

ON *BOCCARDIA HAMATA* (WEBSTER), NEW COMBINATION  
(POLYCHAETA, SPIONIDAE)

JAMES A. BLAKE<sup>1</sup>  
Biology Department  
Fresno State College  
Fresno, California

INTRODUCTION

During the summer of 1964 studies were conducted on spionid polychaete larvae taken from plankton hauls at Morro Bay, California. Conspicuous larvae of a certain polydorid metamorphosed in the laboratory. They were first identified as *Polydora hamata* Webster which is known from the Atlantic and Gulf coasts of the United States but not the Pacific coast. These young worms (up to 34 segments) possessed branchiae on segments 7 to 12 (characteristic of the genus *Polydora*), posterior notopodial hooks, and small terminal protuberances on the pygidium (similar to pl. IX, fig. 118 of Webster, 1879a). With continued growth of the organism small branchiae became evident on segments 2, 3, and 6 which indicated the worms belonged to the genus *Boccardia* and had the characteristics of *B. uncata* Berkeley, a well-known Pacific species. Information gained from a subsequent examination of preserved adults of *P. hamata* and *B. uncata* from the Atlantic, Gulf, and Pacific coasts of the United States and *P. uncatiformis* Monro from Uruguay has necessitated the following taxonomic revision.

*Polydora hamata* Webster is herein transferred to the closely related genus *Boccardia*. *Boccardia uncata* Berkeley and *Polydora uncatiformis* Monro are herein placed in synonymy with *Boccardia hamata* (Webster), new combination. Further support for this revision follows a discussion of the adult morphology and ecology of *B. hamata*. The larval development will be presented in a later paper.

ACKNOWLEDGMENTS

This paper represents a portion of a thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts in the Department of Biology at Fresno State College. This study was in part supported by research grant GB-13990 from the National Sci-

<sup>1</sup>Present address: Department of Zoology, University of Maine, Orono, Maine 04473.

ence Foundation. under the supervision of Dr. Keith H. Woodwick. The author is indebted to Dr. Woodwick for supplying laboratory facilities, library materials, and technical assistance and for critically reading this paper. A special debt of gratitude is extended to my wife, Crystal, who assisted in collecting and sorting of specimens.

***Boccardia hamata*** (Webster), new combination

Figures 1-11.

*Polydora hamata* Webster, 1879a, pp. 251-252, pl. 8, figs. 111-116, pl. 9, figs. 117-118; 1879b, p. 119; Hartman, 1944a, pp. 336, 340; 1951, pp. 82-83; 1959, p. 384; Hopkins, 1958, pp. 273-275; Rioja, 1960, pp. 304-306.

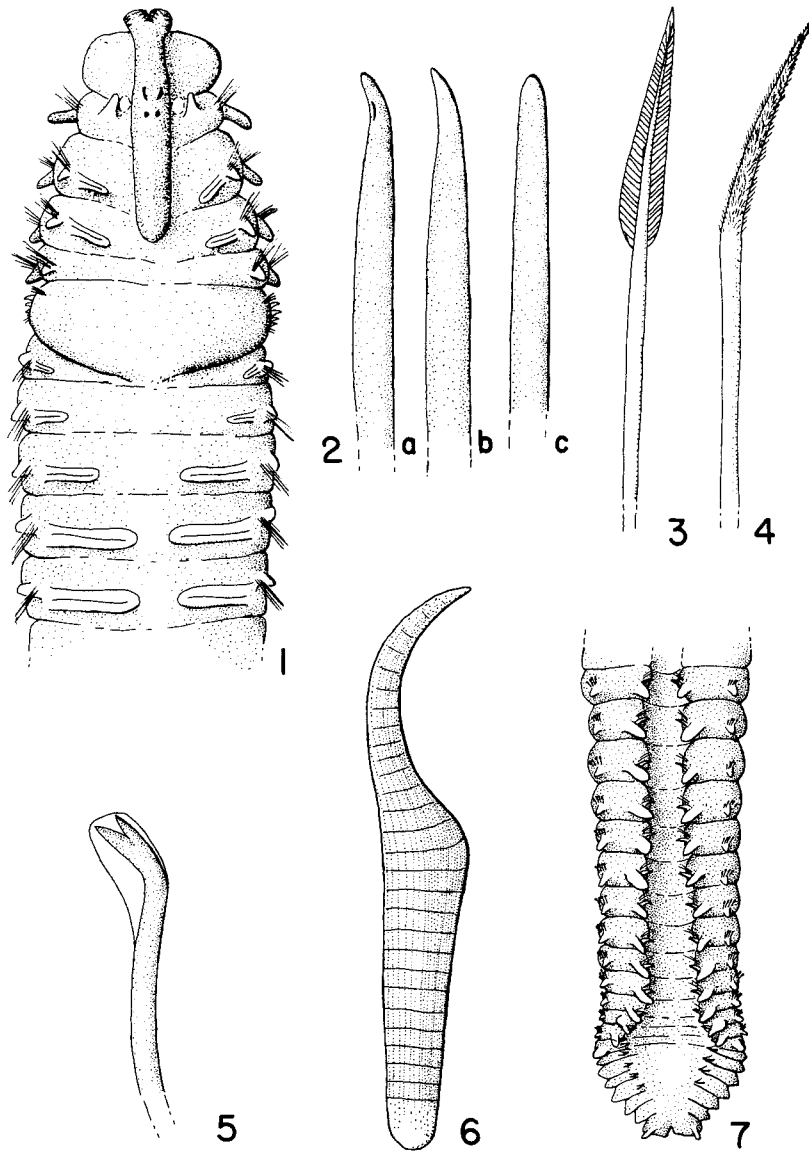
*Boccardia uncata* Berkeley, 1927, p. 418, figs. 9-13; Okuda, 1937 (as *Polydora (Boccardia) uncata*), pp. 238-240, figs. 16-17; Hartman, 1941, p. 304, pl. 48, figs. 46; 1944b, p. 260; 1954, p. 9; 1959, p. 375; 1961, p. 168, pl. 15; Berkeley and Berkeley, 1952 (as *Polydora (Boccardia) uncata*), pp. 14-15, figs. 18-21; Filice, 1958, p. 290; Reish, 1961, p. 86; 1963a, p. 25; 1963b, p. 427; Imajima and Hartman, 1964, p. 281.

