

PROCEEDINGS
OF THE
CALIFORNIA ACADEMY OF SCIENCES

Vol. 48, No. 1, pp. 1-26, 16 figs., 2 tables.

July 28, 1992

REVISION OF THE SOFT CORAL GENUS *MINABEA*
(OCTOCORALLIA: ALCYONIIDAE) WITH NEW
TAXA FROM THE INDO-WEST PACIFIC

By

Gary C. Williams

*Department of Invertebrate Zoology, California Academy of Sciences
Golden Gate Park, San Francisco, California 94118*

ABSTRACT: A revised diagnosis for the soft coral genus *Minabea* Utinomi, 1957 (family Alcyoniidae) is provided as a result of recently collected material representing five new species from a wide geographic region in the Indo-West Pacific. At the present time the genus is thought to consist of nine species distributed from Africa to Fiji, and Japan to New Zealand, from the shallow waters of coral reefs to regions of deep water up to 370 meters. A comparison of the world species, related genera, and geographic distributions is included.

Received May 28, 1991. Accepted November 10, 1991.

INTRODUCTION

The genus *Minabea* Utinomi, 1957 (family Alcyoniidae) was formerly applied to five digitiform soft corals with dimorphic polyps. These included *M. ozakii* Utinomi, 1957 and *M. robusta* Utinomi and Imahara, 1976, from Japan. *Anthomastus phalloides* Benham, 1928, from New Zealand and *A. agilis* Tixier-Durivault, 1970, from New Caledonia, were transferred by Utinomi and Imahara (1976) to the genus *Minabea*. *Anthomastus agilis* differs from other species of both *Anthomastus* and *Minabea*, as well as those of other alcyoniid genera, and therefore is considered a member of a new genus that has not yet been published (P. N. Alderslade, pers. comm.). *Bellonella indica* Thomson and Henderson, 1905, from Sri Lanka, can be transferred to *Minabea* as well (F. M. Bayer, pers. comm. and the present study).

Recent explorations in the Indo-West Pacific have provided additional material that can be

allocated to the genus *Minabea* but not to any of the previously described species. This additional material has been collected from the Indian Ocean coast of South Africa, northwestern Australia and the Great Barrier Reef, Fiji, the Bismarck Sea of Papua New Guinea, Belau, and Guam in the Mariana Islands. The material represents five previously undescribed species, which are presented here as new species. Thus, the range of this genus of nine species is extended to include the Indo-West Pacific from the southeastern coast of Africa to Fiji in the western Pacific, and Japan in the north to New Zealand in the south.

A comparison of *Minabea* with the superficially similar genera *Acrophytum* Hickson, 1900, and *Verseveldtia* Williams, 1990 (both from South Africa) is presented, along with biogeographic considerations. A morphological and faunistic comparison of all species of *Minabea* is also included.

MATERIALS AND METHODS

All material was collected by means of SCU-BA or steel dredge. Colonies were preserved in 70% ethanol. Sodium hypochlorite was used to dissociate sclerites from tissue. Drawing tubes attached to a dissecting microscope and a compound microscope were utilized to depict colonies and sclerites. A Hitachi S-510 scanning electron microscope was used to make micrographs of sclerites. Institutions that sent or stored material for study are abbreviated in the text as follows: BMNH: British Museum (Natural History), London, England; CASIZ: California Academy of Sciences, Department of Invertebrate Zoology, San Francisco, California; MSM: Marine Science Museum, Tokai University, Shizuoka, Japan; NTM: Northern Territory Museum of Arts and Sciences, Darwin, Australia; SAM: South African Museum, Cape Town, South Africa; USNM: United States National Museum (Smithsonian Institution), Washington, D.C.

SYSTEMATIC ACCOUNT

Key to the World Species of *Minabea*

- 1. Colonies digitiform (fingerlike to cylindrical or clavate) 2
- Colonies dome-shaped (hemispherical to conical) 8
- 2. Sclerites of the colony include spindles or rods 3
- Spindles or rods absent 5
- 3. Sclerites include slender, relatively smooth rods of the interior *M. ozakii*
- Smooth rods absent 4
- 4. Colonies elongate fingerlike, tapering distally. Sclerites as radiates and thorny spindles *M. phalloides*
- Colonies short cylindrical. Sclerites as eight radiates and thorny spindles *M. kosiensis*
- 5. Surface of coenenchyme with two distinct types and sizes of sclerites: small radiates and large robust barrels *M. cosmarioides*
- Sclerites throughout the colony not of conspicuously disparate sizes 6
- 6. Polyparium forms >50% total colony length. Colonies from shallow water (< 30 meters depth) 7
- Polyparium forms <50% total colony length. Colonies from deep water *M. indica*

- 7. Sclerites as eight-radiates and elongate barrels *M. aldersladei*
- Sclerites as radiates, robust barrels and tuberculate spheroids *M. robusta*
- 8. Colonies hemispherical, usually longer than wide. Stalk prominent. Polyps restricted to extreme distal end of colony, which may be somewhat flattened or rounded to conical. Sclerites as barrels and eight-radiates *M. acronocephala*
- Colonies conical, wider than long. Stalk inconspicuous. Polyps completely cover most of the colony, which tapers distally to form a central apex. Sclerites as six- or eight-radiates and double stars *M. goslineri*

Minabea Utinomi, 1957:139; Utinomi and Imahara, 1976:206. Bayer, 1981:913. Tixier-Durivault, 1987:154.

REVISED GENERIC DIAGNOSIS.—Colonies unbranched and hemispherical to digitiform: low and dome-shaped to elongate and finger-like. Polyps dimorphic. The distal polyparium arises from a proximal stalk that is variable in length. Polyps evenly distributed over distal portion of colony and capable of complete retraction. Siphonozooids are minute, numerous and surround the autozooids, which are larger and fewer in number. Polyps not forming calyces. Polyps without sclerites. Sclerites of surface and interior of colony densely set: mostly barrels and six- or eight-radiates with spindles, rods, tuberculate spheroids; seven-radiates or double stars sometimes occurring. Color red, orange, yellow or pinkish-white to cream-white. An alcyoniid genus of at least nine species from the Indo-West Pacific, 1–370 meters in depth.

DISTRIBUTION.—New information presented in this study as well as in previously published distributional data shows that the genus *Minabea* has a wide Indo-West Pacific distribution that includes southeastern Africa, Sri Lanka, northwestern Australia, the Great Barrier Reef, New Zealand, Fiji, Papua New Guinea, Belau, Guam, and Japan (Fig. 16). A triangle roughly formed by Guam, northwestern Australia and Fiji has the highest number of species with three. In addition there are four outlying regions: Japan with two species to the north, Sri Lanka with one species and southern Africa with two species to the west, and New Zealand with one species to the south.

***Minabea acronocephala* sp. nov.**

(Figs. 1A, 2, 3)

TYPE MATERIAL.—Holotype: CASIZ 078414, in small caves along vertical surface of outer barrier reef, The Pinnacle (5°10'S, 145°50'E), PAPUA NEW GUINEA. **Madang Province:** Bismarck Sea, 9–18 meters depth, 15 November 1990, Scuba, G. C. Williams. Paratypes: CASIZ 078415, two colonies (each cut longitudinally into two halves), same data as holotype.

OTHER MATERIAL.—CASIZ 078416, 15 colonies, same data as holotype. CASIZ 078417, 9 colonies, in small caves and overhangs on outer wall of barrier reef, north of Wongat Island (5°10'S, 145°50'E), PAPUA NEW GUINEA. **Madang Province:** Bismarck Sea, 6–21 meters depth, 25 November 1990, G. C. Williams. CASIZ 078418, 2 colonies, in small caves and overhangs along walls, The Quarry (4°52'S, 145°48'E), PAPUA NEW GUINEA. **Madang Province:** Bismarck Sea, 8–15 meters depth, 20 November 1990, Scuba, G. C. Williams. NTM-C-2976, 1 colony, FIJI. **Viti Levu:** Suva Harbor (18°15'S, 178°30'E), 5–10 meters depth, November 1984, C. Ireland.

DIAGNOSIS.—Colonies dome-shaped. Stalk conspicuous and longer than polyparium. Polyps restricted to the distal extremity of the colony. Sclerites eight-radiates and barrels (0.05–0.13 mm long), with short medial waists. Color variable: yellow, orange, red.

DESCRIPTION.—The thirty colonies that were examined range in height from 4 to 14 mm and from 4 to 9 mm in width. The colonies are dome-shaped (hemispherical to sub-digitiform), the total height usually being somewhat greater than the diameter, although some colonies may be slightly wider than tall. The stalk is usually conspicuous and longer than the polyparium, being distinctly demarcated from it. The stalk arises from the basal holdfast, which may be somewhat spreading, and gives rise to the slightly enlarged distal polyparium, as the distal half of the colonies represent the greatest width. The polyps are restricted to the extreme distal end of the colony, which is often somewhat flattened to low-rounded or sometimes conical. In preserved material, the siphonozoids often are indicated by nothing more than minute pores approximately 0.07 mm in diameter surrounding the markedly larger retracted autozooids, which measure approximately 1 mm in diameter. The sclerites are densely distributed in the surface coenenchyme as well as throughout the interior of the colonies. These sclerites are primarily eight-radiates and barrels 0.05–0.13 mm long, relatively finely tuberculated, with short medial waists (0.007–0.015 mm in length). A few sclerites may possess more elongate medial regions. Sclerites of the polypary surface range in length from 0.05 to 0.13 mm.

The interior of the polyparium contains sclerites that are 0.08–0.12 mm long. Sclerites from the surface and interior of the stalk measure 0.05–0.11 mm in length. The colonies are variable in color, ranging from entirely yellow or yellow with reddish polyparies and deeper red autozooids, to red-orange with yellow polyparies and autozooids. Some colonies are entirely reddish with deeper red autozooids. The holdfast region varies from yellow to orange or salmon.

DISTRIBUTION.—This species is known from the vicinity of Madang, Papua New Guinea, in the Bismarck Sea, and Suva Harbor, Fiji, between 5 and 21 meters in depth. At Madang, colonies are encountered mostly along the outer walls of barrier reefs: on the ceiling or sides of caves, alcoves, or depressions found along areas of vertical relief.

ETYMOLOGY.—The specific epithet is derived from the Greek *akron* = extremity, summit, highest point, and *kephale* = a head; in reference to the restriction of the polyp-bearing portion to the distal-most extremity of the colony.

REMARKS.—*Minabea acronocephala* can be distinguished from other species of the genus by having a low, dome-shaped growth form with a somewhat flattened or low-rounded to conical distal region and prominent stalk, polyps restricted to the extreme distal end of the colony, and sclerites that are predominantly eight-radiates or barrels with short medial waists.

***Minabea aldersladei* sp. nov.**

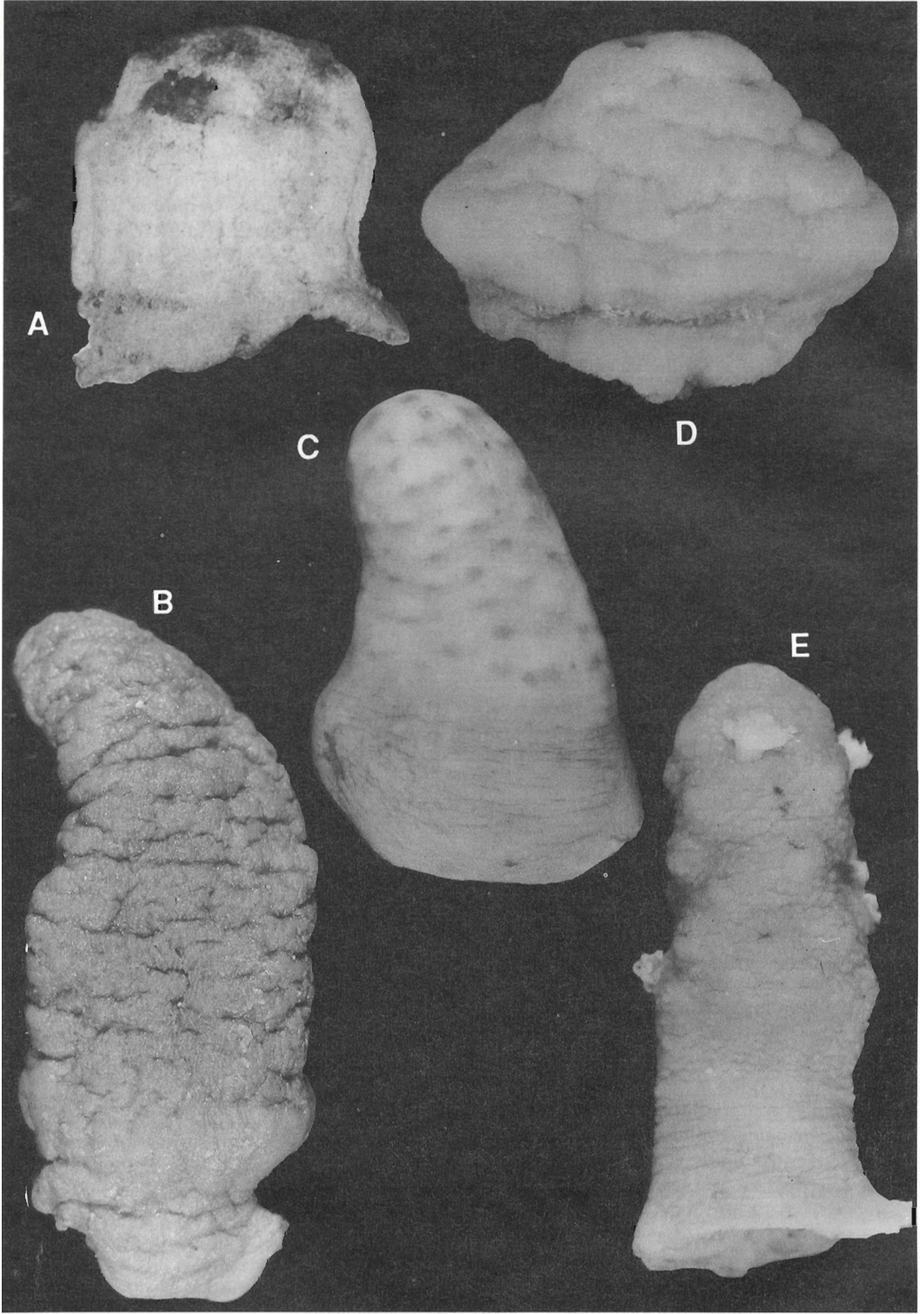
(Figs. 1B, 4, 5)

Bellonella indica (non Thomson and Henderson, 1905): Bayer, 1974:261; Faulkner and Chesher, 1979:267, pl. 22.

