

Terrace II younger or recurrent movement of the lower thrust which has deformed and tilted this terrace, possibly within the last 10,000 years.

#### LITERATURE CITED

HAZZARD, J. C.

1944. Some features of Santa Susana Thrust, vicinity of Aliso Canyon Field, Los Angeles County, California, *Amer. Assoc. Petroleum Geologists Bull.*, 28:1780-1781.

JENNINGS, R. A.

1957. *Geology of the southeastern part of Oat Mountain Quadrangle and adjacent parts of the San Fernando Quadrangle*. Unpublished M. A. Thesis, University of California, Los Angeles, 105 p.

## HOLOTHURIANS OF THE GENERA *ELPIDIA* AND *KOLGA* FROM THE CANADIAN BASIN OF THE ARCTIC OCEAN

CANDIDO P. AGATEP

Allan Hancock Foundation  
University of Southern California  
Los Angeles, California 90007

A number of bottom samples taken from the drifting ice station *Arlis II* (Arctic Research Laboratory Ice Station 2) as it drifted across the Arctic Basin included representatives of two genera of elaspodid holothurians, *Elpidia* and *Kolga*. These specimens were found at two stations: 298 (Shirley) and 380 (Brusca), in the Canadian Basin, a subdivision of the Arctic Basin. At station 298 the sixty-four specimens found appear to be the typical subspecies of *Elpidia glacialis* Theel and the fifty-seven animals from station 380 are *Kolga hyalina* Danielssen and Koren. These animals were collected by the use of a Menzies Trawl (Menzies, 1964) which employs a net with mesh opening of about 0.5 mm.

Specimens are deposited in the collections of the Allan Hancock Foundation, University of Southern California, Los Angeles, California.

*Elpidia glacialis glacialis* Hansen 1956

Figures 1 and 2

Hansen 1956, pp. 34-38, fig. 1-6.

*Material examined:* Station 298 (Shirley) Arctic Basin, Lat. N. 84°21'7", Long. E. 170°48', depth 3175 meters, sixty-four complete specimens.

*Description:* Specimens ovate, slightly more than twice as long as broad, length ranging from 8 to 15 mm. Body semicircular in cross section. Mouth located anteroventrally, surrounded by ten small tentacles, the ends of which have two large retractable processes on outer margins; processes in most of specimens are clearly visible on five dorsal tentacles. Anus posterior. Dorsal surface convex, tapering slightly towards posterior; ventral surface flat. Dorsal surface with three pairs of well developed papillae (Fig. 1 A). On a 15 mm.-long specimen members of first pair of papillae, located at anterior end, over 3 mm. in length; those of second pair, just behind level of first pair of tubefeet are smallest, 2 mm.; last pair lie between levels of the third and fourth pairs of intermediate tubefeet. In an 8 mm.

specimen dorsal papillae almost half as long as in 15 mm. specimen. Lengths of dorsal papillae also correspond to size of animal. Dorsal papillae were luminescent when specimens were freshly collected (Delton Shirley, *pers. comm.*). Midventral radius naked, while ventrolateral surface carries four pairs of tubefeet of which two middle pairs larger than first and last pairs.

Skin rough, transparent. Color in alcohol white.

Calcareous deposits in integument small rods of varying length which have four arms near center, one from each side, and two very short processes projecting outward (Figs. 1 B and C). Main rods four long and more or less straight while arms short. Some spicules lack shorter processes while a few large spicules have an extra process on either end of main rod (Fig. 1 C).

Calcareous ring corresponds closely to the description by Theel (1882), being composed of five spicules each with four pairs of bilaterally symmetrical arms. They surround gullet with ends of outer arms joined together and inner arms lying side by side with arm of adjacent spicule, forming a delicate network (Fig. 1 D). Single polian vesicle oval, transparent. Gonad composed of slightly long branching tubules.

