxasteridae Lambert, 1920
Genus Heteraster d’Orbigny, 1853
Heteraster macroholcus (Nisiyama)

Pl. 82, Figs. 1, 2

1968. Paraheteraster macroholcus, Nisiyama, Palaeont. Soc. Japan, Special Papers, no. 13, p. 190, pl. 21, fig. 3; ibid., no. 11 (1966), pl. 18, figs. 3, 12, 13.

Material:—GSJ. F6024 and 6025, from loc. HK-204 (coll. Kohi); IGH:Hi-a-001 and 002, from loc. H-105 (coll. H. Tanaka); IGH:Hi-b-001 and 002 from loc. H-106 (coll. H. Tanaka). Ten comparable specimens from loc. HK-204, two from loc. H-105, one from loc. H-106 and one from loc. Su-102 were also examined.

Descriptive Remarks:—The specimens available are secondarily deformed. They are characterized by the deep and very long frontal sinus, distinct anterior notch, very posteriorly placed apical system, superficial paired ambulacra, and deeply sunken peristome. Moreover, the frontal ambulacrum shows an irregular alternation of two to eight longer slit-shaped pores and one shorter slit-shaped pore in the outer row and somewhat inward disposition of pores (slightly smaller or shorter than the normal round to oval pores), opposite to shorter outer pores, in the inner row (see Tanaka, 1965, text-fig. 4), thus the pore pairs lining up in three (or better to say rather four) files. The number of longer pores alternating with a shorter pore varies from place to place in one specimen and also differs between individuals, ranging from two to eight with the commonest occurrence of two to five. Furthermore, in a specimen (IGH:Hi-a-002) represented by an external mould of the aboral surface, a broad, diffuse peripetalous granular band or pseudo-fasciole is seen which is covered with streaks of granules very slightly smaller than those covering the rest of the aboral surface and decorated with tubercles.

Occurrence:—Locs. HK-204 (siltstone to mudstone), H-105 (siltstone to fine sandy siltstone) and H-106 (siltstone to fine sandy siltstone); Upper Formation of the Haidateyama Group, Lower Barremian. One specimen probably re-
ferable to this species is found in the fine sandy siltstone of the same formation at loc. Su-102.

_Heteraster bungoensis_ Tanaka et Noda, sp. nov.

Pl. 82, Figs. 3—6; Pl. 83, Fig. 4; Text-figs. 2, 3

**Material:**—Holotype, GSJ. F6013, represented by an internal mould, from loc. HK-204 (see p. 447), (coll. Kohi); paratypes, GSJ. F6014 and 6036, represented by an internal mould, respectively, from the same locality (coll. Kohi). Designated as paratypes are also GSJ. F6033A, B (A, internal mould; B, imperfect external mould of aboral surface) and GSJ. F6039A, B (A, internal mould; B, imperfect external mould of aboral surface), from loc. K-613 (= loc. 1 in Tanaka and Okubo, 1954), west of Kumai, Yuasa-cho, Arida-gun, Wakayama Prefecture, Upper Member of the Arida Formation, Lower Barremian (coll. K. Tanaka). Three comparable specimens from locs. H-106 and Su-104 (coll. H. Tanaka) are also available.

**Diagnosis:**—Test medium-sized, heart-shaped in outline, somewhat rounded polygonal, weakly emarginate in front, more or less longer than wide, evenly rounded at the antero-lateral margins, rather straight at the postero-lateral margins, widest slightly in front of the midpoint, contracted behind, relatively low; frontal sinus rather short, somewhat broad, shallow, not sharply limited, expanding towards the ambitus with constant depth, extending to the peristome; anterior notch shallow, moderately broad. Aboral surface gently arched with steeper anterior slope, highest slightly behind the apical system, abruptly truncated behind; posterior truncated surface slightly concave; posterior margin very shallowly emarginate. Oral surface more or less inflated in the plastral region and antero-lateral regions, depressed around the peristome. Apical system small, slightly posterior, ethmorphact, with four gonopores arranged in a quadrate form; posterior genital plates mutually contiguous.

Frontal ambulacrum rather short, shallowly sunken throughout its length, subpetaloid; petaloid part extending about four-fifths the way to the anterior margin; poriferous zones about half as wide as the interporiferous zone at the middle; near the middle part double pairs of longer pores alternating with a pair of shorter pores; near the proximal part and also near the distal part a pair of longer pores alternating with a pair of shorter pores; longer pore pairs slit-shaped, somewhat longer in the outer row than in the inner row, somewhat circumflexed, widely set; shorter pore pairs small, elongate oval to oval, more or less longer in the outer row than in the inner row, close together; pore pairs lining up in four files.