TYPE MATERIAL.—Holotype: CASIZ 078419, in small caves on vertical relief, Magic Passage (5°10'S, 145°50'E), PAPUA NEW GUINEA. **Madang Province:** Bismarck Sea, 10–15 meters depth, 14 November 1990, G. C. Williams. Paratypes: CASIZ 078420, 2 colonies (one of which is cut longitudinally into two halves), same data as holotype. Paratypes: NTM C-10796 and C-10797, 2 colonies, same data as holotype.

OTHER MATERIAL.—Same data as holotype, 3 colonies CASIZ 078421. PAPUA NEW GUINEA. **Madang Province:** Bismarck Sea, 5°10'S, 145°50'E: Outer Pig Island, 12 m, Scuba, T. M. Gosliner, 17 November 1990, 1 colony (distal part only) from a vertical wall, CASIZ 078422. Wongat Island, 14 m, Scuba, G. C. Williams, 13 November 1990, 1 colony from vertical surfaces shoreward of the island, CASIZ 078423. Daphne's Reef, 10 m, Scuba, G. C. Williams, 13 November 1990, 1 colony from depression in wall surface, CASIZ 078424.

AUSTRALIA. Queensland: Great Barrier Reef. Low Isles, 16°18'S, 145°35'E, P. Murphy, 11 June 1976, 2 colonies, one of them cut in half longitudinally, SAM-H4263; M. Strepcher



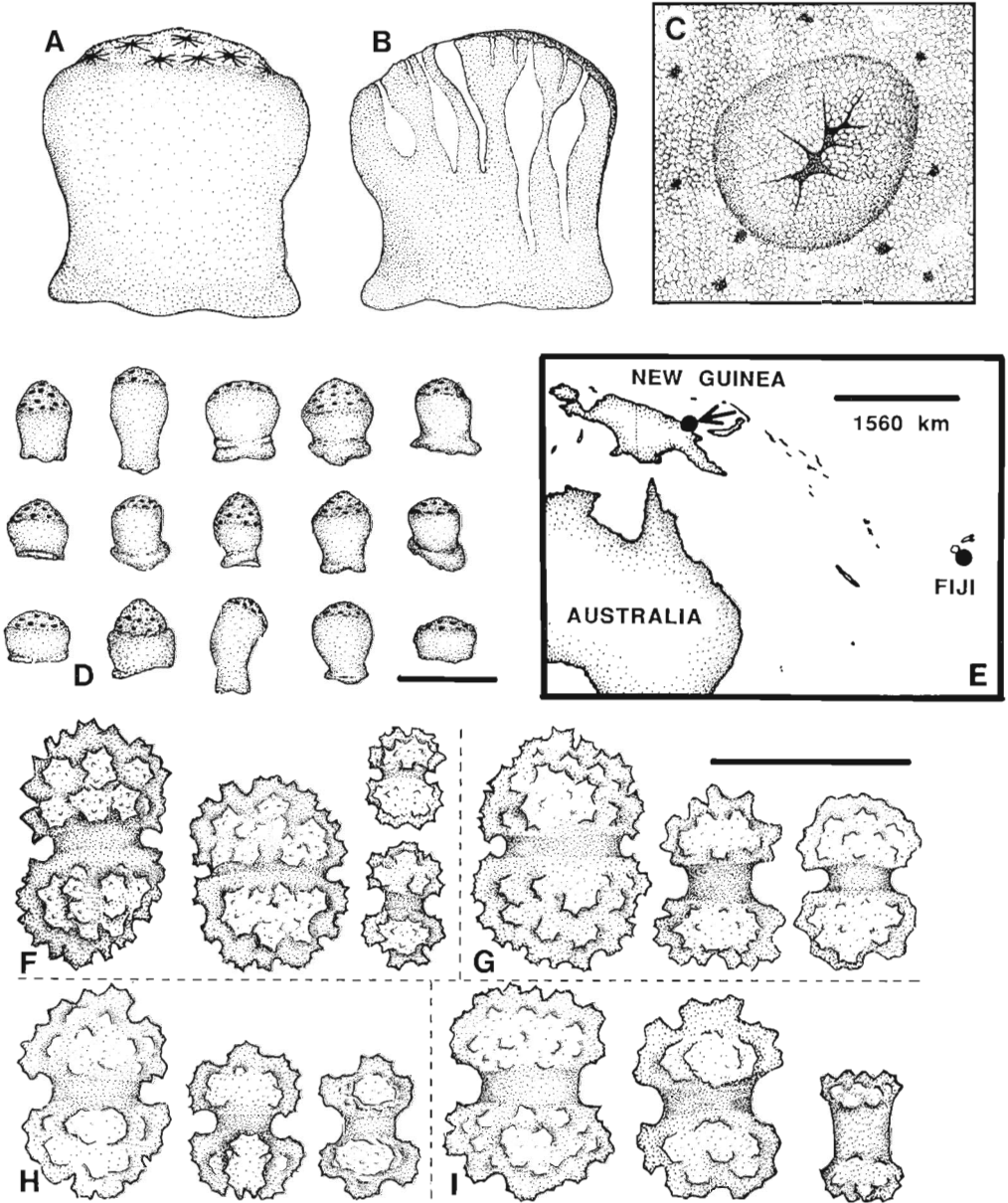


FIGURE 2. *Minabea acronocephala* A, A single colony, 5.4 mm in height. B, Longitudinal section through colony in A showing gastric cavities of autozooids and siphonozooids. C, Detail of a single autozooid surrounded by nine siphonozooids, length of figure represents 1.6 mm. D, Fifteen colonies showing variability of colony shape, scale bar represents 10 mm. E, Map of the Coral Sea and southwestern Pacific Ocean showing distribution of the species; black dots represent collecting stations, arrow shows type locality. F, Surface sclerites of the polyparium. G, Interior sclerites of the polyparium. H, Stalk surface sclerites. I, Stalk interior sclerites. Scale bar for F-I represents 0.1 mm.

FIGURE 1. Photographs of holotypes. A, *Minabea acronocephala* (8 mm in height). B, *M. aldersladei* (38 mm in height). C, *M. cosmarioides* (42 mm in height). D, *M. goslineri* (9 mm in height). E, *M. kosiensis* (26 mm in height).

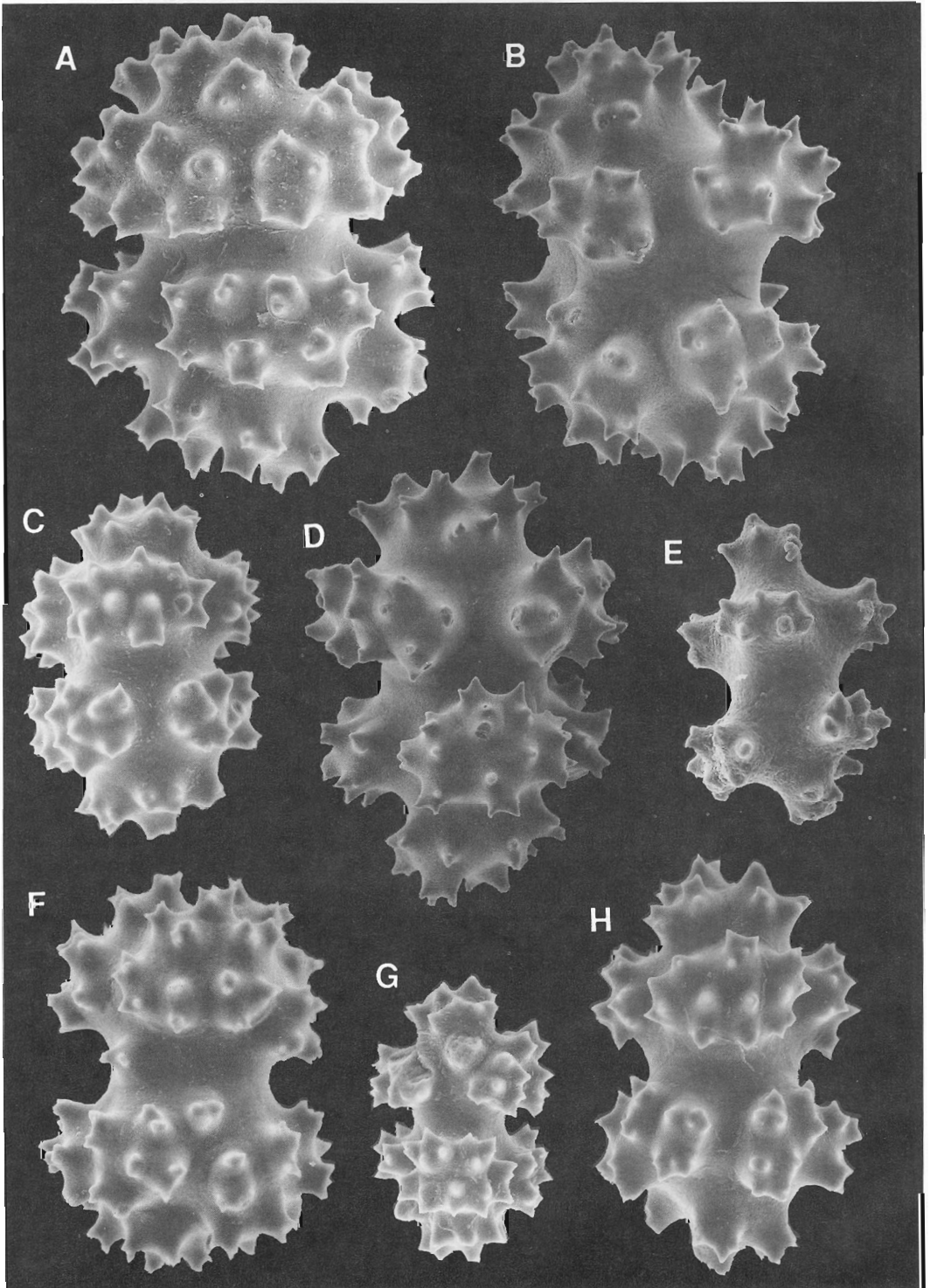


FIGURE 3. *Minabea acronocephala* Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.10 mm. B, 0.10 mm. C, 0.07 mm. D, 0.10 mm. E, 0.06 mm. F, 0.08 mm. G, 0.06 mm. H, 0.09 mm.

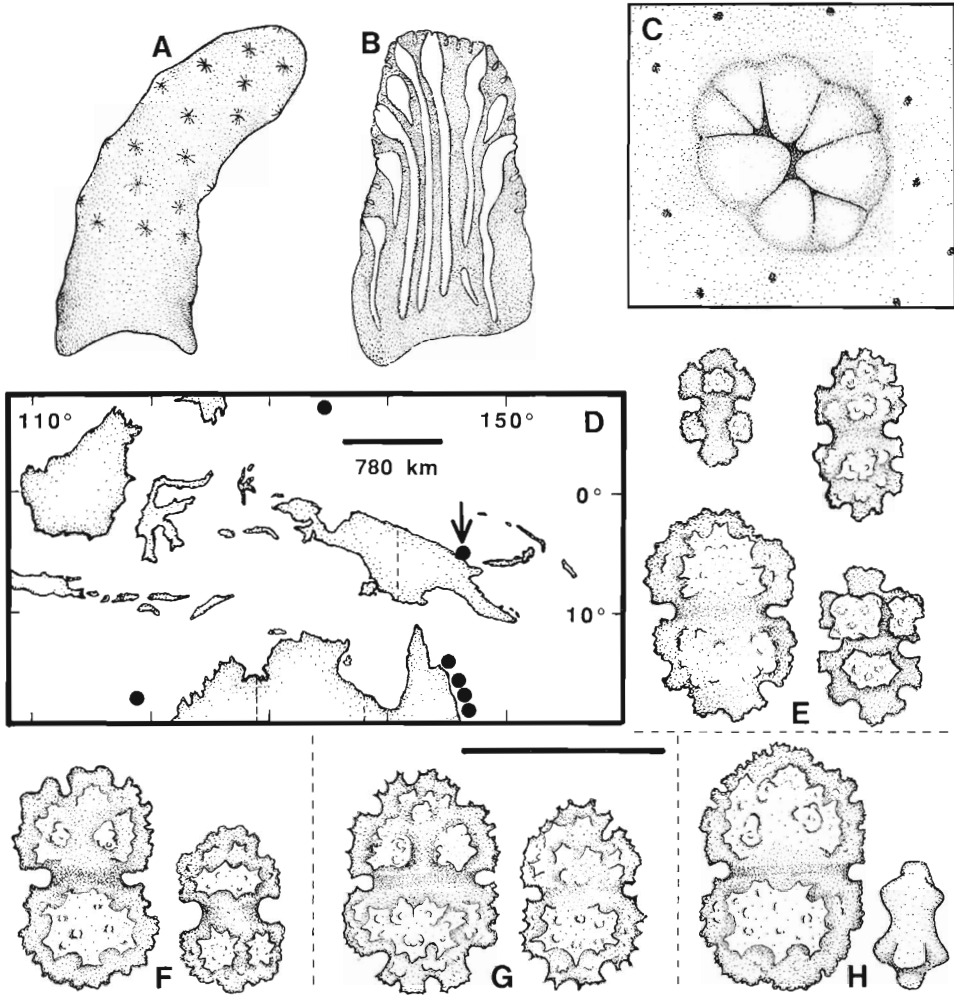


FIGURE 4. *Minabea aldersladei* A, A single colony, 25 mm in height. B, Longitudinal section through a colony showing gastric cavities of autozooids and siphonozooids. C, Detail of a single autozooid surrounded by 10 siphonozooids, length of figure represents 1.6 mm. D, Map of the western Pacific Ocean showing distribution of the species; black dots represent collecting stations, arrow shows type locality. E, Surface sclerites of the polyparium. F, Interior sclerites of the polyparium. G, Stalk surface sclerites. H, Stalk interior sclerites. Scale bar for E-H represents 0.1 mm.

