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*HANSENOTHURIA BENTI*, NEW GENUS, NEW SPECIES  
(ECHINODERMATA: HOLOTHUROIDEA) FROM THE  
TROPICAL WESTERN ATLANTIC: A BATHYAL,  
EPIBENTHIC HOLOTHURIAN WITH  
SWIMMING ABILITIES

John E. Miller and David L. Pawson

*Abstract.*—*Hansenothuria benti*, new genus, new species, is described and illustrated from material collected with the Research Submersibles *Johnson-Sea-Link* I and II on bathyal slopes of the Bahama Islands at depths of 639–904 m. This species was also observed at St. Vincent, Lesser Antilles, at depths of 363–447 m. On several occasions, *H. benti* has been observed to swim in response to physical disturbance.

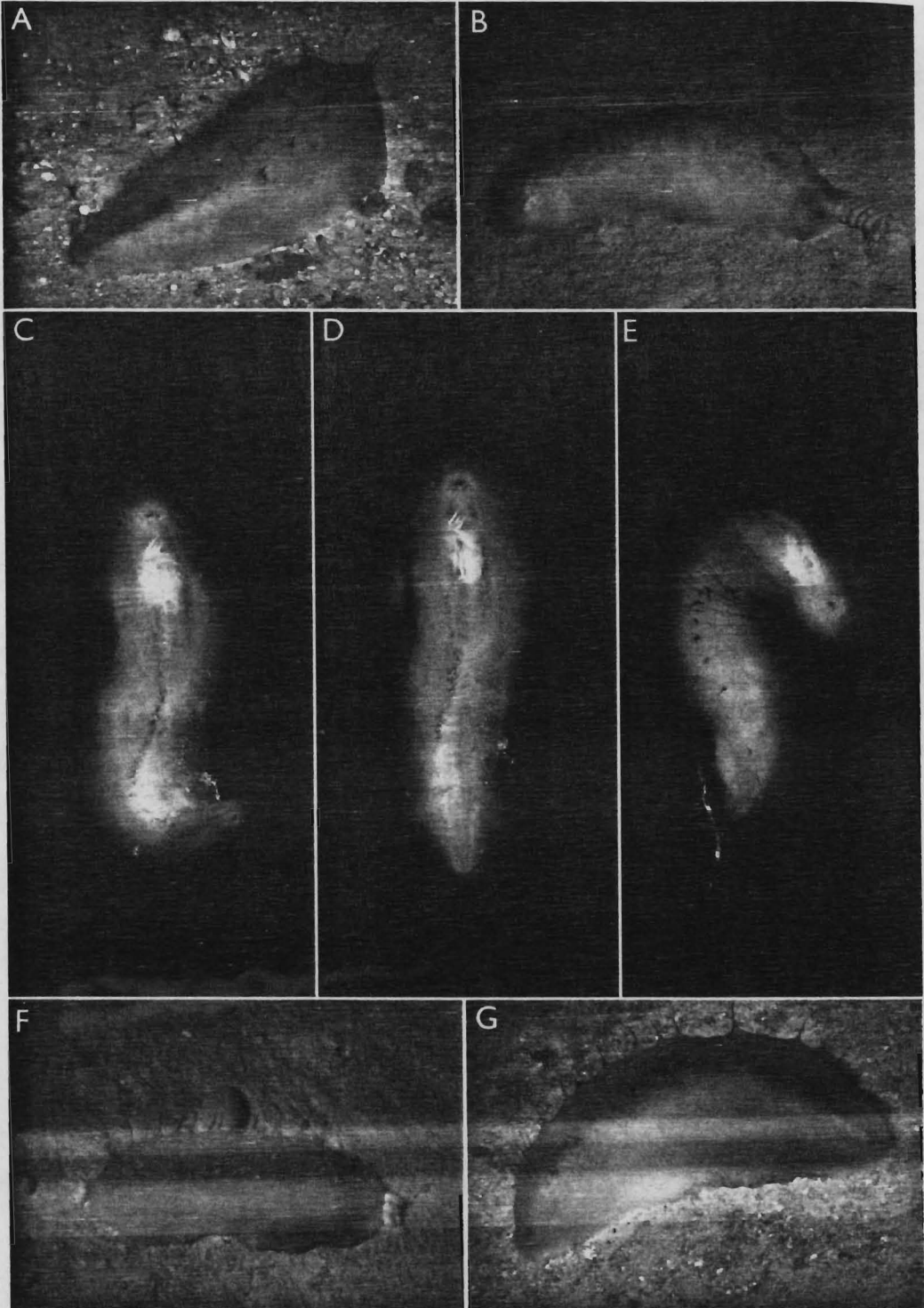
From 1983 to 1988, in collaboration with Dr. Gordon Hendler (Los Angeles County Museum—LACM) and Porter M. Kier (Director Emeritus, National Museum of Natural History, Smithsonian Institution—SI), we studied the composition and ecology of the echinoderm fauna of the bathyal slopes of the Bahama Islands using the research submersibles *Johnson-Sea-Link* (JSL) I and II (Harbor Branch Oceanographic Institution, Inc.—HBOI). A total of 84 dives was made to depths of 200–904 m, and the diverse echinoderm fauna, comprising at least 180 conspicuous species, was sampled, photographed, and videotaped. Of the 10 bathyal holothurian species encountered, one of the most common proved to be a new genus and species of the Family Synallactidae. In April 1989, after this paper was accepted for publication, the authors participated in a JSL expedition to the Lesser Antilles, and this new species was again observed, on seven of 10 dives conducted off the west coast of St. Vincent. It is of particular interest for it has the ability to swim when disturbed. It is a facultative swimming species (*sensu* Miller & Pawson 1990) whose swimming behavior is described in detail elsewhere (Miller & Pawson 1990).