*Remarks:* All sixty-four specimens in the collection have the same number and position of the dorsal papillae. Theel's (1876) specimen taken between Australia and Antarctica has three pairs of dorsal papillae, the second pair situated at the middle while the first and third pairs are located near both ends of the dorsal surface. Although Theel (1876) considered the small number of dorsal papillae in his specimen to be insignificant variation from the "typical" form of *E. glacialis*, Hansen (1956) subsequently recognized this form as a subspecies, on the basis of much additional material. *Elpidia glacialis sundensis* Hansen has three pairs of dorsal papillae arranged in the same manner as that of the above specimen (Fig. 1 F). *Elpidia glacialis glacialis* Hansen (Fig. 2 A) has three to five pairs, two or four near the anterior end of the body and one near the posterior end. *Elpidia glacialis solomonensis* Hansen, however, has spicules closely similar to those of specimens described in this paper, but otherwise differs in having six to eight pairs of dorsal papillae (Fig. 2 F). *Elpidia glacialis theeli* Hansen (Fig. 2 D) and *Elpidia glacialis kermadecensis* Hansen (Fig. 2 A) differ from the specimens described above both in the number and arrangement of the dorsal papillae and shape of the spicules.

Specimens collected near the Kara Sea (Schorygin, 1948) have

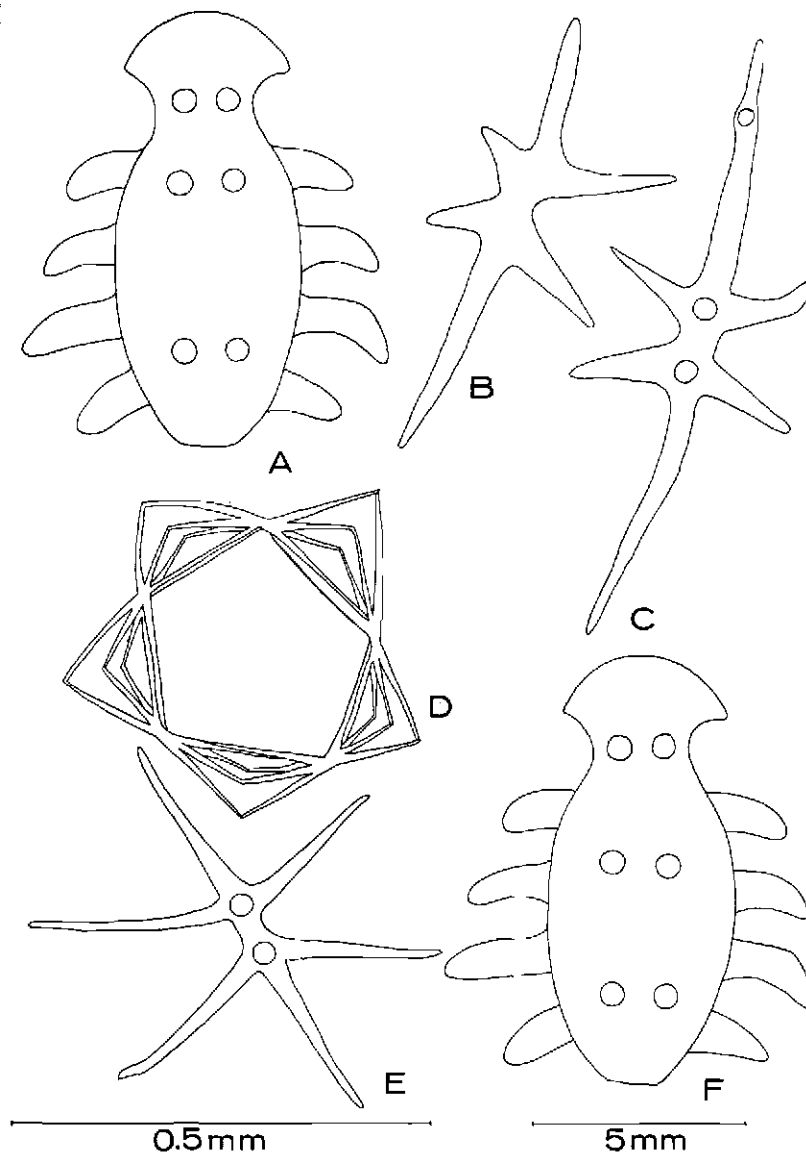


Figure 1. 5 mm. for whole animals only; 0.5 mm. for spicules only. A. *Elpidia glacialis glacialis*, Arctic Basin, showing dorsal aspect; B-C. *E. g. glacialis*, spicules from body wall; D. *E. g. glacialis*, calcareous ring; E. *E. g. sundensis*, Sunda Trench, showing spicule from body wall (taken from Galathea Report); F. *E. g. sundensis*, dorsal aspect.