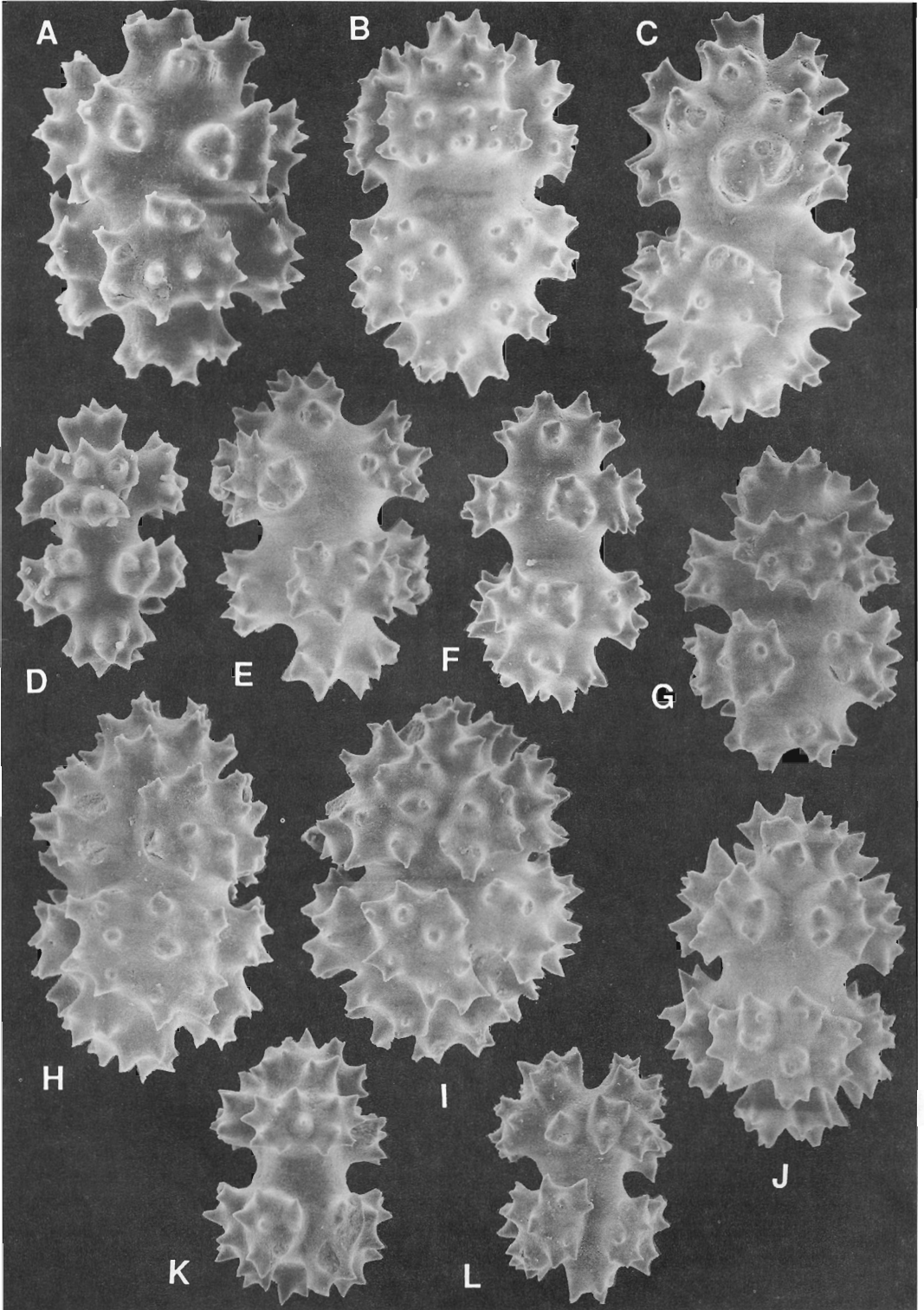
and C. Duke, 11 June 1972, 10 colonies, NTM C-1902; 1 colony, NTM C-5451. Snake Reef, 14°20'S, 145°10'E, 2–5 m, P. Alderslade, 14 December 1990, 5 colonies, NTM C-10427; 10–12 m, J. Hooper, 14 December 1990, 2 colonies, NTM C-10449; 1 colony, NTM C-10448. Flinders Reef, 17°30'S, 148°10'E, 20–25 m, Z. Dinesen, NTM C-4083. Off Cairns, 16°50'S, 145°45'E, 7–10 m, D. Schubot, November 1978, 10 colonies NTM C-901. Moore Reef, 17°00'S, 146°15'E, P. Alderslade, 1979, 1 colony NTM C-1904.

Western Australia: edge of Clerke Reef, Rowley Shoals, 17°23'S, 119°23'E, 19 m, J. Hooper, 18 July 1987, 1 colony, NTM C-5889.

BELAU. Palau Islands: Ngemelis Islands, Great Reef, Bailechesengel Island, 7°08'N, 134°29'E, 4.6 m, D. Faulkner, 28 August 1973, 5 colonies, USNM 58498.

DIAGNOSIS.—Colonies elongate-digitiform, tapering distally, often curved. Stalk restricted to proximal most one-sixth to one-third of colony. Sclerites elongate barrels and eight-radiates 0.04–0.12 mm long. Color either uniform yellow or uniform red-orange.

DESCRIPTION.—The 55 colonies that were examined vary in length from 19 to 69 mm and 7 to 18 mm in width. The colonies are elongate digitiform, often somewhat curved. Rarely, colonies may be bifurcated forming two distal lobes. The colonies taper gradually distally forming a



rounded distal end, the holdfast and stalk being the widest portion of the colonies. The polyps are evenly distributed throughout the entire surface of the polyparium. In all but one specimen, the polyps are retracted. The partially extended autozooids from this specimen are approximately 1.5 mm long by 0.8 mm wide. The retracted autozooids measure approximately 0.8–1.0 mm in diameter and are surrounded by siphonozooids that form minute pores approximately 0.03–0.10 mm in diameter. The stalk forms the proximal most one-third to one-sixth of the colony, while the polyparium comprises the distal most two-thirds to five-sixths. The sclerites of the colonies are all elongate barrels and eight-radiates, 0.04–0.12 mm in length. The median waists of the sclerites vary from 0.005 to 0.010 mm in length in barrels to 0.012–0.025 mm long in radiates. The surface and interior coenenchyme of the polyparium contain sclerites that are 0.04–0.11 mm in length. Sclerites from the surface of the stalk are 0.05–0.11 mm long, while those of the interior are 0.06–0.12 mm long. Two color varieties are known: colonies from the Madang region of the Bismarck Sea are either entirely lemon-yellow or uniformly reddish-orange, while colonies from Australia are either a uniform, rich golden-yellow or entirely orange to deep red-orange. All sclerites are colored orange or yellow, none are colorless. Exsert autozooids are white.

DISTRIBUTION.—The Madang region of the Bismarck Sea (Papua New Guinea), Rowley Shoals (northwestern Australia), the Great Barrier Reef (Queensland, Australia), and Belau; 2–25 meters in depth.

ETYMOLOGY.—This species is named for Phil Alderslade of the Northern Territory Museum, Darwin, Australia, a friend, colleague, and enthusiastic student of the Octocorallia, who generously supplied numerous colonies of this species for study.

REMARKS.—Unlike other species of *Minabea*, *M. aldersladei* has this unique combination of characters: an elongate, often curved finger-like growth form that tapers distally, polyps cover over two-thirds of the surface of the colony, scler-

rites of elongate barrels and eight-radiates, and colony color that is either entirely yellow or uniform red-orange.

Some colonies of *M. aldersladei* collected off Cairns (Great Barrier Reef) resemble colonies of *M. goslineri* in that they are yellow in color and low-conical in growth form. The sclerite complement of the Cairns material contains many barrels in addition to radiates, which is characteristic of *M. aldersladei*. On the other hand, the sclerites of *M. goslineri* are exclusively radiates.

The sclerites of *M. acronocephala* and *M. aldersladei* are very similar in appearance. In addition, the two species exhibit sympatric distribution at Madang, Papua New Guinea. In fact, colonies of both species may occur in the same caves or overhangs on the outer wall of the Sek Island to Pig Island barrier reef. However, these species differ significantly in three respects. *Minabea acronocephala* is short and dome-like or button-shaped; the polyps are confined to the distal-most extremity of the colony, resulting in a conspicuous and prominent stalk that makes up the bulk of the colony, and the colonies usually contain both red and yellow sclerites. In *M. aldersladei*, on the other hand, the colonies are usually long and finger-like; the polyps cover the distal two-thirds or more of the colony resulting in a short and less conspicuous stalk, and the colonies are always either uniformly yellow or red-orange.

Minabea aldersladei bears a superficial resemblance to *M. indica* (Thomson and Henderson, 1905). The two species are differentiated below under **REMARKS** for *M. indica*.

***Minabea cosmarioides* sp. nov.**

(Figs. 1C, 6, 7)

TYPE MATERIAL.—Holotype: SAM-H4260, dredged from a bottom of coarse sand and stones, off Mbotyi (31°33.2'S, 29°51.9'E), SOUTH AFRICA. **Indian Ocean:** Transkei, 250 meters depth, 4 July 1986, steel dredge, R. N. Kilburn and D. Herbert on board RV *Meiring Naude*.

OTHER MATERIAL.—SAM-H4087, 1 colony cut longitudinally into two halves, same data as holotype.

DIAGNOSIS.—Colonies robust digitiform, nearly cylindrical, slightly tapering to a broadly rounded apex. Polyparium forming the distal two-

FIGURE 5. *Minabea aldersladei* Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.08 mm. B, 0.08 mm. C, 0.09 mm. D, 0.06 mm. E, 0.07 mm. F, 0.07 mm. G, 0.07 mm. H, 0.08 mm. I, 0.08 mm. J, 0.07 mm. K, 0.06 mm. L, 0.05 mm.