The Family Synallactidae has a worldwide distribution in bathyal and abyssal depths, and at present it comprises approximately 15 genera and 120 species. Synallactid genera and species are usually difficult to characterize, and the family is in urgent need of a thorough revision. Under these circumstances we are reluctant to erect a new genus for the species described here, but its unique diagnostic features preclude referral of the species to any of the existing confamilial genera.

#### Methods

The JSL submersibles carry four passengers to a maximum depth of 904 m for 3–5 h per dive. Each submersible is equipped with an array of sophisticated tools that allow the occupants to sample, photograph, and videotape benthic or pelagic organisms. During a dive, several environmental parameters, for example temperature, conductivity and depth, are automatically monitored and recorded at intervals preselected by the scientist. Additional information on the submersibles can be found in Askew (1984).

For in situ photography, we used a laser-aiming device (Fig. 2, U.S. Patent #4,



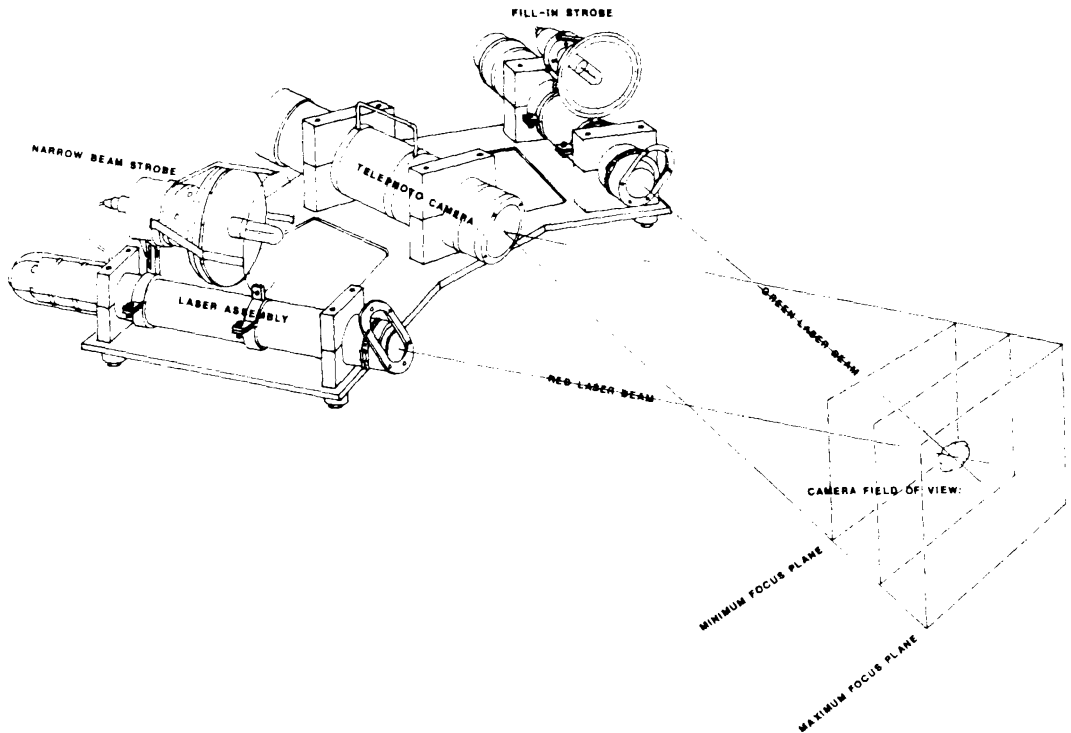


Fig. 2. Diagram of laser-aimed camera system (U.S. Patent #4,777,501) developed for the *Johnson-Sea-Link* submersibles to photograph benthic organisms at bathyal depths.

777,501) developed by HBOI engineers to aim and focus a Benthos camera system (Model 372) on the animals being studied. A detailed description of the laser-aiming system is found in Caimi & Tusting (1987). Because the distance between the film plane and the subject photographed remained constant throughout a dive, we were able to calculate the exact field of view in each photograph and thereby determine the precise length of living specimens prior to collection.

Order Aspidochirotida Grube, 1840  
Family Synallactidae Ludwig, 1894  
*Hansenothuria*, new genus

*Diagnosis.* — Body fragile, translucent, semi-cylindrical, tapering gently anteriorly and posteriorly, four to five times as long as broad. Ventral surface flat, body arched, middorsal interradiial area depressed. Ventrolateral margin fringed with short to long papillae joined by continuous brim; brim broadest anteriorly, where component po-