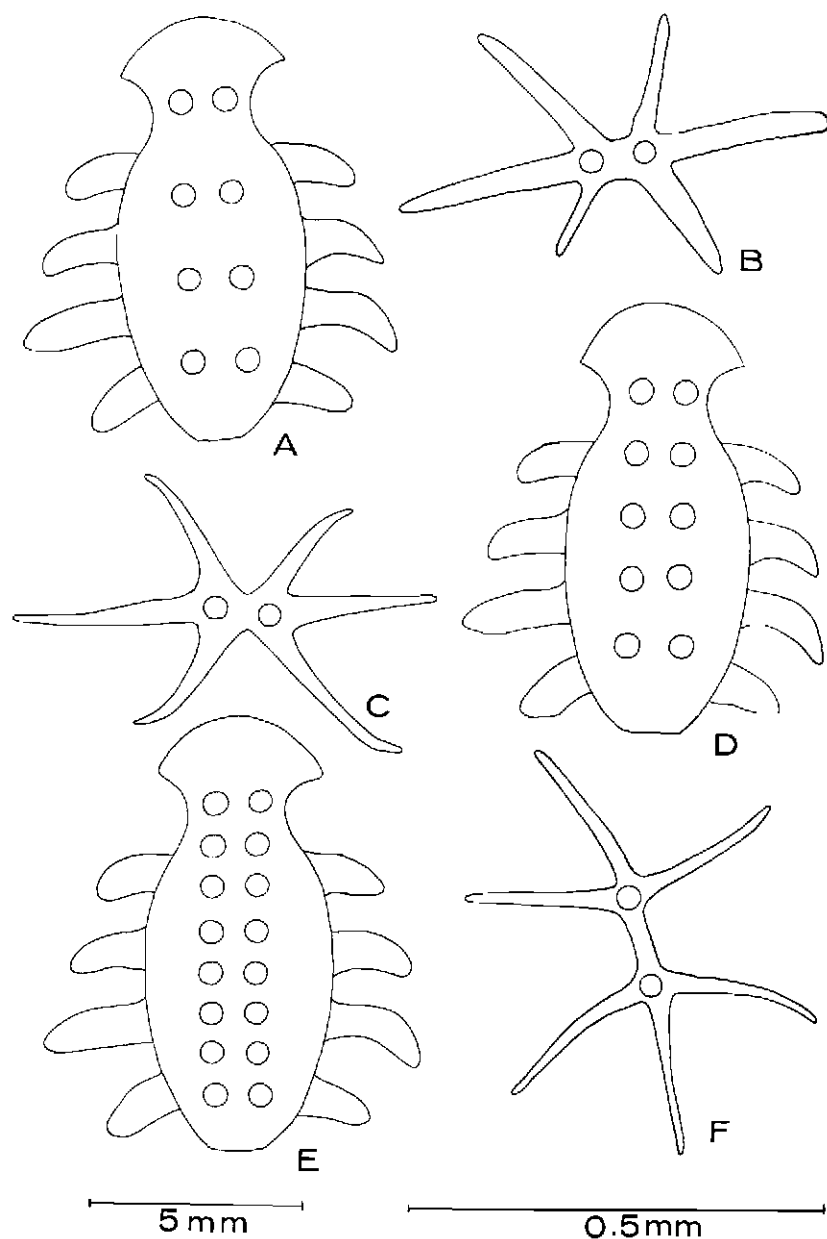


Figure 2. 5 mm. for whole animals only; 0.5 mm. for spicules only. A. *Elpidia glacialis kermadecensis*, Kermadec Trench, showing dorsal aspect; B. *E. g. kermadecensis*, spicule from body wall (taken from Galathea Report); C. *E. g. solomonensis*, New Britain Trench, showing spicule from body wall (taken from Galathea Report); D. *E. g. theeli*, Tasman Sea, showing dorsal aspect; E. *E. g. solomonensis*, dorsal aspect; F. *E. g. theeli*, spicule from body wall (taken from Galathea Report).

four pairs of dorsal papillae, three pairs on the anterior and one pair near the posterior end. In another collection taken in the Kurile-Kamchatka Trench (Diakonov, 1955) specimens have four pairs of dorsal papillae equi-distant from each other, two pairs anterior and two pairs posterior. Schorygin's are similar to *E. glacialis glacialis*, Diakonov's to *E. glacialis kermadecensis*.

Variation of the dorsal papillae of *E. glacialis* of the "Ingolf" and "Godthaab" collections has been thoroughly studied by Heding (1942). The "Ingolf" specimens collected from the deep water of the Norwegian Sea and together with specimens from "Godthaab" station 54 occupied in the deep parts of Baffin Bay have normally four pairs of dorsal papillae, three pairs on the anterior and one pair on the posterior end. Heding (1940) has shown further, in his study of the "Valdivia" specimens taken in 24°35'3" N, 17°4'7" W, that the animals agree in number and arrangement of the dorsal papillae with those of the "Ingolf" collections. Theel (1876) reported that the specimens collected by the Swedish Arctic Expedition from the Kara Sea have four pairs of dorsal papillae arranged in the same manner as those specimens of Schorygin and Diakonov.

Heding (1942) observed that there is distinct variation in the number and arrangement of the dorsal papillae of *E. glacialis* between the two above collections and also with the depth at which the animals live. Specimens taken from shallow water or close to shore, as specimens from the Baffin Bay, have five pairs, four anteriorly and one posteriorly. However, animals collected from deep water of Baffin Bay usually have four to five pairs of dorsal papillae, three to four anterior and one posterior.