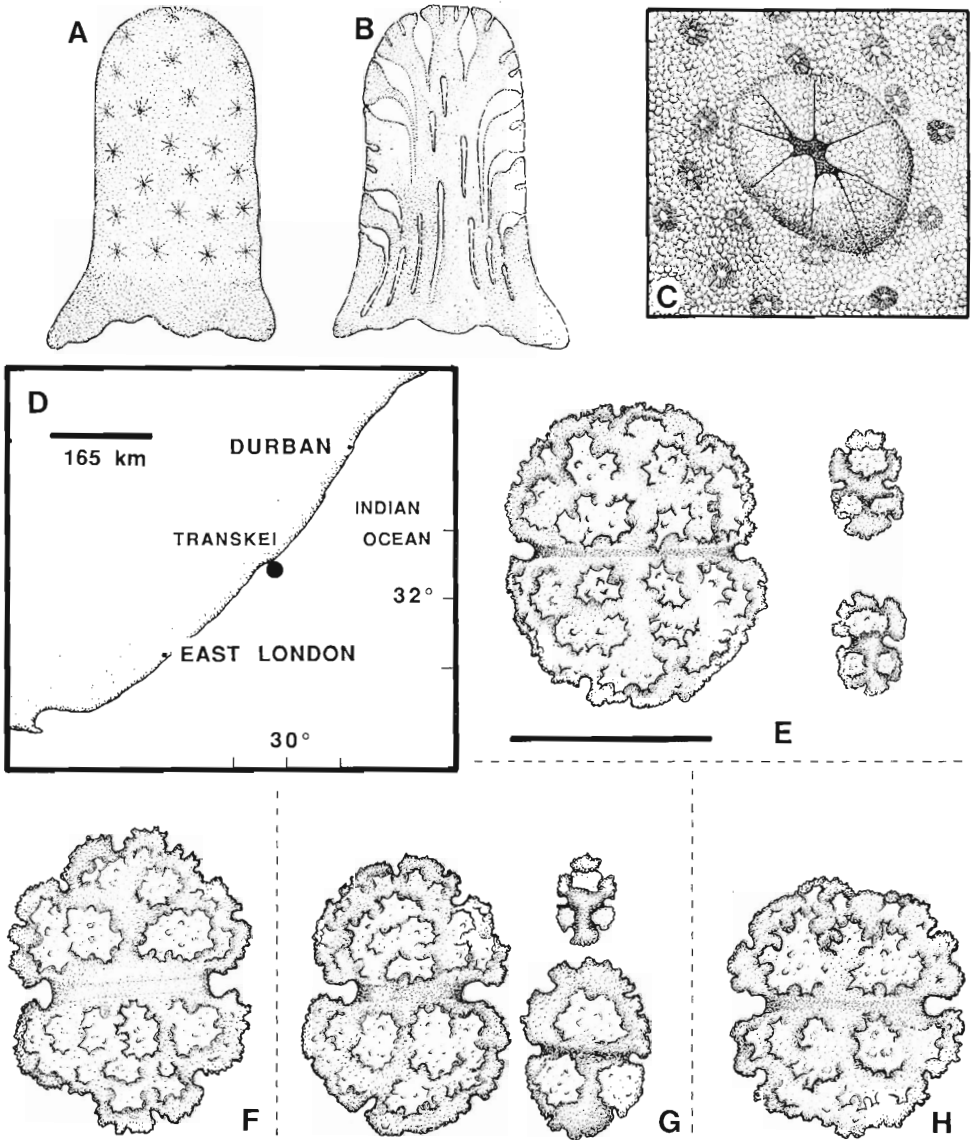
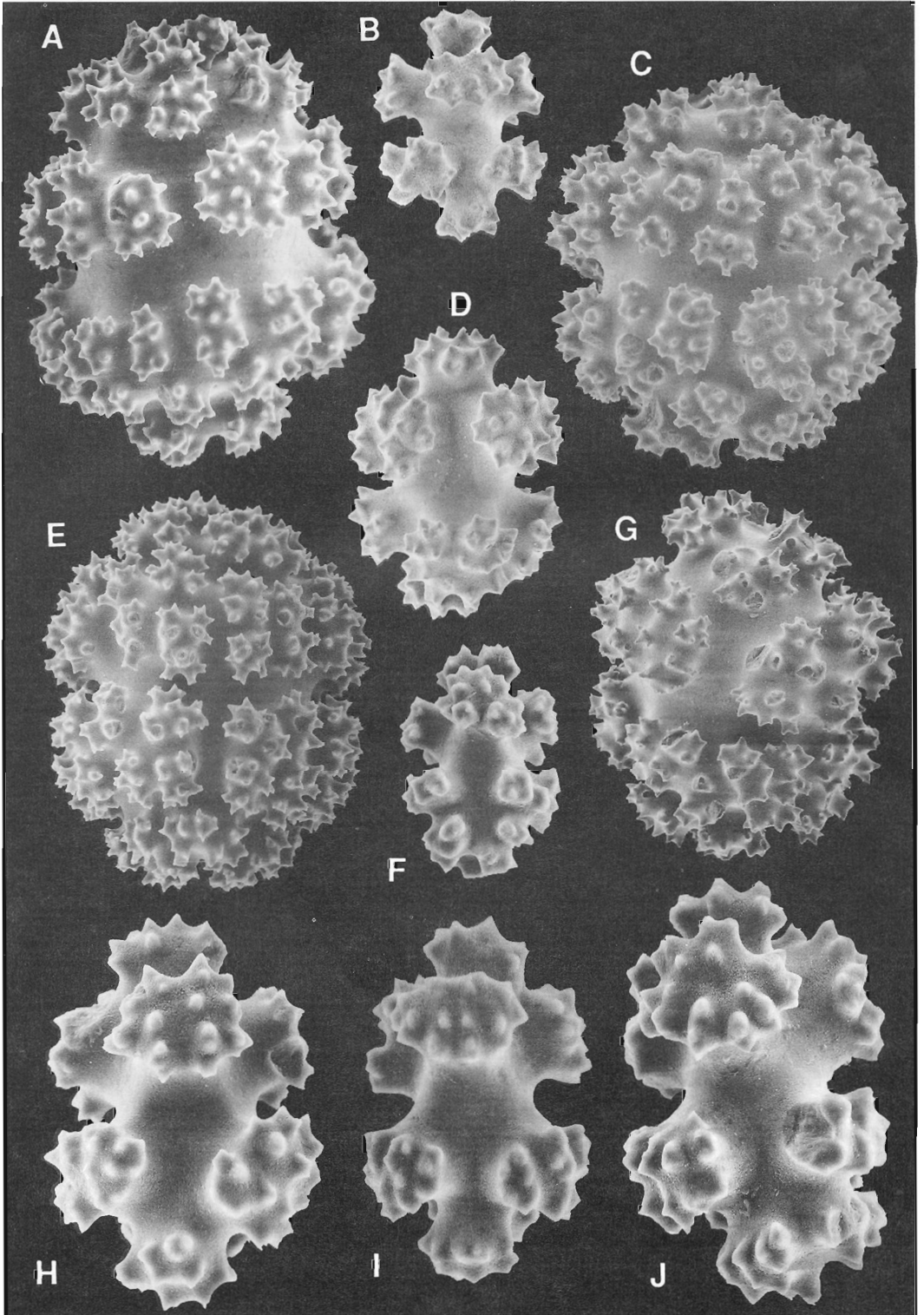


FIGURE 6. *Minabea cosmarioides* A, A single colony, 34 mm in height. B, Longitudinal section through colony in A showing gastric cavities of autozooids and siphonozooids. C, Detail of a single autozooid surrounded by 16 siphonozooids, length of figure represents 2.5 mm. D, Map of southeastern Africa showing distribution of the species; black dot represents type locality and sole collecting station. E, Surface sclerites of the polyparium. F, Interior sclerites of the polyparium. G, Stalk surface sclerites. H, Stalk interior sclerites. Scale bar for E-H represents 0.1 mm.

thirds or three-quarters of the colonies. Sclerites of two distinct kinds: smaller eight-radiates 0.05–0.11 mm long and large rotund barrels 0.14–0.19 mm long. Color dull brownish-orange.

DESCRIPTION.—The two colonies examined are 41 mm long by 15–28 mm wide and 34 mm long by 14–23 mm wide. The holotype is the larger of the two specimens. The colonies are digitiform

FIGURE 7. *Minabea cosmarioides* Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.13 mm. B, 0.05 mm. C, 0.15 mm. D, 0.06 mm. E, 0.15 mm. F, 0.05 mm. G, 0.14 mm. H, 0.06 mm. I, 0.05 mm. J, 0.06 mm.



and robust, cylindrical, and the polyparium tapers distally only slightly if at all. The distal extremity is broadly rounded. The proximal third to a quarter of the colonial length represents the stalk while the polyparium comprises the distal two-thirds to three-fourths of the colony length. The stalk broadens proximally to form the spreading holdfast. The polyps are evenly distributed over the entire surface of the polyparium. The numerous siphonozooids measure approximately 0.2 mm in diameter and surround the retracted autozooids, which are approximately 1.6 mm in diameter. In the smaller colony, five autozooids of the apex region were preserved extended and measure 5 mm long by 1.5 mm wide. The autozooids of the holotype were all preserved completely retracted. The sclerites of the surface coenenchyme are of two distinct types: smaller eight-radiates 0.05–0.07 mm long and large rotund barrels 0.14–0.19 mm in length. All sclerites have very short waists 0.005–0.012 mm in length. Radiates of the surface of the polyparium vary in length from 0.05 to 0.07 mm, while the barrels from the same area are 0.14–0.19 mm long. Sclerites of the interior of the polyparium are large barrels, 0.17–0.19 mm long. Radiates of stalk surface are 0.05–0.11 mm in length, while the barrels are 0.17–0.19 mm long. Sclerites of the interior of the stalk are also large barrels and measure 0.15–0.18 mm in length. Color of the colonies is predominantly a dull brownish-orange. The polyparium may be whitish with brownish-orange retracted autozooids and siphonozooids, resulting in a blotchy appearance, while the stalk is uniformly brownish-orange. Extended autozooids are a uniform greyish-white. The brownish-orange coloration is restricted to sclerites of the surface of the coenenchyme, as the interior of the colony is a uniform yellowish-white and the sclerites are colorless.

DISTRIBUTION.—This species is known only from the type locality off the central coast of Transkei, South Africa in the western Indian Ocean; 250 meters in depth.

ETYMOLOGY.—The specific epithet is derived from the chlorophyte genus *Cosmarium* and the Greek suffix *oides*, denoting likeness of form, in reference to the shape of the larger sclerites, which superficially resemble the body shape of various species of this genus of placoderm desmid.

REMARKS.—*Minabea cosmarioides* is differentiated from other species of the genus by the

occurrence of two very distinct types of sclerites in the surface coenenchyme (small eight radiates and large rotund barrels), and only large rotund barrels in the interior of the colony.

***Minabea goslineri* sp. nov.**

(Figs. 1D, 8, 9)

TYPE MATERIAL.—Holotype: CASIZ 078425, on protected shady sides of dead coral pinnacles, shoreward of Anae Island (13°20'S, 144°40'E), MARIANA ISLANDS. **Guam:** Agat Bay off Nimitz Beach, 1–3 meters depth, 5 December 1990, Scuba, T. M. Gosliner. Paratypes: CASIZ 078426, 3 colonies (one of which is cut longitudinally into two halves), same data as holotype.

OTHER MATERIAL.—CASIZ 078427, 27 colonies, same data as holotype.

DIAGNOSIS.—Colonies low-conical in shape, wider than long. Stalk short and inconspicuous. Polyps cover entire surface of conical or rounded polyparium. Sclerites six- or eight-radiates and double stars (0.05–0.12 mm long), with elongate median waists. Colony color uniform yellow.

DESCRIPTION.—The 31 colonies examined range from 3 to 10 mm in height and from 6 to 14 mm in diameter. Colonies are short, often broader than long, dome-shaped to slightly conical. The stalk is very short and often inconspicuous as the polyparium arises very close to the holdfast. The length of the stalk is usually considerably less than that of the polyparium. The polyparium often tapers to a central apex at the distal terminus. The polyps cover the entire surface of the conical or rounded polyparium, which represents most of the bulk of the colony. In preserved and retracted specimens, the siphonozooids are seen as minute pores approximately 0.8 mm in diameter, which surround the larger autozooids that are approximately 1.0 mm in diameter. The siphonozooids superficially may be very inconspicuous or not evident due to the extreme retraction in preserved material. Sclerites are six- or eight-radiates and double stars (0.05–0.12 mm long) with relatively robust tuberculation, and elongate median waists (0.010–0.025 mm long). The sclerites are densely distributed in the surface as well as in the interior of the colonies. Sclerites of the surface of the polyparium vary in length from 0.06 to 0.12 mm, while the interior of the polyparium has sclerites that are 0.09–0.12 mm in length. Sclerites of the surface of the stalk are 0.05–0.10 mm long, while those of the stalk interior vary from 0.08 to 0.10 mm in length. Color of the colonies is lemon yellow throughout.