Fig. 1. *Hansenothuria bentii*, new genus and species. *In situ* photographs—A. French Bay, San Salvador Is., JSL-I-2005, 694 m, TL = 20.3 cm; B. off Plana Cays, JSL-I-2274, 829 m, TL = 17.2 cm; C–E, swimming postures, off Cockburn Town, San Salvador Is., JSL-I-2331, 649 m, TL = 23.0 cm, bright streak to left of posterior end of specimen in E is sediment-laden mucus strand shed by active swimming movements; F. Fernandez Bay, San Salvador Is., JSL-I-2048, 759 m, TL = 16.5 cm; G. Fernandez Bay, San Salvador Is., JSL-I-2048, 759 m, TL = 21.5 cm. Photo credit for C–G: C. Young and L. Cameron, HBOI.

Table 1.—Material examined/observed and distribution data for *Hansenoithuria bentii*, new genus, new species.

Dive No	Date	Locality <sup>1</sup>	Coordinates	Depth (m)	No. individuals collected/observed	Total length (cm)	Submersible observers
JSL-II-808	09-IV-84	S of Cross Harbor Pt., Great Abaco Island	25°52.20'N 77°15.5'W	700 699	2	10.8 (PR) 12.5 (PR) <sup>2</sup>	J. Miller M. Flake
JSL-II-813	12-IV-84	N of Egg Island	25°30.85'N 76°55.10'W	739	1	NR	D. Pawson T. Askew
JSL-I-1647	13-VIII-85	NW of Crooked Island	22°47.75'N 74°23.50'W	791	6+	NR	K. Reinhart D. Liberatore
JSL-II-1699	07-XI-85	Fernandez Bay, San Salvador Island	24°03.30'N 74°33.05'W	659	1	12.8 (PO)	L. Cameron M. Flake
JSL-I-1705	10-XI-85	Off Cockburn Town, San Salvador Island	24°04.35'N 74°33.30'W	762 691 711 707	4	10.1 (PO) 13.9 (PO) 14.9 (PO) ≈20 (PO)	L. Cameron D. Liberatore
JSL-I-1904	25-X-86	W of Black Rock	26°14.84'N 77°42.35'W	677	1	NR	L. Cameron C. Caddigan
JSL-I-1960	15-III-87	Off Nassau Harbor, New Providence Island	25°06.47'N 77°20.67'N	657	1	11.2 (PR)	S. Pomponi M. Adams
JSL-I-2005	23-IV-87	French Bay, San Salvador Island	23°55.05'N 74°31.67'W	694	1	20.3 (PO)	D. Pawson M. Adams
JSL-I-2009	25-IV-87	Off Cockburn Town, San Salvador Island	24°03.20'N 74°33.33'W	694	1	10.0 (PO)	J. Miller C. Caddigan
JSL-I-2048	16-V-87	Fernandez Bay, San Salvador Island	24°03.30'N 74°33.10'W	759	2	16.5 (PO) 21.5 (PO)	L. Cameron M. Adams
JSL-II-1497	18-X-87	Off Morgan's Bluff, Andros Island	25°12.20'N 77°59.93'W	639	1	NR	G. Hendler T. Askew
JSL-II-1503	22-X-87	Off Nassau Harbor, New Providence Island	25°06.43'N 77°23.81'W	666 744	2	18.0 (PO) 18.4 (PO)	L. Cameron M. Adams
JSL-II-1515	27-X-87	N of Egg Island	25°30.85'N 76°55.10'W	691	many	1 measured 18.4 (PO)	C. Young M. Adams
JSL-I-2264	13-IX-88	Off Riding Rock, San Salvador Island	24°03.61'N 74°33.37'W	903 904 895	3	8.0 (PR) 12.0 (PR) 15.0 (PR)	D. Billett D. Liberatore