Text-fig. 2. Apical system of _Heteraster bungoensis_ Tanaka et Noda, sp. nov., GSJ. F6039A, paratype.

Text-fig. 3. _Heteraster bungoensis_ Tanaka et Noda, sp. nov., GSJ. F6039B, paratype. a, Frontal ambulacrum. b, Right anterior ambulacrum. c, Right posterior ambulacrum.
Paired ambulacra flexuous, superficial, sub-petaloid. Anterior paired ambulacra nearly as long and wide as the frontal ambulacrum; petaloid parts rather long, extending about two-thirds the way to the ambitus, open distally; poriferous zones unequal, widest near the middle, tapering towards the ambitus and the apical system; anterior poriferous zones much narrower than the posterior zones which are narrower than the interporiferous near the middle; pores in the anterior poriferous zones oval in the inner row, short slit-shaped in the outer row, close together; pores in the posterior poriferous zones short slit-shaped in the inner row, very long slit-shaped and acuminated inwards in the outer row, rather close together; pores of each pair somewhat circumflexed, nonconjugate.

Posterior paired ambulacra somewhat shorter, narrower, less flexuous and diverging at a smaller angle than the anterior; petaloid parts short, extending about halfway to the margin, nearly two-thirds as long as those of the anterior paired ambulacra, open distally; poriferous zones unequal, widest near the middle, tapering towards the ambitus and the apical system; anterior poriferous zones much narrower than the posterior zones which are somewhat narrower than the interporiferous near the middle; pores in the anterior poriferous zones oval in the inner row, short slit-shaped in the outer row, closely set; pores in the posterior poriferous zones of slit shape, much longer in the outer row than in the inner row, rather close together; pores of each pair more or less circumflexed, nonconjugate.

Peristome near the anterior fourth, small, moderately deep, subpentagonal, wider than long. Plastron mesamphisternous. Periproct rather large, transversely oval, high up on the posterior truncated surface, at half the height of the test, partly visible from above. Tubercles small, perforate, crenulate, scrobiculate; closely spaced on the plastron, widely scattered elsewhere; interporiferous zones of the paired ambulacra dotted with smaller tubercles; numerous granules between tubercles. No fascioles.

Measurements:—The specimens available are deformed by the subsequent distortion. The holotype represented by the least deformed specimen is 23.4 mm long, 22.2 mm wide, and 9.2 mm high.

Remarks:—The holotype and other specimens available from the Haidateyama Group are small (probably young) individuals. Accordingly, two specimens (GSJ. F6033 and 6039; coll. K. Tanaka), one of which is a much larger individual, and a comparable specimen (GSJ. F6008; coll. K. Tanaka) represented by a relatively large individual, from the Barremian Arida Formation in Wakayama Prefecture are also dealt with here. The largest of the Arida specimens, though incomplete and secondarily depressed, probably attains about 47 mm in length.

Comparison:—This new species resembles Heteraster nelixis Nisiyama (1950, p. 42, text-figs. 1—3) from the Barremian of several areas in the Chichibu Terrane, Southwest Japan, but differs from that species in having a test of cordate outline, an apical system which is slightly behind the centre, a rather short and shallow frontal sinus, a shallow anterior notch and a subpentagonal peristome.

The present species is easily distinguishable from the other two Japanese contemporary species, Heteraster macroholcus (Nisiyama) (1950, p. 44, text-figs. 4—6; Tanaka, 1965, p. 133, pl. 16, figs. 3, 4, text-fig. 4) and H. yuasensis (Tanaka et Okubo) (1954, p. 223, pl. 7, fig. 6, text-fig. 7; Tanaka, 1965, p. 136, pl. 16, figs. 6, 7, text-fig. 6), in many respects. The apical system is much less posterior and the frontal sinus is much shorter and much shallower in the new species with a test of cordate outline than in Heteraster macroholcus with a test of ovate outline. Heteraster bungoensis sp. nov. has superficial paired ambulacra as against sunken in H. yuasensis. The frontal sinus extends towards the anterior margin with constant depth, forming a shallow but distinct anterior notch in the present species, whereas in Heteraster yuasensis it becomes much shallower and indistinct near the ambitus, thus the anterior notch, if any, being very indistinct. The new species has a subpentagonal peristome, and both Heteraster macroholcus and H. yuasensis have a transversely
oval peristome. As to the mode of arrangement of pore pairs in the frontal ambulacrum, *Heteraster bungoensis* as well as *H. yuasensis* shows the *Enallaster* type (four files) of Devriès (1955), whereas *H. macroholcus* does show the *Heteraster* type (three files).