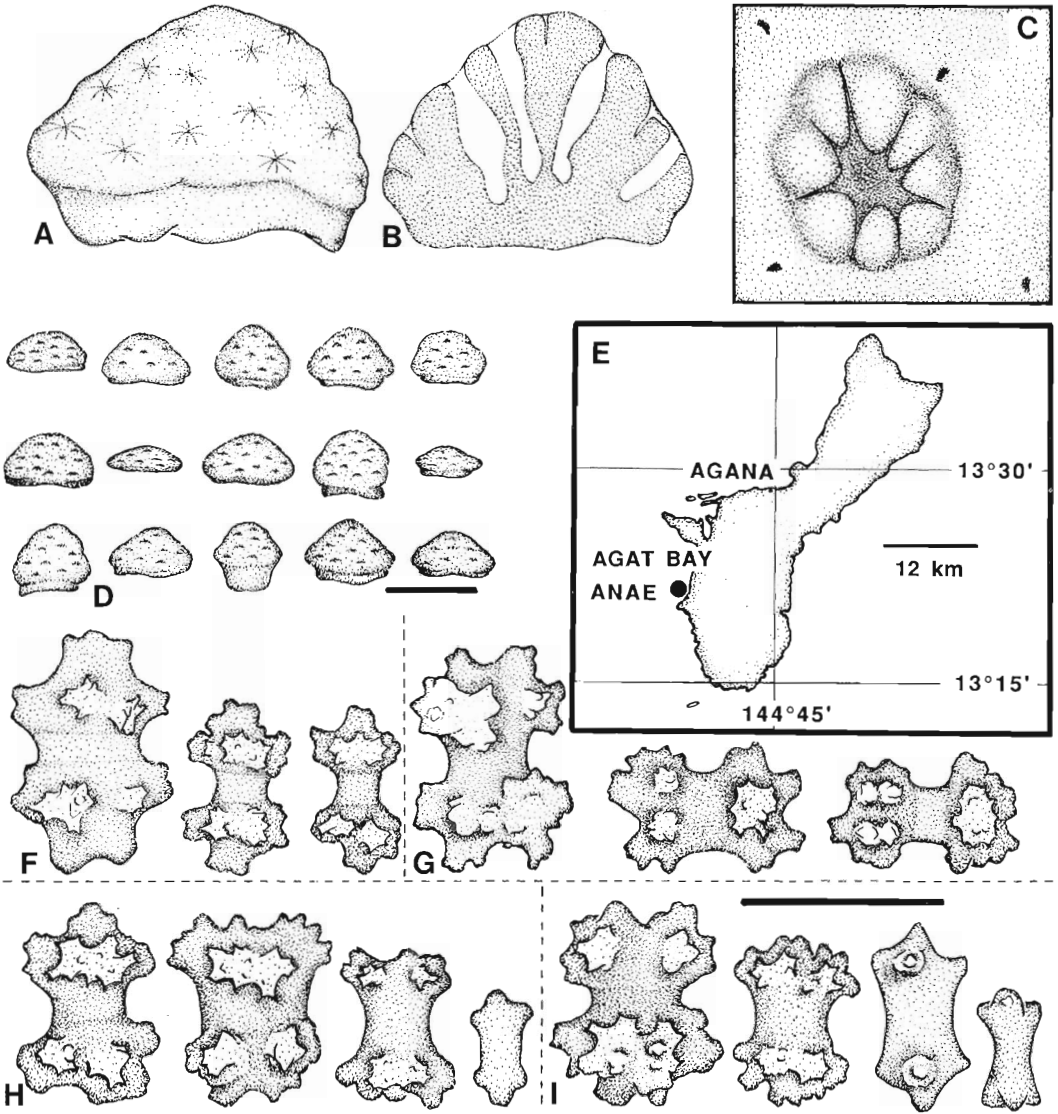


FIGURE 8. *Minabea goslineri* A, A single colony, 7.2 mm in height. B, Longitudinal section through colony in A showing gastric cavities of autozooids and siphonozooids. C, Detail of a single autozoooid surrounded by four siphonozooids, length of figure represents 1.6 mm. D, Fifteen colonies showing variability of colony shape, scale bar represents 12 mm. E, Map of Guam, Northern Mariana Islands, showing distribution of the species; black dot represents type locality and only collecting station. F, Surface sclerites of the polyparium. G, Interior sclerites of the polyparium. H, Stalk surface sclerites. I, Stalk interior sclerites. Scale bar for F-I represents 0.1 mm.

DISTRIBUTION.—*Minabea goslineri* is known only from the type locality (Guam, Mariana Islands, in the western Pacific; 1–3 meters in depth). Colonies are found on protected, shady sides of overhangs or vertical surfaces in shallow water of areas with coral heads or coral reef.

ETYMOLOGY.—This species is named for its

discoverer, Dr. Terrence M. Gosliner of the California Academy of Sciences, a long-time friend and colleague.

REMARKS.—*Minabea goslineri* is differentiated from other members of the genus by its low conical growth form, in which the diameter of the colonies is generally greater than the total height,

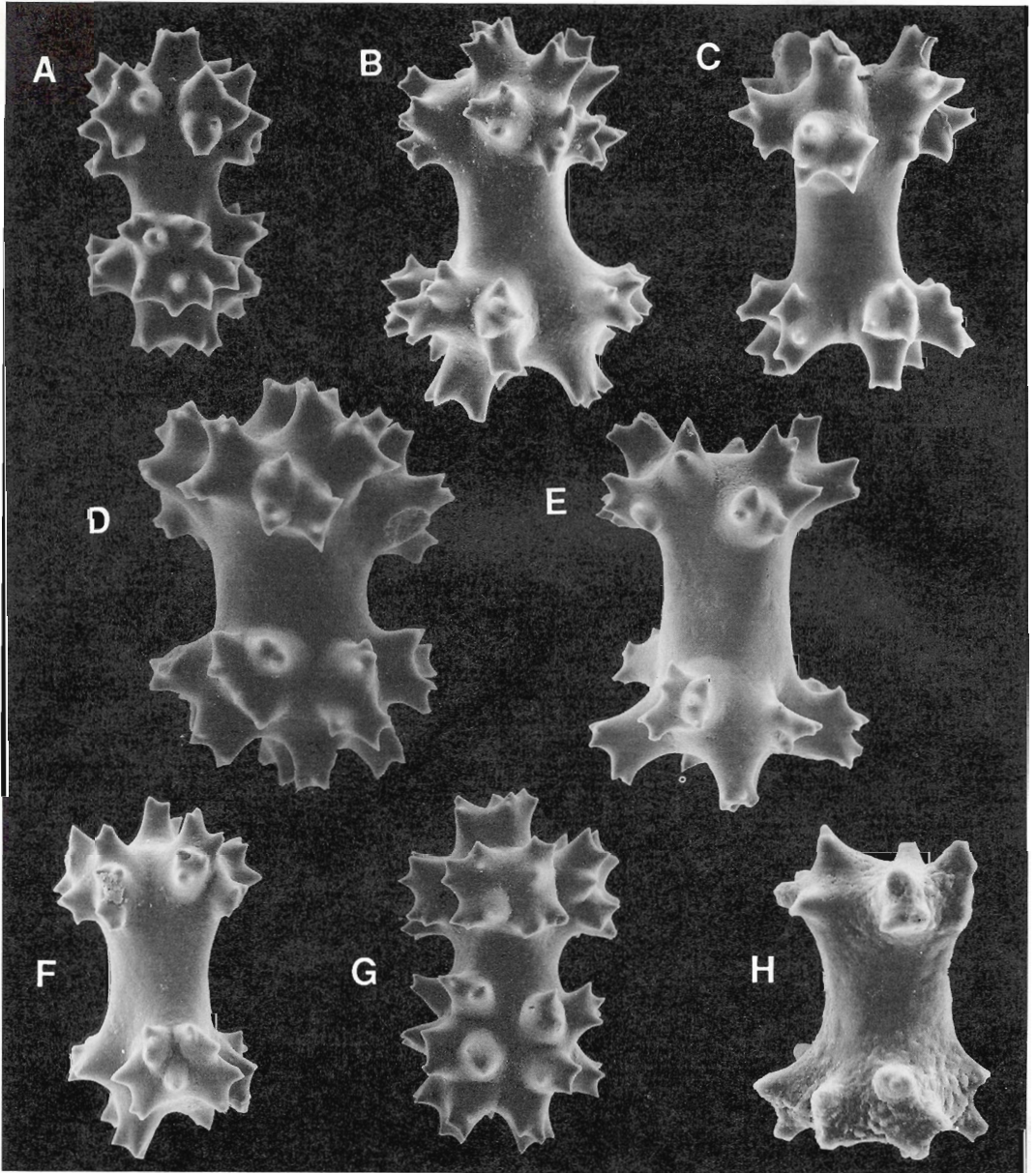


FIGURE 9. *Minabea goslineri* Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.06 mm. B, 0.07 mm. C, 0.07 mm. D, 0.08 mm. E, 0.07 mm. F, 0.07 mm. G, 0.07 mm. H, 0.06 mm.

an inconspicuous stalk, and sclerites that are six- or eight-radiates (many tending toward double stars) with conspicuously elongate median waists.

Minabea indica (Thomson and Henderson, 1905), comb. nov.
(Figs. 10, 11)

Bellonella indica Thomson and Henderson, 1905:274, pl. 6, fig. 5. *Non* Bayer, 1974: 261. *Non* Faulkner and Chesher, 1979:267, pl. 22.

TYPE MATERIAL.—Holotype: BMNH Reg. No. 1933. 3. 13. 206 (labeled as *Nidalia indica*), SRI LANKA. South of Galle: deep water, Sir. J. A. Thomson Collection, one specimen in which part of the polyparium has been cut way longitudinally and is missing.

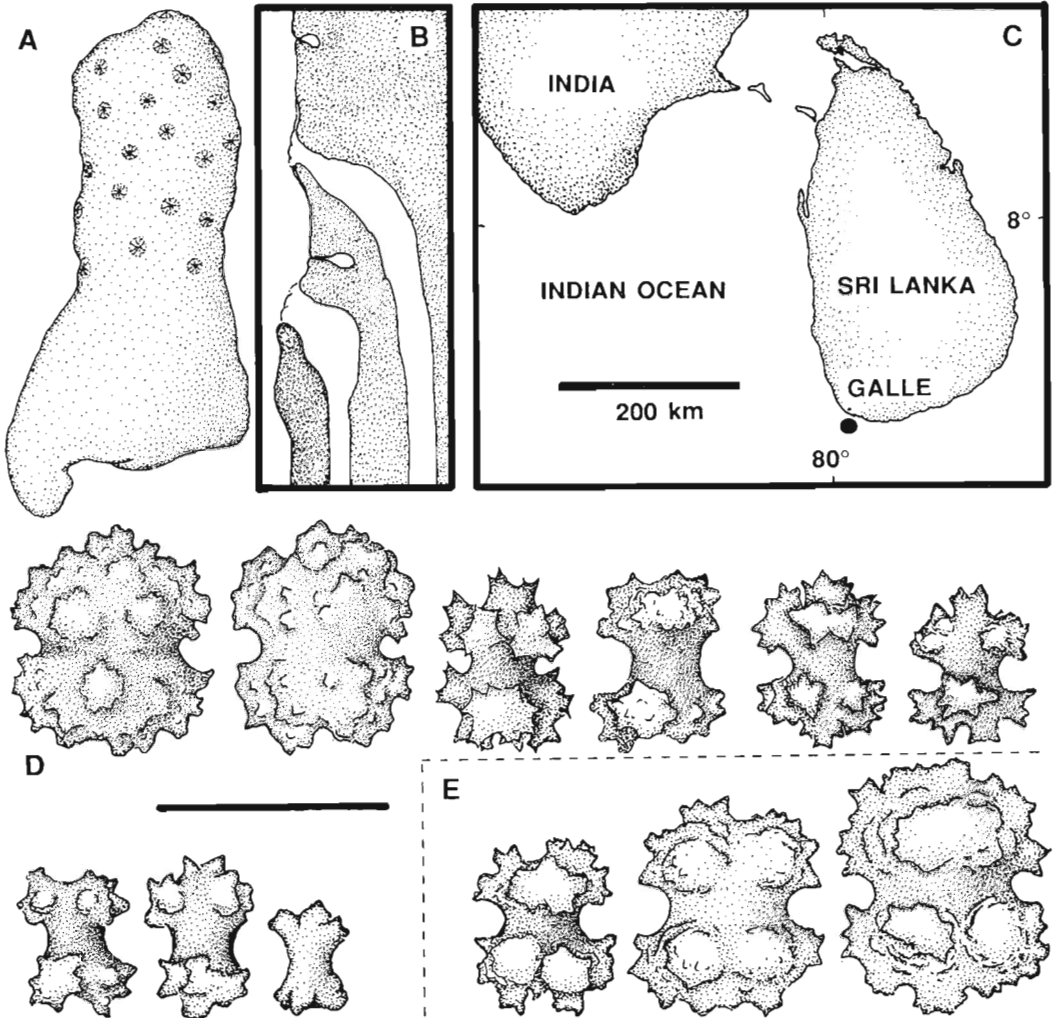


FIGURE 10. *Minabea indica* (Thomson and Henderson, 1905). A, The holotype, 20 mm in height. B, Longitudinal section through part of the polyparium showing two autozooids and two smaller siphonozooids, length of figure represents 5.5 mm. C, Map of southern India and Sri Lanka showing the type locality (black dot). D, Sclerites from the surface and interior of the polyparium. E, Sclerites from the surface and interior of the stalk. Scale bar for D-E represents 0.1 mm.

DIAGNOSIS.—Colony digitiform, cylindrical in shape. Polyparium restricted to the distal-most 40–50% of the colony. Sclerites robust barrels, six- seven- or eight-radiates, and double stars (0.045–0.11 mm). Color red-orange with yellow retracted polyps.