Table 1.—Continued.

Spec No	Date	Locality	Coordinates	Depth (m)	No. individuals collected/observed	Total length (cm)	Submersible observers
JSI-I-2274	18-IX-88	W of Plana Cays	22°36.5'N 73°38.6'W	829 821 817 814	5	17.2 (PO) 20.3 (PO) 21.5 (PO) 2 (NR)	G. Hendler C. Caddigan
JSI-I-2331	21-X-88	Off Cockburn Town, San Salvador Island	24°02.50'N 74°32.35'W	649	1	23.0 (PO)	L. Cameron D. Liberatore
JSI-I-2332	21-X-88	Off Cockburn Town, San Salvador Island	24°02.50'N 74°32.35'W	644	1	NR	J. Piraimo D. Liberatore
JSI-I-2340	25-X-88	N of Egg Island	25°27.52'N 76°54.32'W	610	1	NR	B. Bingham D. Liberatore

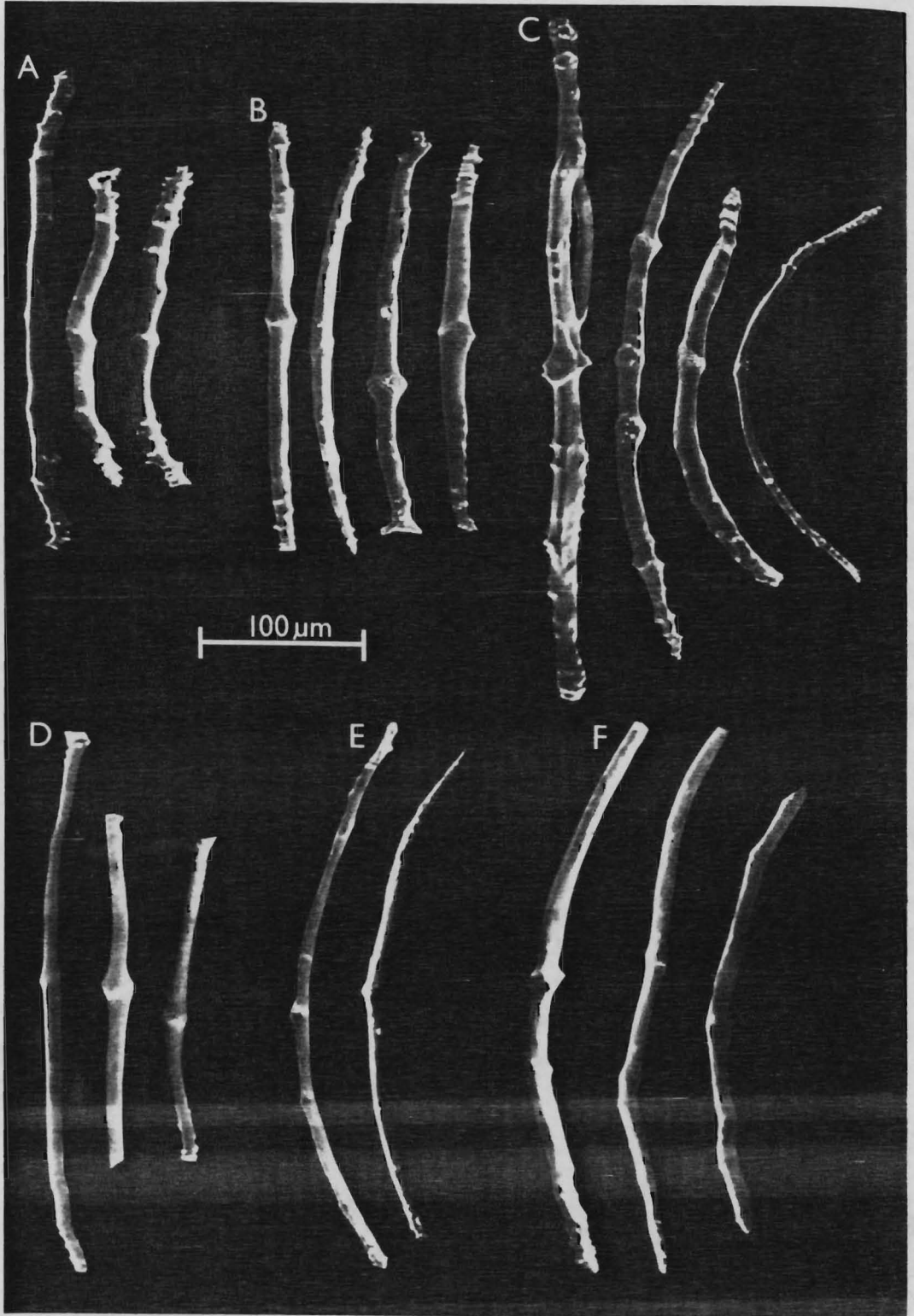
1— all localities in the Bahama Islands; St. Vincent data not included here.