*Polydora uncatiformis* Monro, 1938, pp. 311-313, figs. 1-3; Hartman, 1959, p. 385.

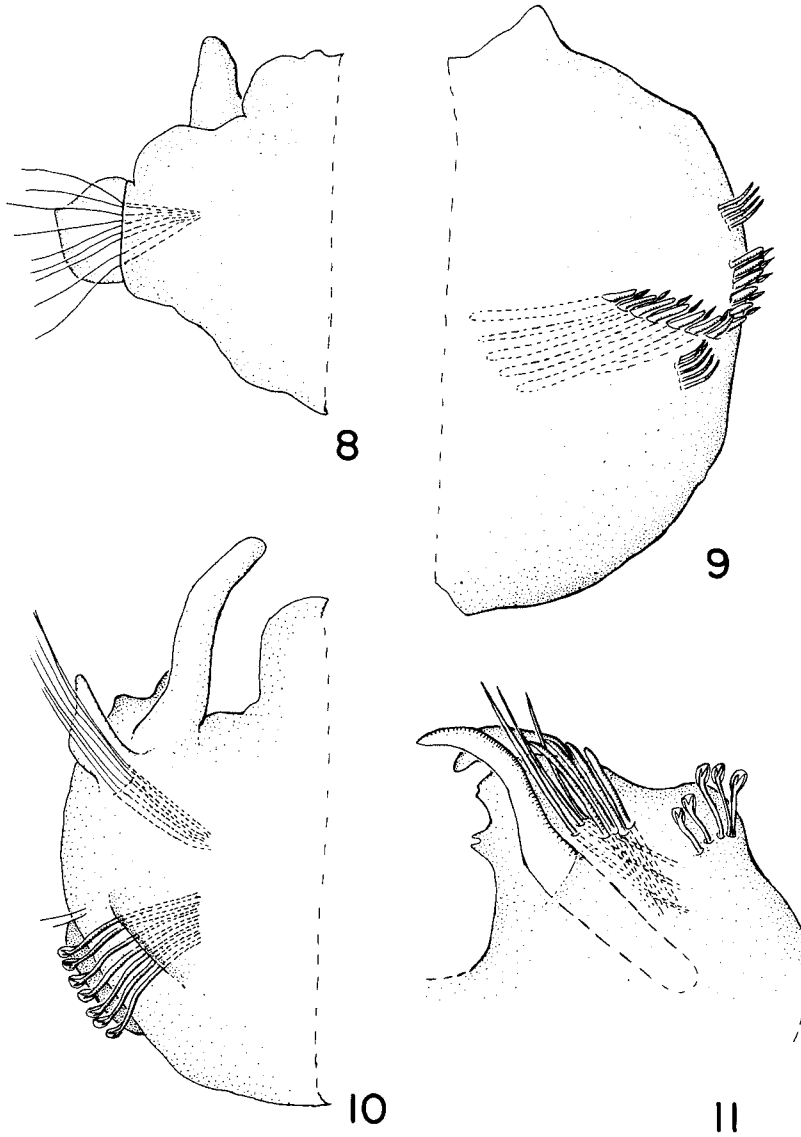
ADULT MORPHOLOGY

The largest specimens from Morro Bay, California were 37.0 mm. long and 0.8 mm. wide and had more than 270 segments. Specimens examined from Atlantic, Gulf of Mexico, and other Pacific localities were shorter and had fewer segments. Branchiae are present on segments 2, 3, 6 and posteriorly throughout most of the body length. The posterior abranchiolate segments bear heavy curved notopodial hooks. Preserved specimens from mud flats are often a muddy brown color possibly because they feed on detrital silt. Preserved specimens from other habitats are flesh colored. Living specimens are light tan and have red blood pulsing through the palps, branchiae, and the dorsal and ventral vessels.

The prostomium is distinctly bifid anteriorly, almost flaring in young specimens (Fig. 1). It expands broadly in the region of the eyes and as a caruncle extends to the posterior border of the third segment. There is no nuchal tentacle. The four eyes consist of a large, irregularly shaped anterior pair and a small, round posterior



*Boccardia hamata* (Webster). *Figure 1.* Anterior end in dorsal view, x 53. *Figure 2.* Modified setae from segment five, seen at different angles, x 280. *Figure 3.* Companion seta from segment five, x 633. *Figure 4.* Superior dorsal seta from segment five, x 633. *Figure 5.* Ventral hooded hook from a posterior segment, x 700. *Figure 6.* Notopodial hook from a posterior segment, x 573. *Figure 7.* Posterior end in dorsal view, x 40.



*Boccardia hamata* (Webster). *Figure 8*. A first parapodium in anterior view, x 100. *Figure 9*. A fifth parapodium in posterior view, x 60. *Figure 10*. A median parapodium in anterior view, x 100. *Figure 11*. A posterior parapodium in posterior view, x 100.

pair. The peristomium is variable in shape, depending upon age and contraction during preservation. In younger specimens the peristomium is narrower than the first segment, but in older specimens and those greatly contracted during preservation it is more truncate and as wide as the first segment. Palpi arise from the peristomium between the first notopodium and the prostomium; they extend back over the dorsum to about segment ten.