DESCRIPTION.—The preserved colony is 20 mm in length, although Thomson and Henderson (1905) recorded it as 24 mm long. The polyparium is 6 mm in width, while the stalk is 9 mm wide at its base. The polyps are restricted to the distal-most two-fifths to one-half of the total col-

ony length. The autozooids have bright yellow sclerites in their bases but these do not form permanent calyces. The colony is tightly contracted and consequently the siphonozooids are not visible on the surface. These can only be observed in the longitudinal section of the colony. The sclerites are densely distributed throughout the surface and interior of the colony. The sclerites of the polyparium are highly variable in type, 0.045–0.11 mm in length, and composed of robust barrels, six-radiates, seven-radiates, and eight-radiates, with some radiates

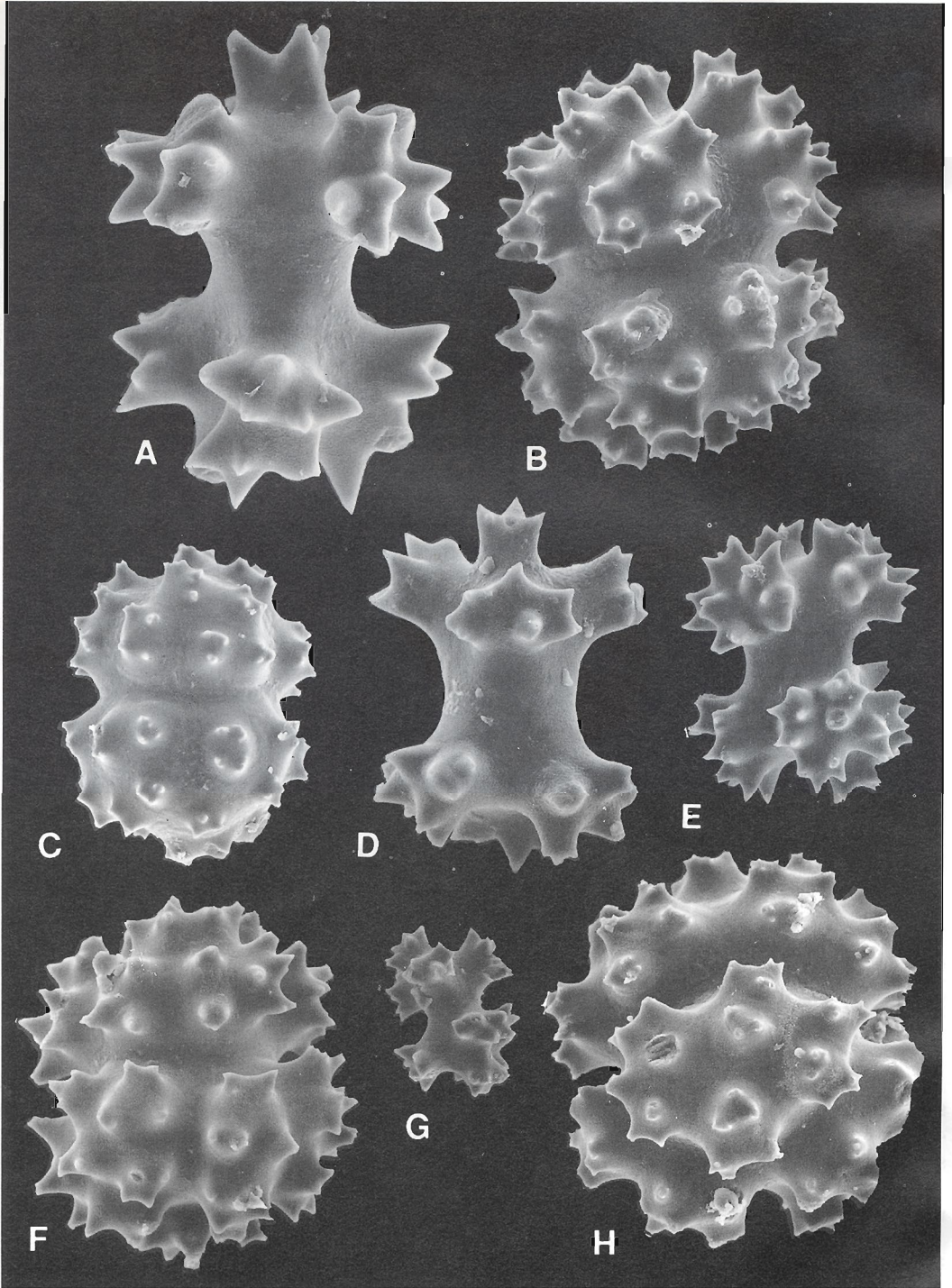


FIGURE 11. *Minabea indica* (Thomson and Henderson, 1905). Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.06 mm. B, 0.08 mm. C, 0.07 mm. D, 0.05 mm. E, 0.08 mm. F, 0.08 mm. G, 0.05 mm. H, 0.08 mm.

approaching double stars with elongated median waists. The stalk contains sclerites that are mainly robust barrels with some radiates. Colony color is dichromatic, crimson-vermillion with yellow retracted polyps.

DISTRIBUTION.—The species is known only from the type locality, southwestern Sri Lanka, central Indian Ocean, in deep water (specific depth and latitude/longitude not given).

REMARKS.—*Bellonella indica* can be allocated to the genus *Minabea* on the basis of having dimorphic polyps and sclerites that are mostly radiates and barrels (which are not illustrated in the original description). The absence of permanent calyces and presence of siphonozooids precludes the acceptance of *Bellonella* as the valid generic designation. Thomson and Henderson (1905:274) make the following ambiguous statement regarding the presence of autozooids and siphonozooids: "Smaller forms occur among the larger, but there is no evidence of dimorphism of zooids." The severely contracted nature of the specimen makes seeing the siphonozooids extremely difficult.

The yellow/red dichromatic coloration and the restriction of the polyps to less than half of the colony length, as well as the species' occurrence in deep water, serve to distinguish it from both *M. robusta* and *M. aldersladei* (the two species that it seems to resemble most closely). *Minabea robusta* contains tuberculate spheroids, while *M. aldersladei* and *M. indica* do not. *Minabea indica* can be differentiated from *M. aldersladei* as follows: In *M. aldersladei* the polyparium comprises 66–83% of the colony; the sclerites are elongated barrels or eight radiates; the colony color is monochromatic (uniform yellow or red-orange); and the species is restricted to shallow water (2–25 m). In contrast, *M. indica* has the polyparium restricted to 40–50% of the colony; the sclerites are variable (robust barrels, six-, seven-, eight radiates, and double stars); the color is dichromatic (red-orange and yellow); and the species is known only from deep water.

Minabea kosiensis sp. nov.

(Figs. 1E, 12, 13)

TYPE MATERIAL.—Holotype: SAM-H4261, dredged from a bottom of small rocks, Kosi River mouth (26°55.2'S, 32°56.1'E), SOUTH AFRICA. Zululand: Indian Ocean, 370 meters depth, 7 June 1987, steel dredge, G. C. Williams on board RV *Meiring Naude*. Paratype: One colony cut longitudinally into two halves, SAM-H4262, same data as holotype.

OTHER MATERIAL.—One colony, SAM-H4076, same data as holotype.

DIAGNOSIS.—Colonies digitiform, relatively short, cylindrical in shape. Sclerites eight-radiates, thorny spindles and intermediate forms (0.06–0.24 mm long). Color white with salmon-pink retracted autozooids and siphonozooids.

DESCRIPTION.—The three colonies examined are 20, 26, and 30 mm in length, all with an average width of 9 mm. The colonies are digitiform, relatively short, cylindrical in shape as the distal region does not taper to any appreciable degree and the distal terminus of a particular colony is broadly rounded. The distal-most three-quarters to one-half of the colonies are occupied by the polyparium, while the proximal-most one-quarter to one-half comprises the stalk. Proximally the stalk produces a somewhat spreading holdfast. The polyps are evenly distributed over the surface of the polyparium. The retracted autozooids are approximately 1.2 mm in diameter and are surrounded by minute siphonozooids that measure approximately 0.12–0.16 mm in diameter. Several autozooids that were preserved extended in two of the colonies measure approximately 2.5 mm in length by 1.5 mm in width. Sclerites are eight-radiates and thorny spindles as well as forms intermediate between these two (0.06–0.24 mm in length). Some of the spindles may be slightly club-shaped and have conspicuous, sharply pointed tubercles. The sclerites from the surface coenenchyme of the polyparium are 0.06–0.23 mm in length. Sclerites from the surface of the stalk are 0.06–0.20 mm long. Sclerites from the interior of the polyparium measure 0.10–0.24 mm in length. In the interior of the stalk, the sclerites are 0.12–0.15 mm in length. The stalk sclerites are predominantly thorny radiates or intermediate forms with very few elongate spindles present, while the polyparium contains both spindles and radiates in approximately equal numbers. Color of the colony is white with light salmon-pink, retracted autozooids and siphonozooids. The extended autozooids are uniform white. The spindles and sclerites of intermediate form are colorless, while the smaller radiates are reddish in color. The interior of the colonies is white due to the colorless nature of the sclerites, while the pinkish coloration is restricted to the surface coenenchyme of the polyparium, which contains reddish radiates.

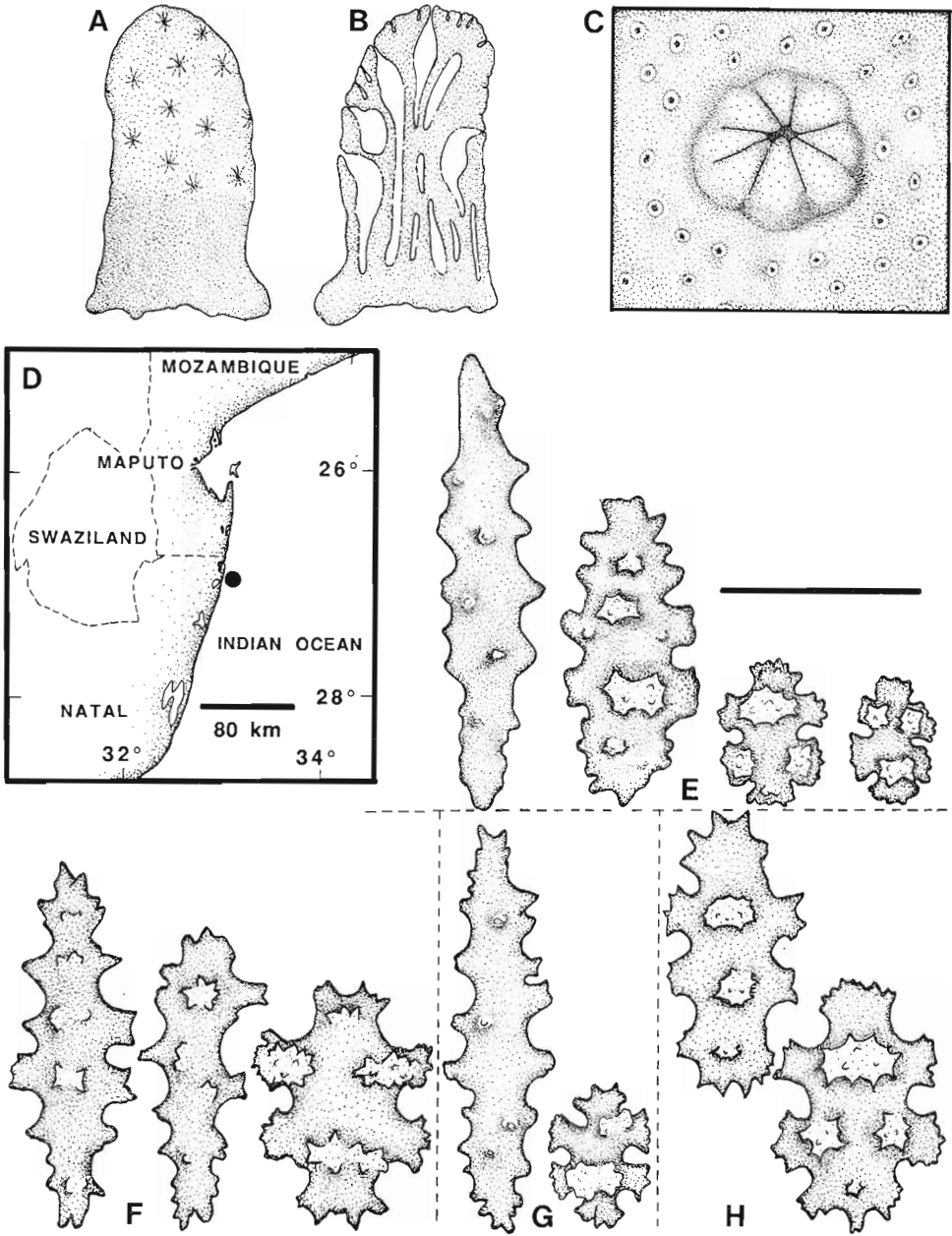


FIGURE 12. *Minabea kosiensis* A, A single colony, 20 mm in height. B, Longitudinal section through colony in A showing gastric cavities of autozooids and siphonozooids. C, Detail of a single autozooid surrounded by 28 siphonozooids, length of figure represents 2.4 mm. D, Map of southeastern Africa showing distribution of the species; black dot represents type locality and only collecting station. E, Surface sclerites of the polyparium. F, Interior sclerites of the polyparium. G, Stalk surface sclerites. H, Stalk interior sclerites. Scale bar for E-H represents 0.1 mm.

DISTRIBUTION.—This species is known only from the type locality at Kosi Bay (border of South Africa and Mozambique), 370 meters in depth.

ETYMOLOGY.—The specific epithet is derived from the name of the type locality, *Kosi* Bay (near the border of Mozambique and Zululand), and the Latin suffix *-ensis*, meaning belonging to.