It is interesting to note that none of the specimens from the "Godthaab" collections taken from the deep water in Baffin Bay show the characteristics of the Arlis II specimens. The same is true for specimens collected from the Kara Sea which were described by Theel (1876) and animals taken from the Barent and Kara Sea (Schorygin, 1948).

The differences between the specimens of Arlis II and those of the previously described subspecies of *Elpidia glacialis* are insufficient to warrant a separate subspecific status. It is, therefore, the best course to refer these specimens to the subspecies *glacialis* as they are similar to one another. To accommodate these animals, it is necessary to amend the number of dorsal papillae in the key of *Elpidia glacialis glacialis* from the original 3 to 4 and 1, to 2 to 4 and 1 respectively. The key to the subspecies would be as follows (Hansen, 1956):

- A. Dorsal papillae large, body vaulted.
1. Dorsal papillae divided into an anterior and a posterior group, with 2 to 4 and 1 pairs respectively. . . . .  
     . . . . . *Elpidia glacialis glacialis* Hansen 1956:38.
  2. Three pairs of dorsal papillae, placed on the head, the mid part, and the hind part of the body, respectively. . . . .  
     . . . . . *Elpidia glacialis sundensis* Hansen 1956:35.
- B. Dorsal papillae small and regularly distributed; body depressed.
- I. Spicules with very high vertical apophyses.
    3. 5 to 7 pairs of dorsal papillae, with violet spots. . . . .  
     . . . . . *Elpidia glacialis theeli* Hansen 1956:37.
  - II. Spicules with low vertical apophyses.
    4. 4 to 6 pairs of dorsal papillae. . . . .  
     . . . . . *Elpidia glacialis kermadecensis* Hansen 1956:36.
    5. 6 to 8 pairs of dorsal papillae. . . . .  
     . . . . . *Elpidia glacialis solomonensis* Hansen 1956:35.