This species is similar to *Heteraster lepidus* (de Loriol) (1887–88, p. 91, pl. 15, fig. 4) from the Lower Barremian (Rey, 1972) of Portugal, in the cordate outline of test, the shallow frontal sinus and the shallow anterior notch. However, it differs from that species in that the frontal ambulacrum shows *Enallaster*-type arrangement of pore pairs, the anterior paired ambulacra have longer petaloid parts, and in that both the anterior and the posterior paired ambulacra have wider posterior poriferous zones whose outer pores are much longer than those of the anterior zones.

The present species also resembles *Heteraster couloni* (Agassiz) (d’Orbigny, 1853, p. 179, pl. 848) from the Barremian of France and Switzerland, but is separated from that species by its lower test, shallower frontal sinus, somewhat shorter petaloid parts of the paired ambulacra, less divergent posterior paired ambulacra, and by its features of pore pairs in all the ambulacra. Particularly, the new species shows *Enallaster*-type arrangement of pore pairs in the frontal ambulacrum as against *Heteraster*-type in *Heteraster couloni*.

*Heteraster bungoensis* is also akin to *H. pomeli* (Ficheur) (1900, p. 592, pl. 10, figs. 5–8) from the Lower Aptian of Algeria, in the outline of the test, the apical system and features of the pore pairs in all the ambulacra. However, it differs from that species in that the test is relatively low, the frontal sinus is shallow and not constricted immediately behind the anterior margin, and in that the anterior notch is shallow.

Occurrence:—Loc. HK-204; Upper Formation of the Haidateyama Group, Lower Barremian; siltstone. This species occurs also in the siltstone of the Upper Member (Lower Barremian) of the Arida Formation in the Yuasa area, Wakayama Prefecture. Moreover, several specimens probably identical with this species are found in the siltstone of the Upper Formation of the Haidateyama Group at locs. H-106 and Su-104.

*Heteraster* sp.

Pl. 83, Fig. 5

Material:—GSJ. F6027, represented by an internal mould, from loc. Su-104 (coll. H. Tanaka).

Description:—The specimen is poorly preserved and longitudinally compressed secondarily. Nevertheless, it measures about 12.5 mm in length.

The test seems to have a rather heart-shaped outline. The frontal sinus is rather shallow, becoming much shallower towards the ambitus, thus the anterior notch, if any, is probably indistinct. The apical system is somewhat posterior and has four gonopores.

The frontal ambulacrum is rather shallowly sunken and subpetaloid. Each poriferous zone consists of about twenty pore pairs. A pair of slit-shaped pores widely spaced regularly alternates with a pair of elongate oval pores close together, the pore pairs lining up in four files. However, at least in the left poriferous zone a double pair of longer pores is placed at the middle.

The paired ambulacra are somewhat flexuous, slightly sunken and subpetaloid. The anterior paired ambulacra consist of anterior poriferous zones with oval to elongate oval pores close together and much wider posterior poriferous zones with slit-shaped pores widely set. The posterior paired ambulacra have much shorter petaloid parts than do the anterior paired ambulacra. They consist of similar poriferous zones with rather slit-shaped pore pairs.

Remarks:—The present specimen is so poorly preserved and very small (probably young) that the specific identification is impossible. However, it is very closely similar in many respects to and probably the same species as certain echinoid specimens that have been referred to as *Heteraster* sp. (Tanaka and Kozai, 1982, p. 345, pl.
55, fig. 4), from the Yunoki Formation (Upper Barremian) of the Monobe area, Kochi Prefecture. It may also be noted that the present form shows some resemblance to a *Heteraster* species, from the Upper Member (Lower Barremian) of the Arida Formation of the Yuasa area, Wakayama Prefecture (Tanaka and Okubo, 1954, p. 224, pl. 7, fig. 7, text-fig. 7), which has been compared with *Heteraster böhmi* (de Lorie) (presumably synonymous with *H. bravoensis* (Böse) according to Cooke, 1955), as is the case with the above Monobe specimens (Tanaka and Kozai, 1982). Anyhow, we refrain from further taxonomic discussion of the present form, because of the very small size and poor preservation of the material available.