The first segment is half as wide as the second. The conical-shaped notopodial lobes are shifted dorsally and come to lie alongside the prostomium (Fig. 8). In some specimens they may stand erect, in others they may fold over. There are no notopodial setae. The neuropodial lobe is laterally located and is flattened on its anterior and posterior sides. When seen dorsally it appears finger-like. A small fan-shaped fascicle of slender capillary setae is present in the neuropodium.

The second and third segments differ from segment one in having well developed notopodial lobes with capillary setae, long finger-like neuropodial lobes, and ventral fascicles with more capillary setae. The branchiae which begin on segment two are only slightly longer than the notopodial lobes, while the branchiae of segment three are at least twice as long as the notopodial lobes.

Segment four lacks branchiae but is similar in other respects to segments two and three. It is somewhat compressed posteriorly by the large fifth segment.

The modified fifth segment is large and well developed, overlapping segment six with a heavy dorsal musculature. Parapodial lobes are absent. The dorsal setae are modified to include a small bundle of superior dorsal geniculate setae (Fig. 4) just above a semi-circle of alternate heavy, modified spines and pennoned companion setae (Fig. 9). The heavy spines have a simple falcate appearance with no accessory structures (Fig. 2). The companion setae have the main shaft extending to the end of the pennon and they are closely interspaced among the heavy spines (Fig. 3). The neuropodium includes only a small tuft of geniculate setae located ventral to the modified dorsal setae.

Segment six is narrower than segment seven. The notopodial lobe and its capillary setae are more ventrally located than on segment seven. The neuropodium is present as an elongated dorso-ventral raised ridge, possessing a fascicle of capillary setae on its anterior side. Branchiae resume on the sixth segment as a small pair, slightly longer than the notopodial lobe.

The bidentate neuropodial hooded hooks are first present on segment seven, continuing throughout the rest of the body. Segments in the middle of the body have hooded hooks with the main fang directed dorsally (Fig. 10), while those at the posterior end are reversed with the main fang directed ventrally (Fig. 11). Anteriorly a small tuft of slender capillary setae accompanies the hooded hooks. The setae diminish in number towards the middle of the body, but increase again in those posterior segments possessing specialized notopodial hooks.