2— selected as holotype; TL of live specimen = ≈20 cm.

NR— not recorded

PO— TL determined from seafloor photograph.

PR— TL determined from preserved material.



dia may reach 25 mm length. Midventral radius naked; ventrolateral radii with numerous, minuscule hair-like feet in two or three rows. Each lateral dorsal radius with 10–31 short (15 mm), sharply pointed papillae arranged in slightly zigzag row. Excepting endplates in ventral feet, ossicles exclusively simple rods, occurring only in tentacles, papillae and feet. Gonad as two tufts of tubules, one to each side of dorsal mesentery.

*Remarks.*—*Hansenothuria* superficially resembles some species of the genera *Bathyploetes* Östergren, 1898 and *Paelopatides* Théel, 1886 in body shape and in possessing a marginal brim that aids in swimming but it differs from these genera, and most other synallactid genera, in possessing very simple body wall ossicles. *Hansenothuria* further differs from *Bathyploetes* in having a dorsally positioned anus, and from *Paelopatides* in lacking feet along the midventral radius. Ossicles appear to be consistently absent from *Benthothuria* Perrier, 1898 and *Paroriza* Herouard, 1923; neither of these genera seems to bear any close relationship to *Hansenothuria*.

*Type species.*—*Hansenothuria benti*, new species, designated herein.

*Etymology.*—The genus name is of feminine gender. This holothurian is named for our friend and colleague, the late Dr. Bent Hansen, Zoological Museum, Denmark, in recognition of his superb contributions to our knowledge of deep-sea holothurians.

### *Hansenothuria benti*, new species

Figs. 1, 3; Tables 1, 2

*Diagnosis.*—As for the genus. Color in life variable, light blue to pale purple; dorsal papillae translucent to black.

*Material examined.*—Collection and locality data for the Bahama Islands specimens/photographs studied during our dives aboard *Johnson-Sea-Link* I and II are presented in Table 1. Due to the delicate nature of this species, it was difficult to preserve; accordingly only a few specimens collected preserved well enough to be catalogued as museum material. The following specimens have been deposited at the National Museum of Natural History, Smithsonian Institution (USNM), the Indian River Coastal Zone Museum, HBOI (IRCZM) or the Los Angeles County Museum of Natural History (LACM).

Holotype: USNM E38201, 12.5 cm total length (TL), JSL-II-808, 699 m.

Paratypes: one specimen, USNM E38202, 10.8 cm TL, JSL-II-808, 700 m; one specimen, USNM E38203, 10.0 cm TL, JSL-I-2009, 694 m; one specimen, USNM E38204, 8.0 cm TL, JSL-I-2264, 903 m; one specimen, IRCZM 71:00447, 12.0 cm TL, JSL-I-2264, 904 m; two specimens, USNM E38205, too damaged to measure, JSL-I-2274, 814 m; one specimen, USNM E38206, 20.3 cm TL, JSL-I-2274, 821 m; USNM E38207, 21.5 cm TL, JSL-I-2274, 817 m; one specimen, LACM 88-205.1, 15.0 cm TL, JSL-I-2264, 895 m.