**Occurrence:**—Loc. Su-104; Upper Formation of the Haidateyama Group, Lower Barremian; siltstone.

Suborder Hemiasterina Fischer, 1966
Family Hemiasteridae Clark, 1917
Genus *Pseudowashitaster* Tanaka, 1982
*Pseudowashitaster mysticus* Tanaka

Pl. 83, Figs. 1—3


**Descriptive Remarks:**—The test, though incomplete and secondarily deformed, appears to have an oval outline. The frontal sinus is very long and deep, forming a conspicuous notch in the anterior edge of the test. The apical system is very eccentric behind and ethmophract, with four gonopores. The frontal ambulacrum is very long, deeply sunken and composed of oval inner pores and slit-shaped outer pores which are scarcely or occasionally set more or less inwards. The paired ambulacra are very unequal in length and width, flexuous, subpetaloïd and open distally. The anterior paired ambulacra are very long, considerably narrow almost throughout the way but rapidly widened near the ambitus and are very slightly sunken. The posterior paired ambulacra are short, broad and flush. All the paired ambulacra consist of anterior poriferous zones with minute, round pore pairs and much wider posterior poriferous zones with longer and elongated pore pairs. The peristome is far anterior. The periproct is oval, vertically elongate and high up on the posterior truncated surface. The plastron is mesamphisternous. The peripetalous fasciolo is distinct, narrow and continuous.

The largest one (GSJ. F6022) of the specimens, though transversely compressed secondarily, probably attains a little more than 70 mm in length.

It has been pointed out by Tanaka and Kozai (1982) that *Pseudowashitaster mysticus* shows intraspecific variation in arrangement of outer pores in the frontal ambulacrum. In one (GSJ. F6021) of the specimens, for example, a shorter pore is placed somewhat inwards three times at intervals of 12 to 14 longer pores within a series of 52 pores in the middle part of the right poriferous zone, and also three times at intervals of 9 to 15 longer pores within a series of 33 pores in the middle to distal parts of the left poriferous zone. In GSJ. F6026 one shorter pore is set more or less inwards every 7 to 11 longer pores in the middle part of the right poriferous zone. On the other hand, IGH: Hi-b-003 has only two shorter pores within a series of about 50 pores in the middle part of the right poriferous zone.

**Occurrence:**—Loes. HK-204 (siltstone to mudstone), H-105 (siltstone) and H-106 (siltstone); Upper Formation of the Haidateyama Group, Lower Barremian.

**Concluding Remarks**

Among the echinoid specimens examined
from the Upper Formation of the Haidateyama Group, the following four species are described in this paper:

*Heteraster macroholcus* (Nisiyama)

*Heteraster bungoensis* Tanaka et Noda, sp. nov.

*Heteraster* sp.

*Pseudowashitaster mysticus* Tanaka

Of the above four, *Heteraster macroholcus* is numerically dominant. This species is known to occur in the Middle to Upper Members (= Am to Au in Obata and Ogawa, 1976) of the Arida Formation of the Yuasa area, Wakayama Prefecture (Nisiyama, 1950; Tanaka and Okubo, 1954), in the lower part of the Ishido Formation of the Sanchu Graben, Saitama — Gumma Prefecture (Tanaka, 1965), and also in the Monobe Formation of the Monobe area, Kochi Prefecture (Tanaka and Koizai, 1982). These three echinoid horizons are assigned to the Barremian, strictly speaking, to the Lower Barremian respectively (Obata and Ogawa, 1976; Obata *et al.*, 1976; Tashiro *et al.*, 1980).

*Pseudowashitaster mysticus* was reported from the Yunoki Formation of the Monobe area (Tanaka and Koizai, 1982), the lower part of the Ishido Formation (Tanaka, 1965), and also from the Upper Member of the Arida Formation (Tanaka and Koizai, 1982). The first of these formations is correlated with the Upper Barremian (Tashiro *et al.*, 1980).

*Heteraster bungoensis* sp. nov. is found not only in the Haidateyama Group but also in the Upper Member (Lower Barremian) of the Arida Formation.