*Kolga hyalina* Danielssen and Koren

Danielssen and Koren, 1882, pp. 3-20, Tab. I, fig. I-II, Tab. II, fig. 12-25, Tab. III, fig. 26-30.

Theel 1882, p. 3.

*Material examined:* Station 380 (Brusca) Arctic Basin, Lat. 80°37' 4"N, Long. 173°14' E, depth 2850 meters, fifty-seven specimens.

*Description:* Body elongated oval, about three times as long as broad; mouth anteroventral; anus posterodorsal. Tentacles ten, with terminal parts divided into four knobs; each knob divided into two smaller processes.

Dorsal surface convex with three pairs of closely set papillae in slightly curved row on anterior margin; center pair slightly larger than others. Ventral surface flat, with fourteen pairs of tubefeet arranged symmetrically along sides.

Calcareous ring and calcareous deposits are described by Danielssen and Koren (1882) and Theel (1882). Color in alcohol white.

*Remarks:* This species is distributed not only in the Arctic Ocean (Theel, 1882; Danielssen and Koren, 1882) but also the Antarctic Ocean as collected by the *Eltanin*, station 913, Lat. 65°48'-65°38' S, 115°00'-114°55' W, depth 4473 meters and station 1148, Lat. 65°14'3"-65°25'3" S, Long. 117°29'5"-117°29' W, depth 4850.

## ACKNOWLEDGMENTS

For access to the specimens described in this paper, I am grateful to Dr. John L. Mohr, principal investigator, University of Southern California. I wish to thank Dr. David L. Pawson, Division of Echinoderms, United States National Museum and Dr. Bent Hansen, Zoological Museum, Universitetsparken, Copenhagen, Denmark for their help and advice. I am grateful to Mr. Stephen R. Geiger, University of Southern California, for his helpful advice, to Messrs. Delton Shirley and Gary Brusca who collected the specimens and to Mr. A. Charles Gross for technical assistance. Work was supported by a contract NONR 228(19), NR 307-270 between the office of Naval Research, Department of the Navy and the University of Southern California, Los Angeles, California and by a grant (G-19497) from the National Science Foundation.

## LITERATURE CITED

- DANIELSSEN, D. C. and J. KOREN  
 1882. Holothurioidea. *Norwegian North-Atlantic Expedition 1876-1878*, 4: 94 p.
- DIAKONOV, A. M.  
 1955. Echinodermata. *Observational Data of the Scientific Research Drifting Station of 1950-1951*, 2: Sec. 4, p. 24.
- HANSEN, B.  
 1956. Holothurioidea from depths exceeding 6000 meters. *Galathea Report*, 2: 33-35.
- HEDING, S. G.  
 1940. Holothurien II. *Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition*.  
 1942. Holothurioidea II. *Danish Ingolf Expedition*, 4: 1-39.
- MENZIES, R. J.  
 1964. Improved technique for benthic trawling at depths greater than 2000 meters. In *Biology of the Antarctic Seas, Antarctic Research Series*, 1: 93-109. Amer. Geophysical Union, Publ. 1190 (Washington).
- SCHORYGIN, A. A.  
 1948. Echinodermata. *Fauna and Flora of the Northern Seas of the U.S.S.R.* Moskva, Gosudarstvennoe isdatelstvo Sovetskkaia Nauka, pp. 465-495.
- THEEL, H.  
 1876. Memoire sur l'*Elpidia*, nouveau genre d'Holothuries. *Svenska vetenskapsakademien Handlingar*, n. f., 14: 3-30.  
 1882. Holothurioidea. *Report on the Scientific Results of the Exploring Voyage of H.M.S. Challenger 1873-76*, Zoology 4 (Pt. 2): 1-176.