*External morphology.*—Subcylindrical species of moderate size; 13–23 cm TL in life, approximately four to five times as long as broad (Fig. 1D). Body fragile; body wall thick, gelatinous, transparent; internal structures (intestine, Fig. 1A, G; gonad, Fig. 1C–E) usually visible through body wall. Anterior and posterior ends gently tapering; anterior end high, bluntly rounded (Fig. 1B), posterior end low, narrowed to form short “tail” (Fig. 1A). Ventral surface a flattened sole with minute, hairlike tube feet along

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Fig. 3. Scanning electron micrographs of skeletal ossicles from *Hansenothuria benti*: A–C (holotype of 12.5 cm TL, measured preserved) A, Rods from dorsal papillae; B, Rods from ventrolateral papillae; C, Rods from tentacles; D–F (paratype of 10 cm TL, measured from seafloor photograph) D, Rods from dorsal papillae; E, Rods from ventrolateral papillae; F, Rods from tentacles.



Table 2.—Length of skeletal rods in appendages of *Hansenothuria bentii*. n, number of ossicles measured;  $\bar{x}$ , mean; SD, standard deviation; ossicles taken from holotype, 12.5 cm TL (preserved length).

Length ( $\mu\text{m}$ ) of rods from:	n	$\bar{x}$	SD	Range
Lateral papillae of brim	25	155.6	34.4	109.3 – 230.2
Dorsal papillae	25	180.5	41.1	109.3 – 260.5
Ventrolateral feet	25	226.6	59.3	114.0 – 376.7
Tentacles	25	266.6	67.6	178.8 – 423.5

lateral radii (Fig. 1C–E); midventral radius naked. Ventrolateral margin composed of brim of webbed podia (Fig. 1F). Brim widest at anterior and posterior ends of body (Fig. 1D). Bodywall high with steep-sloping sides; dorsal interradius distinctly sunken, forming shallow trough between radii (Fig. 1A). Each dorsal radius with 10–31 slender, hair-like papillae with pointed tips (Fig. 1A, B, E–G). Papillae regularly spaced in slightly zigzag rows, extending along length of body. Number of papillae per radius tending to increase with size of specimen. Papillae completely contractile, varying in length up to 15 mm. Mouth ventral, at extreme anterior end (Fig. 1C–E), surrounded by 20 peltate tentacles. Tentacles, short, with thick trunks, terminating in flat, circular disks. Anus dorsal, situated just above posterior brim (Fig. 1C).

*Internal anatomy.*—Holotype (USNM E38201) and one paratype (USNM E38202) dissected to examine internal features; both specimens lacking intestinal tract and respiratory trees. *Holotype* (male): Two bulbous polian vesicles attached to circum-oral water ring. Gonad in 2 tufts, one on each side of dorsal mesentery; each tuft with upwards of 10 tubules, some branching 2–3 times, others unbranched. Tubules extending posteriorly for two-thirds length of body cavity. Radial longitudinal muscles unequally developed: dorsal muscles larger than ventral.

*Paratype* (female): Gonad apparently fully developed, tubules up to 30 mm TL. Tubules swollen throughout length, filled with

eggs in germinal vesicle stage. Eggs dense, yolky, subspherical; measuring up to 600  $\mu\text{m}$  in diameter. Longitudinal muscle bands divided; those to either side of dorsal mesentery with four bundles of strands; remaining three bands with two bundles each.

*Ossicles* (see Table 2 for measurements).—Only two ossicle types occur in body wall. Simple rods present in dorsal papillae (Fig. 3A, D), papillae of lateral brim (Fig. 3B, E), tentacles (Fig. 3C, F), and ventral feet. Rods straight to curved, with one or more enlarged areas near middle, and few to several spinules near ends. Average length of rods from tentacles and ventral feet considerably longer than those from dorsal and lateral papillae (Table 2). Delicate end plate ossicles, composed of two or more pieces, in tube feet; plates have polygonal perforations and irregular, scalloped margins.