To sum up, so far as the material available is concerned, it is evident that all the three species mentioned above are restricted to the Barremian and moreover, occur in common in the Lower Barremian.

Various molluscan species occur abundantly at the echinoid localities in the Upper Formation of the Haidateyama Group. Among them, *Ancyloceras* (Ancyloceras) sp. aff. *A. (A.) vandenheckii* Astier, though somewhat imperfect, was considered as suggestive of the uppermost Barremian or the lowermost Aptian (Noda, 1977), but is not convincing. Very recently another diagnostic ammonite, *Crioceratites* (*Crioceratites*) sp. aff. *C. (C.) koechlini* (Astier), was obtained from about the same locality as the above ammonite, and it suggests an Early Barremian age (Matsumoto *et al.*, 1982). Thus, the Haidateyama echinoid faunule is compatible with the ammonoid-based correlation. It is also not inconsistent with the bivalve-based age assignment by Tashiro *et al.* (1983). In short, it is reasonable to correlate the Upper Formation of the Haidateyama Group with the Lower Barremian.

---

**Explanation of Plate 82**

Figs. 1-2. *Heteraster macroholcus* (Nisiyama) ........................................ Page 447

1. GSJ. F6024 from loc. HK-204, Haidateyama area, aboral (a) and left lateral (b) views, ×1.3.

2. GSJ. F6025 from loc. HK-204, aboral (a) and oral (b) views, ×1.1.

Figs. 3-6. *Heteraster bungoensis* Tanaka et Noda, sp. nov. .......................... Page 448

3. GSJ. F6013, holotype, from loc. HK-204, Haidateyama area, aboral (a), oral (b), left lateral (c), anterior (d) and posterior (e) views, ×1.4.

4. GSJ. F6036, paratype, from loc. HK-204, aboral (a) and oral (b) views, ×1.6.

5. GSJ. F6033, paratype, from loc. K-613, Yuasa area, aboral (a), oral (b) and left lateral (c) views, ×1.7.


All specimens illustrated here are internal moulds.
References


Teraoka, Y. (1970): Cretaceous formations in

Arida 有田, Banjo 番匠, Haidateyama 髙越, Honjo 本匠, Ishido 石堂, Itaya 板屋, Kamikoshigoe 上瀬越, Koshigoe 瀬越, Monobe 物部, Minamiamabe 南海部, Notsu 野津, Ono 大野, Sanchu 山中, Shinkai 新間, Sukubo 須久保, Yuasa 湯浅, Yunoki 柚ノ木

九州東部の下部白亜系鍾橋山層群から産したウミ化石: 大分県の秩父帯に分布する下部白亜系鍾橋山層群の上部層から産したウミ化石について, *Heteraster* の 3 種 (既知種・新種・同定不能種) 及び *Pseudowashitaster* の 1 種 (既知種) を識別し、古生物学的記載を行った。*Heteraster* の新種は和歌山県扁溝地域の有田層の上部層（下部パレミアン）からも産する。*Heteraster* の既知種は秩父帯の他地域の下部パレミアンから、*Pseudowashitaster* の 1 種も同じく下部・上部パレミアンから知られている。鍾橋山層群の上部層はアンモナイトによって下部パレミアンに対比されており、ウミ化石の層位はこの対比論と矛盾しない。

田中啓策・野田雅之・田中 均

---

**Explanation of Plate 83**

Figs. 1—3. *Pseudowashitaster mysticus* Tanaka .................................... Page 451

1. GSJ. F6022 from loc. HK-204, Haidateyama area, external cast, aboral (a) and oral (b) views, x1.2.
2. GSJ. F6026 from loc. H-105, Haidateyama area. 2a, Aboral view of an internal mould (A), x1. 2b, Aboral view of an external mould (B), x3. A peripetalous fascicle is seen between two arrows.
3. GSJ. F6021 from loc. HK-204, aboral (a) and oral (b) views, x1.1.

Fig. 4. *Heteraster bungoensis* Tanaka et Noda, sp. nov. .......................... Page 448

GSJ. F6014, paratype, from loc. HK-204, Haidateyama area, aboral (a), oral (b) and left lateral (c) views, x1.4.

Fig. 5. *Heteraster* sp. .............................................................. Page 450

GSJ. F6027 from loc. Su-104, Haidateyama area, aboral view, x2.2.

All specimens illustrated here are internal moulds, unless otherwise stated.