The notopodia from segment eight through the last two-thirds of the worm possess slender capillary setae. In the last 30 segments a dorsal median channel between the notopodia is produced by the dorsal elevation of the parapodia (Fig. 7). Three types of setae are found in each segment of this region; a small bundle of long slender capillary setae, four or five shorter thick capillary setae, and a single large hook curving in towards the midline. This hook is present on the last 20-30 segments of a mature adult. When specimens were placed in a clearing media and mounted on slides numerous cross striations and fine longitudinal lines appeared on the hooks (Fig. 6). These cross striations gave the appearance of overlapping plates. The hooks develop early in the adult life for they are present at about the 21-segmented stage.

The pygidium is composed of two blade-like lappets, each possessing a terminal process (Fig. 7). The processes are variable in size and may be very short, or long and finger-like.

#### DISTRIBUTION AND ECOLOGY

*Boccardia hamata* is known on the Pacific Coast (as *B. uncata*) from British Columbia to Baja California (Berkeley and Berkeley, 1952; Hartman, 1961; Reish, 1963b). It has been reported from oyster beds, estuarine mud, *Dodecaceria* sp. masses, and other littoral conditions. The species is known from Japan, inhabiting mud flats (Okuda, 1937). On the east and gulf coasts of North America it is known to penetrate oyster shells or other gastropod shells (Webster, 1879a-b; Hartman, 1951). It was reported from Uruguay (as *Polydora uncatiformis*), inhabiting brackish water (Monro, 1938).

In central California *B. hamata* inhabits algal holdfasts, hermit crab shells, and estuarine mud. In the holdfasts it constructs tubes in accumulated sand and was the only spionid found in algal holdfasts of *Egregia* sp. collected at Cayucos and *Macrocystis pyrifera* Bory

collected at Monterey. *Boccardia hamata* is found at Cayucos in shells of *Tegula brunnea* (Philippi) inhabited by the hermit crab, *Pagurus granosimanus* (Stimpson). It was associated in those shells with other polydorids including *Boccardia tricuspis* (Hartman), *B. columbiana* Berkeley, *Polydora limicola* Annenkova, and *P. ciliata* (Johnston). In the mud from brackish streams entering Morro Bay it is associated most commonly with the polychaetes *Capitella capitata* (Fabricius), *Hemipodus californiensis* Hartman, *Armandia bioculata* Hartman, *Polydora nuchalis* Woodwick, *Pseudopolydora kempfi* (Southern), *Streblospio benedicti* Webster, and an amphipod, *Corophium* sp. Larvae of *B. hamata* were abundant in the plankton at Morro Bay from June to August, 1964.

#### DISCUSSION

*Polydora hamata* was described by Webster (1879a) from Virginia and New Jersey (1879b). The co-type collection is from Great Egg Harbor, New Jersey (USNM 377). Webster found *P. hamata* inhabiting bivalve shells. Recently it has been reported by Hartman (1951) and Hopkins (1958) from the Gulf of Mexico where it inhabited oyster shells. Rioja (1960) reported it from the Lagoon of Mandina (eastern Mexico) from bivalve shells.

The genus *Polydora* is characterized as possessing branchiae posterior to the modified fifth segment and usually having hooded hooks from segment seven posteriorly. *Polydora hamata* was described as having these characteristics. The type lot of Webster (USNM 377) was kindly sent by Dr. Meredith L. Jones of the United States National Museum. The type material consisted of five slides and two small posteriorly incomplete specimens. One slide was labeled "head" and contained the prostomium and first four segments. Branchiae were present on segments two and three. One of the incomplete specimens possessed branchiae on segments 2, 3, and a small pair on 6. The second specimen was damaged, the anterior end being partially broken through. No branchiae were visible on segments two and three, but small branchiae were present on segment six. Specimens of *Polydora hamata* reported by Hartman (1951) from Louisiana were examined and found to have branchiae on segments 2, 3, 6 and on successive segments.

A comparison of Atlantic and Gulf of Mexico specimens of *P. hamata* with *P. uncatiformis* from Uruguay (paralectotype from the British Museum of Natural History) and *B. uncata* from California

and British Columbia yielded no significant morphological differences.

*Polydora hoplura* Claparède has been compared to *P. hamata* Webster as being its most closely related species (Hartman, 1951; Hopkins, 1958). Since *P. hamata* has been found to be a *Boccardia*, it is apparent now that the two are not so closely related. Hopkins (1958) suggested that *P. hamata* larvae, like the larvae of *P. hoplura* would probably remain in the egg sacs until attaining a stage of 17 or more segments. The development of *B. hamata* has been found not to be of that type and will be reported on in a later paper.