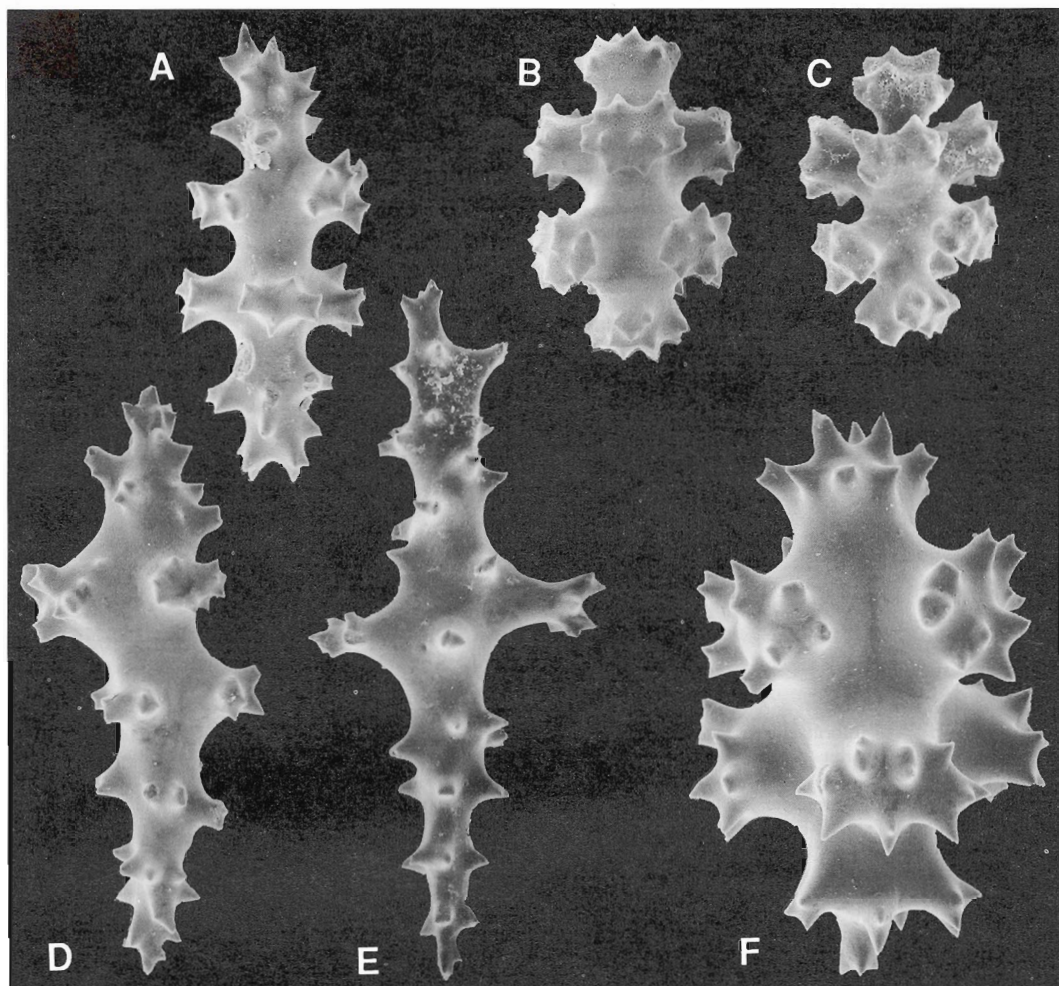


FIGURE 13. *Minabea kosiensis* Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.12 mm. B, 0.06 mm. C, 0.05 mm. D, 0.15 mm. E, 0.23 mm. F, 0.10 mm.

REMARKS.—*Minabea kosiensis* is distinguished from other *Minabea* species by the occurrence of short and slender-digitiform/cylindrical growth form, and sclerites of eight-radiates, elongate spindles, and intermediate forms in the polyparium with a predominance of thorny radiates and intermediate forms in the stalk. Reddish coloration is restricted to radiates in the surface coenenchyme of the polyparium. This species is here recorded as occurring at the greatest depth of any *Minabea* species.

Minabea ozakii Utinomi, 1957

Minabea ozakii Utinomi, 1957:139. Utinomi and Imahara, 1976:205. Alderslade, 1985:113.

REMARKS.—This is the type species for the genus *Minabea*. Type material was not available to me for study. An assessment of the species is presented below (see DISCUSSION—Historical Account).

DISTRIBUTION.—Honshu, Japan.

Minabea phalloides (Benham, 1928)

Anthomastus phalloides Benham, 1928:79.

Minabea phalloides Utinomi and Imahara, 1976:211.

REMARKS.—Type material for this species was not available to me for examination. An assessment is presented below (see DISCUSSION—Historical Account).

TABLE 1. COMPARATIVE CHARACTERS FOR THE GENUS *MINABEA* UTINOMI, 1957.

Species	Colony shape and length	Sclerites	Color	Distribution and depth
<i>Minabea acronocephala</i>	dome-shaped: low hemispherical (4–14 mm)	barrels and eight-radiates (0.05–0.13 mm)	yellow or orange, often with red retracted polyps	New Guinea and Fiji (5–21 m)
<i>Minabea alder-sladei</i>	digitiform: elongate tapering (19–69 mm)	Elongate barrels and eight-radiates (0.04–0.12 mm)	yellow or red-orange	New Guinea, NW Australia, Great Barrier Reef (2–25 m)
<i>Minabea cosmarioides</i>	digitiform: robust cylindrical (34–41 mm)	eight-radiates and rounded barrels (0.05–0.19 mm)	dull brownish-orange	Transkei (South Africa) (250 m)
<i>Minabea goslineri</i>	dome-shaped: low conical (3–10 mm)	double stars, six-radiates and eight-radiates (0.05–0.12 mm)	yellow	Guam (1–3 m)
<i>Minabea indica</i>	digitiform: elongate cylindrical (20–24 mm)	robust barrels, six-, seven-, eight-radiates, double stars (0.045–0.11 mm)	crimson-vermillion with yellow retracted polyps	Sri Lanka (deep water)
<i>Minabea kosien-sis</i>	digitiform: short cylindrical (20–30 mm)	eight-radiates, thorny spindles and intermediates (0.06–0.24 mm)	white with salmon-pink retracted polyps	Natal (South Africa) (370 m)
<i>Minabea ozakii</i>	digitiform: elongate tapering (<45 mm)	eight-radiates, thorny spindles, slender rods (0.037–0.26 mm)	dull orange or cinnamon	Japan (250–270 m)
<i>Minabea phal-loides</i>	digitiform: elongate tapering (47 mm)	radiates and thorny spindles (0.05–0.25 mm)	pale-yellowish	New Zealand (depth unknown)
<i>Minabea robusta</i>	digitiform: elongate tapering (57–170 mm)	radiates, robust barrels and tuberculate spheroids (0.04–0.11 mm)	light yellow-orange with yellow or orange retracted polyps	Japan (25–30 m)

DISTRIBUTION.—New Zealand.

Minabea robusta Utinomi and Imahara, 1976

(Figs. 14, 15)

Minabea robusta Utinomi and Imahara, 1976:206; Figs. 1–3; pl. 1. Alderslade, 1985:113, Fig. 5b.

MATERIAL EXAMINED.—Paratype: MSM-INV-75-048, one partial colony in three pieces, colony originally attached to a boulder, JAPAN. **Suruga Bay:** Uchiura coast, Wakamatsu-zaki (approximately 34°45'N, 138°30'E), 11 June 1975, 30 meters in depth.

DESCRIPTION.—The three portions of the paratype examined are from the polyparium: the distal tip of the colony (25 mm in length by 10–12 mm in width), a middle portion (45 mm long by 15–20 mm in width), and a basal portion (25 mm in length by 30–33 mm in width). None of the material is representative of the stalk. The distal and middle portions are longitudinally sec-

tioned with only one half from each section present. The gastric cavities of the autozooids form parallel straight-sided tubes. The siphonozooids are numerous and prominent, pustulate, approximately 0.5 mm in diameter, and surround the retracted autozooids, which are 1.5–2.0 mm in diameter. The sclerites are variable and include radiates (predominantly eight-radiates), tuberculate spheroids, and robust barrels (0.04–0.11 mm in length). The tuberculation of sclerites from the interior is somewhat more coarsely thorny than that of the surface sclerites.

DISTRIBUTION.—Sagami Bay and Suruga Bay, Honshu, Japan; 25–30 meters in depth.

REMARKS.—The other Japanese species, *Minabea ozakii*, differs from *M. robusta* by having slender rods in the interior. *Minabea robusta* is differentiated from other digitiform members of the genus by the occurrence of tuberculate spheroids and robust barrels in addition to radiates.

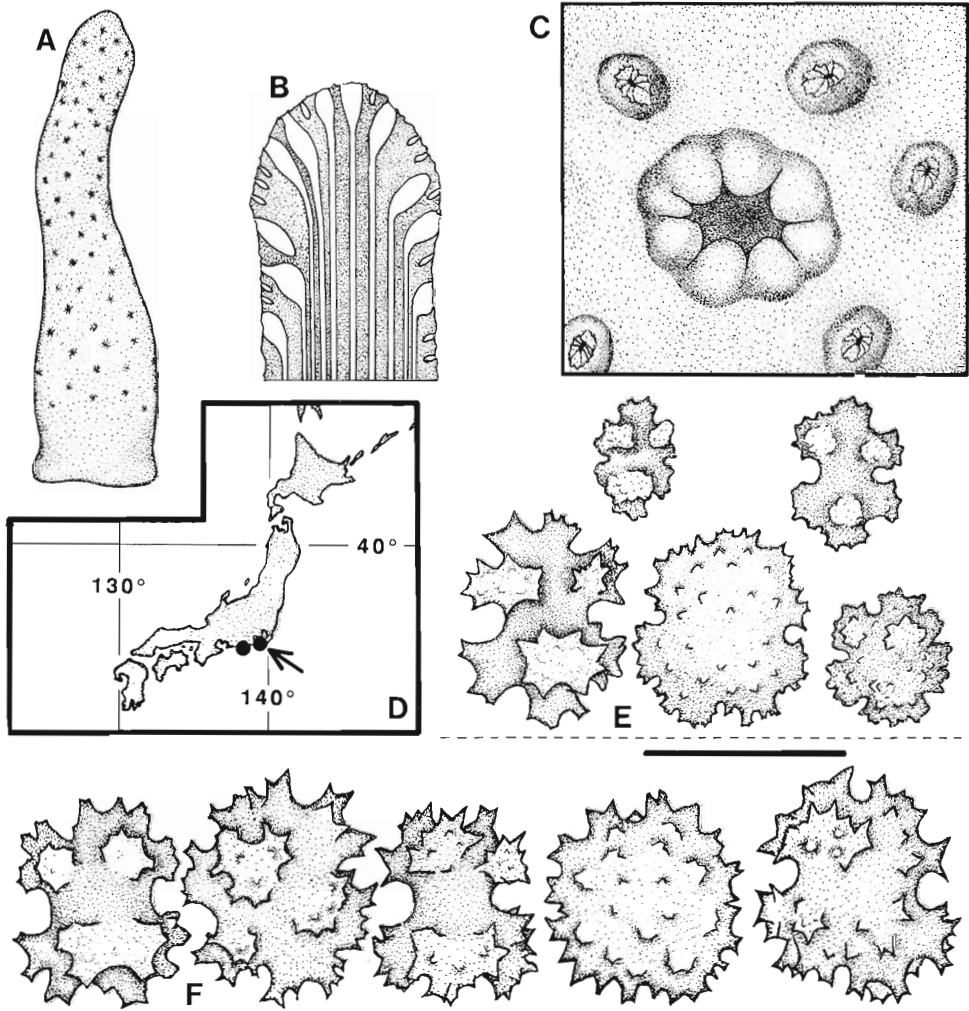


FIGURE 14. *Minabea robusta*. A, Reconstruction of a colony from fragmented paratype (MSM-INV-75-048) and adapted from Utinomi and Imahara, 1976:pl. 1 (Fig. 3), 170 mm in height. B, Longitudinal section of distal terminus of paratype showing gastric cavities of autozooids and siphonozooids; portion shown is 25 mm in height. C, Detail of a single autozoooid surrounded by five siphonozooids, length of figure represents 3.0 mm. D, Map of Japan showing collecting stations for the species (arrow indicates type locality). E, Polyparium surface sclerites. F, Polyparium interior sclerites. Scale bar for E, F represents 0.1 mm.

DISCUSSION

HISTORICAL ACCOUNT.—The genus *Minabea* was established by Utinomi (1957) for *M. ozakii* from near Minabe, eastern entrance to the Inland Sea, Honshu, Japan at 250–270 meters in depth. According to Utinomi, the species is characterized by having an elongate and tapering digitiform shape, in addition to radiates and spindles in the surface of the polyparium and stalk, with the interior of the polyparium containing slender rods. A recent request for loan of type material

of *M. ozakii* was not acknowledged, and thus a detailed comparison with recently collected material representing the new taxa was not possible.

A second species, *M. robusta*, was subsequently described in 1976 by Utinomi and Imahara for material collected in Sagami and Suruga bays, Honshu, Japan at 25–30 meters depth. This species, also elongate and tapering digitiform, was differentiated by the possession of short-waisted capstans (six- or eight-radiates), and robust barrels and tuberculate spheroids in the surface as