*Coloration.*—Bodywall coloration varying from light blue to pale purple; smaller specimens generally lighter colored than larger individuals. Marginal brim of webbed papillae appears transparent (Fig. 1F), usually lacking pigment. Black flecks scattered on dorsal surface, especially along mid-dorsal interradius and on dorsal papillae. Fully extended dorsal papillae grey; contracted papillae appear black. Ventrally, bodywall transparent to white with scattered black flecks along each lateral radius and on some tube feet (Fig. 1C, D). Tentacles white; gonadal tubules, visible through body wall posterior to mouth on ventral surface (Fig. 2C–E), also white.

*Habitat.*—All specimens collected or ob-

served at the Bahamas (see Table 1) occurred in the upper bathyal zone (639–904 m) on slopes ranging from ca. 5°–60°. Sediment composition at collecting sites varied from a thin layer of biogenic sand covering a limestone pavement to a thick layer of silty sand with scattered coral and algal (*Halimeda* spp.) rubble. Off the west coast of St. Vincent, *H. benti* was encountered at depths of 363–447 m, on fairly steep slopes (ca. 30°–50°) covered with terrigenous silty sand.

*Distribution.*—*Hansenothuria benti* is at present known from the Bahama Islands at depths of 639–904 m, and from St. Vincent in the Lesser Antilles at depths of 363–447 m. Our submersible observations were restricted to depths of less than 904 m; it is likely that the species occurs at greater depths and on bathyal slopes of other Caribbean islands.

*Behavior.*—Swimming specimens of *Hansenothuria benti* were observed and videotaped on several occasions. Swimming activity was at first observed after three specimens were captured by the submersible and placed in collection bins for the ascent to the surface. While in the bin, the holothurians swam by flexing and curling the anterior and posterior ends of their bodies. This behavior continued for at least two hours. On several subsequent dives, swimming *H. benti* were videotaped; this species is a facultative swimmer (sensu Miller & Pawson 1990) which spends the majority of its time on the seafloor, venturing upwards into the water column only in response to physical disturbance, e.g., prodding. No individuals of *H. benti* were swimming when first encountered. Swimming behavior in this species is most likely an adaptation to avoidance of predators or physical hazards, such as sediment slumping. A detailed account of active swimming movements in *H. benti* is provided in Miller & Pawson (1990).

*Remarks.*—Of the 10 holothurian species encountered during our dives in the Baha-

mas, only the pelagothuriid elasipod *Enypniasstes eximia* Théel was found to occur in greater abundance than *Hansenothuria benti* at the depths studied. C. Young and L. Cameron (HBOI, pers. comm.) report seeing as many as six or seven individuals within an area of approximately 225 m<sup>2</sup> (the estimated area visible to the occupants of the JSL's forward compartment when visibility is 15 m). At St. Vincent, *H. benti* is a common component of the megabenthos; it was the most frequently observed holothurian on our dives, with densities reaching a peak of four to six individuals/10 m<sup>2</sup>.

Because *H. benti* is a relatively large and common component of the epibenthic invertebrate fauna, it might seem surprising that no individuals of this species were taken by earlier workers sampling the seafloor with dredges and trawls. The explanation for this may lie in the fact that even specimens collected with care by the submersible and carried to the surface in seawater-filled containers arrive aboard ship in very poor condition. During the journey from the seafloor to the surface, the holothurian's epidermal and dermal tissues begin to slough off, and frequently the entire external body-wall is completely autotomized, leaving internal organs surrounded by the longitudinal and circular muscle layers.

#### Acknowledgments

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technology at HBOI for supplying us with specimens, photographs, videotapes, and locality data of *Hansenothuria benti* from their submersible programs. Funding for submersible dives was granted through the following organizations (principal investigators listed in parentheses): HBOI (J. Miller, C. Young, S. Pomponi); National Science Foundation (C. Young, L. Cameron); Smithsonian Institution (J. Miller, D. Pawson). The following HBOI employees are gratefully acknowledged for their patience and perseverance in developing the laser-aimed camera system used in this research: F. Caimi, C. Chulamanis, T. Couture, C. Tietze, R. Tusting, T. Smoyer, HBOI, was most helpful in producing the color plate (Fig. 1). Figure 2 was rendered by J. Hastings, HBOI. P. Linley, HBOI, assisted with photography of the ossicles (Fig. 3). This paper is HBOI Contribution No. 714 and Smithsonian Institution Marine Station at Link Port Contribution No. 247. Contribution No. 14—Studies on bathyal echi-

nodermis of the Bahama Islands, J. E. Miller (HBOI), Principal Investigator.

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