*Boccardia redeki* Horst and *B. truncata* Hartman closely resemble *B. hamata* but each is a distinct species. *Boccardia redeki* (*sensu* Rullier, 1960) has long glandular lobes on the pygidium and the larval development is different. *Boccardia truncata* has no posterior notopodial hooks and the pygidium is collar-like (Hartman, 1936).

#### LITERATURE CITED

BERKELEY, EDITH

1927. Polychaetous annelids from the Nanaimo District 3. Leodicidae to Spionidae. *Contribs. Canad. Biol.*, n. s., 3: 405-422, 1 pl.

BERKELEY, EDITH and CYRIL BERKELEY

1952. Annelida, Polychaeta Sedentaria. In *Canadian Pacific Fauna*. Fish. Res. Board Canada, 9b (2): 1-139, 292 figs.

FILICE, FRANCIS

1958. Invertebrates from the estuarine portion of San Francisco Bay and some factors influencing their distribution. *Wasmann J. Biol.*, 16: 159-211.

HARTMAN, OLGA

1936. New species of Spionidae (Annelida polychaeta) from the coast of California. *Univ. Calif. Publ. Zool.*, 41: 45-52, 22 figs.

1941. Polychaetous annelids. Pt. 3, Some contributions to the biology and life history of Spionidae from California. *Allan Hancock Pac. Exped.*, 7: 289-324, 4 pls.

1944a. New England Annelida. Pt. 2. *Bull. Amer. Mus. Nat. Hist.*, 82 (7): 331-343.

1944b. Polychaetous annelids from California, including the description of two new genera and nine new species. *Allan Hancock Pac. Exped.*, 10 (2): 239-315, pls. 19-26.

1951. The littoral marine annelids of the Gulf of Mexico. *Publ. Inst. Mar. Sci., Univ. Texas*, 2: 7-124, 27 pls.

1954. The marine annelids of San Francisco Bay and its environs. *Allan Hancock Found. Occ. Pap.*, no. 15: 1-20.

1959. Catalogue of the polychaetous annelids of the world. Parts I and II. *Allan Hancock Found. Occ. Pap.* no. 23: 1-628.

- 184 *Bulletin So. Calif. Academy Sciences / Vol. 65, No. 3, 1966*
1961. Polychaetous annelids from California. *Allan Hancock Pac. Exped.*, 25: 1-226, 34 pls.
- HOPKINS, SEWELL H.  
1958. The planktonic larvae of *Polydora websteri* Hartman (Annelida, polychaeta) and their settling on oysters. *Bull. Mar. Sci. Gulf and Caribbean.*, 8 (3): 268-277.
- IMAJIMA, MINORU and OLGA HARTMAN  
1964. The polychaetous annelids of Japan. Parts I and II. *Allan Hancock Found. Occ. Pap.*, no. 26: 1-452, 38 pls.
- MONRO, CHARLES CARMICHAEL ARTHUR  
1938. On a small collection of polychaeta from Uruguay. *Ann. Mag. Nat. Hist.*, ser. 11, 2: 311-314, 3 figs.
- OKUDA, SHIRO  
1937. Spioniform polychaetes from Japan. *J. Fac. Sci. Hokkaido Imp. Univ.*, ser. 6, 5 (3): 217-254, 27 figs.
- RULLIER, FRANCOIS  
1960. Morphologie et development du Spionidae (Annelide polychaete) *Polydora (Boccardia) redeki* Horst. *Cahiers de Biologie Marine*, 1: 231-244, 31 figs.
- RIOJA, ENRIQUE  
1960. Estudios Anelidologicos. XXIV. Adiciones a la fauna de anelidos poliuetos de las costas orientales de Mexico. *Anales Instituto de Biologia Mexico*, 31: 289-316, 39 figs.
- REISH, DONALD J.  
1961. A study of benthic fauna in a recently constructed boat harbor in southern California. *Ecology*, 42 (1): 84-91.  
1963a. Further studies on the benthic fauna in a recently constructed boat harbor in southern California. *Bull. So. Calif. Acad. Sci.*, 62 (1): 23-32.  
1963b. A quantitative study of the benthic polychaetous annelids of Bahia de San Quintin, Baja, California. *Pacific Naturalist*, 3 (14): 399-436, 16 figs.
- WEBSTER, HARRISON E.  
1879a. The Annelida Chaetopoda of the Virginian coast. *Trans. Albany Inst. New York*, 9: 202-269, 11 pls.  
1879b. The Annelida Chaetopoda of New Jersey. *Ann. Rep. New York State Mus.*, 32: 101-128. (the plates cited were not published until reprinted in 1886)