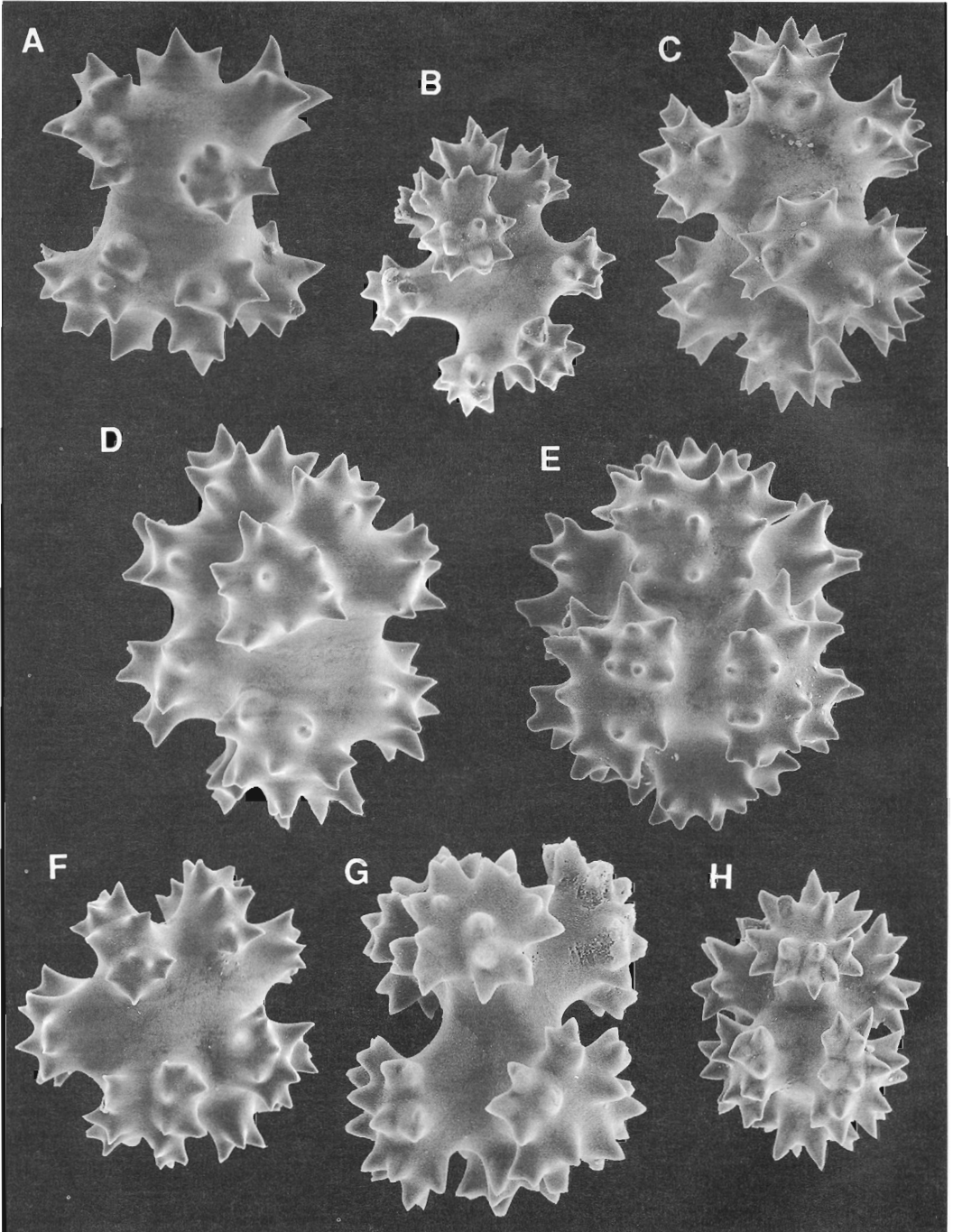


FIGURE 15. *Minabea robusta* Scanning electron micrographs of sclerites. Measurements refer to sclerite length. A, 0.07 mm. B, 0.06 mm. C, 0.08 mm. D, 0.08 mm. E, 0.08 mm. F, 0.06 mm. G, 0.06 mm. H, 0.06 mm.

well as in the interior of the colony. An emended generic diagnosis was included to accommodate both species. A paratype of *M. robusta* (MSM-INV-75-048) was recently acquired on loan and a comparison was subsequently made with recently collected material.

Anthomastus phalloides Benham, 1928 was described presumably from the region of the Foveaux Strait, south of the South Island of New Zealand, at an unrecorded depth. Like the two Japanese species, it is elongate digitiform, and the colony gradually tapers distally. The polypiferous region contains radiates and thorny spindles in contrast to the surface of the stalk which contains only radiates, while the interior also contains spindles in addition to radiates. Tixier-Durivault (1970) described *Anthomastus agilis* Tixier-Durivault, 1970 from New Caledonia (depth unrecorded). The colonial growth form is clavate and the sclerites are spindles and wart clubs. Neither the New Zealand nor the New Caledonia species can be allocated to the genus *Anthomastus* Verrill, 1878, which is characterized by a distinctly capitate growth form, a reduced number of greatly enlarged autozooids, and the occurrence of large thorny spindles or rods in the interior of the colony. Utinomi and Imahara (1976) transferred these two species to the genus *Minabea* and considered them as probable synonyms. Based solely on the description provided by Benham, I agree that *Anthomastus phalloides* should be allocated to *Minabea*. In contrast, Tixier-Durivault's species presents another set of circumstances. According to P. N. Alderslade (pers. comm.), the holotype of *Anthomastus agilis* has interior spindles up to 2.2 mm in length, which clearly indicates that it is not a species of *Minabea*. The taxon is in the process of being redescribed by Alderslade, along with two other species, as members of a new genus of Alcyoniidae.

Bellonella indica Thomson and Henderson, 1905, a single specimen described from "deep water" off of southwestern Sri Lanka in the Indian Ocean, can be allocated to the genus *Minabea* on the basis of digitiform growth habit, presence of dimorphic polyps, sclerites as capstans and related forms, and absence of permanent calyces.

Taking into account the five new species described in the present work, a total of at least nine worldwide species can therefore be recog-

nized for the genus *Minabea*. These taxa are differentiated in Table 1.

SIMILAR GENERA.—Two other alcyoniid genera from the Indian Ocean are superficially similar to *Minabea*. *Acrophytum* Hickson, 1900 and *Verseveldtia* Williams, 1990 both have dimorphic polyps, relatively small and numerous autozooids, and are unbranched with a growth form and complement of sclerites that may resemble *Minabea*.

Acrophytum claviger Hickson, 1900, the only species known in the genus, is distributed along the South African coast between Cape St. Francis (Cape Province) and Port Durnford (Natal). *Acrophytum* is distinguished by its elongate digitiform shape, colorless sclerites that are predominantly clubs and wart clubs, and a marked scarcity of sclerites in the interior of the colony. The colonies are relatively rigid and firm due to the presence of very dense mesoglea.

Verseveldtia, on the other hand, is distinctly capitate with the polyps restricted to the distal portion of the enlarged capitulum; the autozooids contain small platelets; many if not all the colonial sclerites are colored, being predominantly radiates, double stars, barrels and tuberculate spheroids; and they are densely distributed in the interior of the colony. The two described species of *Verseveldtia*, also from South Africa, are distributed between East London (Cape Province) and Durban (Natal). An undescribed species of *Verseveldtia* has recently been recognized from off western Australia (P. N. Alderslade, pers. comm.). *Anthomastus granulosis* Kükenthal, 1910, originally described from Japan and later described from subsequently collected material by Utinomi (1960), has sclerites that closely resemble the barrels and capstans of various species of *Minabea* and *Verseveldtia*, and in addition lacks the sparsely spinose rods in the interior of the colonies that is characteristic of the genus *Anthomastus*. Regarding the markedly capitate nature of Kükenthal's and Utinomi's specimens, it is possible that the species belongs to the genus *Verseveldtia* (Williams 1990). Thomson (1921) applied the name *Anthomastus granulosis* to a specimen from South Africa that is probably identifiable as *Verseveldtia bucciniforme* Williams, 1990.

Minabea differs from *Acrophytum* and *Verseveldtia* by the combination of digitiform growth form, sclerites that are barrels, radiates, or spin-

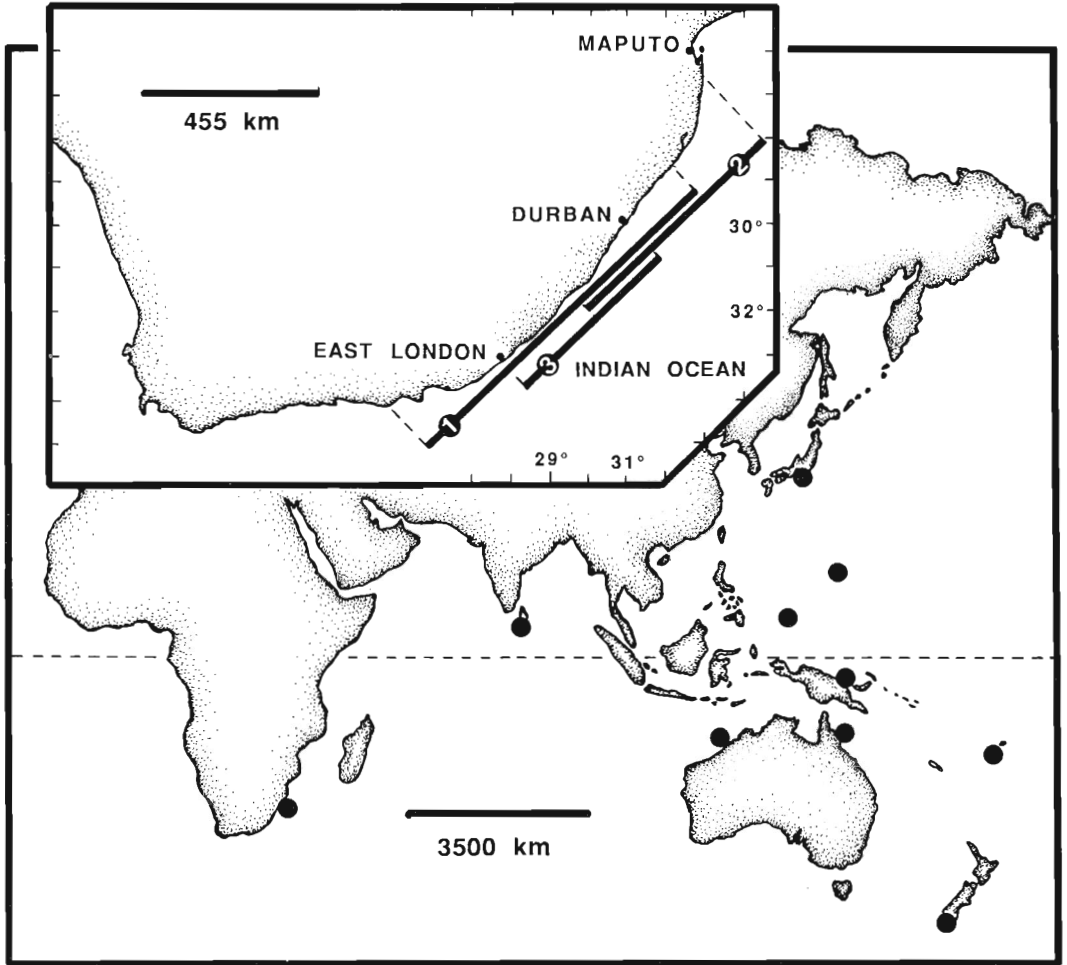


FIGURE 16. Map of the Indo-West Pacific showing distribution of the genus *Minabea*. Inset of southern Africa shows the overlapping distributions of the genera *Acrophytum* (1), *Minabea* (2), and *Verseveldtia* (3).

TABLE 2. COMPARATIVE CHARACTERS FOR THREE SIMILAR GENERA OF DIMORPHIC SOFT CORALS.

Genus	Colony shape in mature colonies	Mesoglea	Siphonozoids	Interior sclerites	Polypary and stalk sclerites	Polyp sclerites	Distribution and depth
<i>Acrophytum</i>	digitiform: finger-like	dense	few, sparse	very sparse	colorless tuberculated clubs	absent	South Africa (30–146 m)
<i>Minabea</i>	digitiform: dome-shaped to fingerlike	thin	many, dense	dense	colored barrels, radiates, double heads, spindles and rods	absent	Indo-West Pacific (1–370 m)
<i>Verseveldtia</i>	Capitate with narrow and elongate stalk	thin	many, dense	dense	colored barrels, double stars, radiates, and tuberculate spheroids	numerous small platelets	South Africa and Western Australia (50–97 m)

dles, which are for the most part colored and distributed throughout the colony.

The geographic ranges of all three genera overlap along the east coast of South Africa between Mbotyi (Transkei) and Durban (Natal) (Fig. 16, inset). The genera are differentiated in Table 2.

ACKNOWLEDGMENTS

This paper represents Christensen Research Institute publication number 21. I wish to thank Director Matthew Jebb and the staff of the Christensen Research Institute, Madang, Papua New Guinea, for their enthusiastic support of field research undertaken during November of 1990. CRI provided a research fellowship for funding of field work during this period. Matthew Jebb translated the abstract into Pidgin English. I am grateful to Terrence M. Gosliner, director of research at the California Academy of Sciences, San Francisco, for the collection of some material; Phil Alderslade of the Northern Territory Museum, Darwin, for kindly providing loans of Australian material; Katsumi Suzuki of the Marine Science Museum, Tokai University, Shizuoka, Japan, for loan of the paratype of *M. robusta*; Charles Hussey, Invertebrate Curation Group, The Natural History Museum (London) for loan of the holotype of *M. indica*; and Timothy E. Coffey of the National Museum of Natural History, Smithsonian Institution, Washington, D.C., for loan of material from Palau. I am indebted to Richard Kilburn and David Herbert of the Natal Museum, Pietermaritzburg, for their help during dredging cruises of the *RV Meiring Naude* in 1986 and 1987; Michelle van der Merwe and Liz Hoenson of the South African Museum, Cape Town, for curatorial assistance; and Lisa Borok and Terrence Gosliner (California Academy of Sciences) for assistance in the preparation of scanning electron micrographs. I express my gratitude to Frederick M. Bayer, of the National Museum of Natural History, Smithsonian Institution, Washington, D.C., for sharing his knowledge of the genus.

SUMMARY (PIDGIN)

Sotpela toksave long dispela stori: wanpela nupela toksave bilong stretim stori bilong wanpela kain malumalu-koral lain (*Minabea* Utinomi, 1957, family Alcyoniidae) i kamap, bikos mipela

bin kisim faivpela nupela kain long solwara nabaut long Pacific na Papua Niugini. Nau tasol i gat nainpela kain samting long dispela lain. Dispela lain i kamap long ol rip i stap insait long Afrika, na i go long Fiji, na Japan, na New Zealand, sampela kain i stap long rip i no daun, na sampela i stap long ples i daunbilo long 370 meters. Sampela toktok long skelim dispela lain wantaim ol kandere lain long narapela hap i kamap.

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