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A NEW SHRIMP OF THE GENUS *GNATHOPHYLLUM*
(DECAPODA, CARIDEA) FROM PUERTO RICO

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The bizarre color patterns displayed by the species of the genus *Gnathophyllum* Latreille, 1819, command attention whenever these stocky little shrimps are encountered. Except for the nearly pantropical and relatively common *G. americanum*, however, sufficient material has not yet become available to permit reliable evaluation of specific characters in the genus. The following description is offered in the hope that it may contribute in a small way to a better understanding of these criteria.

This shrimp was collected during a biological survey on the southeastern coast of Puerto Rico conducted by members of the Limnology Department, Academy of Natural Sciences of Philadelphia, at the request of the Sun Oil Company, without whose support the discovery at this time would have been impossible. The chemical data discussed below were compiled by Robert W. Haug, Chemist in the Limnology Department, and his associates, H. Jesse Steelman and James M. Chance.

Gnathophyllum splendens new species

Figures 1-5

Material: Puerto Yabucoa, one-half mile east of Playa de Guayanés, Municipio de Yabucoa, Puerto Rico; 14-15 July 1969; S. L. H. Fuller: 1 male holotype (USNM cat. no. 134422).

Description: Rostrum (Fig. 2a) sloping ventrad, slightly concave dorsally, reaching about as far as end of antennular peduncle; dorsal margin armed with five teeth, posteriormost situated on carapace behind level of orbital margin, distal two-fifths of margin unarmed, faintly convex and nearly horizontal; ventral margin armed with small but

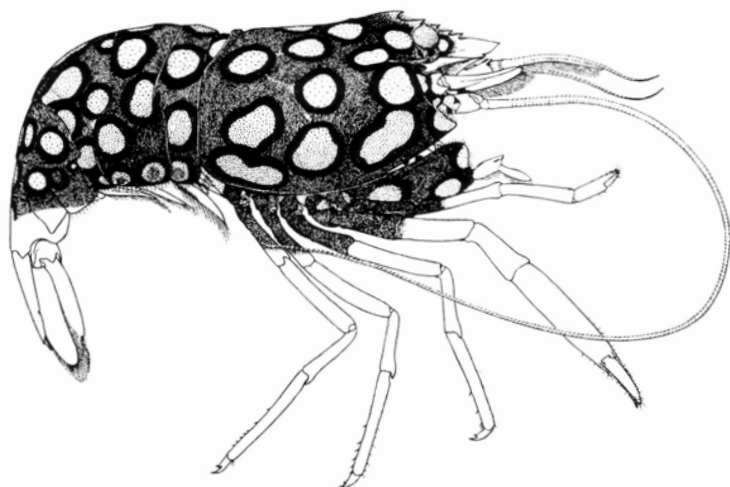


FIG. 1. *Gnathophyllum splendens* new species, male holotype, $\times 3.4$.

distinct tooth nearly opposite midpoint of unarmed portion of dorsal margin; lateral carina near but diverging slightly from ventral margin anteriorly, terminating at about level of anterior dorsal tooth. Middorsal carina extending posteriorly from posterior dorsal tooth, disappearing slightly posterior to midlength of carapace, and surmounted by inconspicuous obtuse prominence at about midlength of carina. Antennal spine large and sharp, directed slightly dorsad and terminating dorsal to orbital angle in lateral view. Anteroventral angle of carapace acutely but bluntly triangular, produced anteriorly nearly to level of anterior rostral tooth. Sternum with pair of subquadrate flaps extending ventrad between coxae of second pereiopods.

Pleura of first three abdominal somites rounded, that of fourth subrectangular, of fifth narrowly but bluntly acute with posterior margin sinuous; sixth somite (Fig. 2*b*) with posteroventral angle sharply acute on left side, rounded (probably abnormal) on right side. Sixth somite nearly one and two-thirds times as long as fifth, slightly more than half as long as telson not including terminal spines; ventral surface smooth, without projection between bases of uropods. Telson (Fig. 2*c*) armed with two pairs of small lateral spines, anterior pair arising nearly two-thirds of length of telson from anterior end, posterior pair nearly in line with and barely distinguishable from series of posterior spines; posterior margin (Fig. 2*d*) with acute median point and armed with two pairs of stout spines, separated by single (perhaps abnormal) slender median spine, lateral pair of posterior spines somewhat longer and stronger than posterior pair of lateral spines but no more than two-fifths as long as intermediate spines of posterior series.

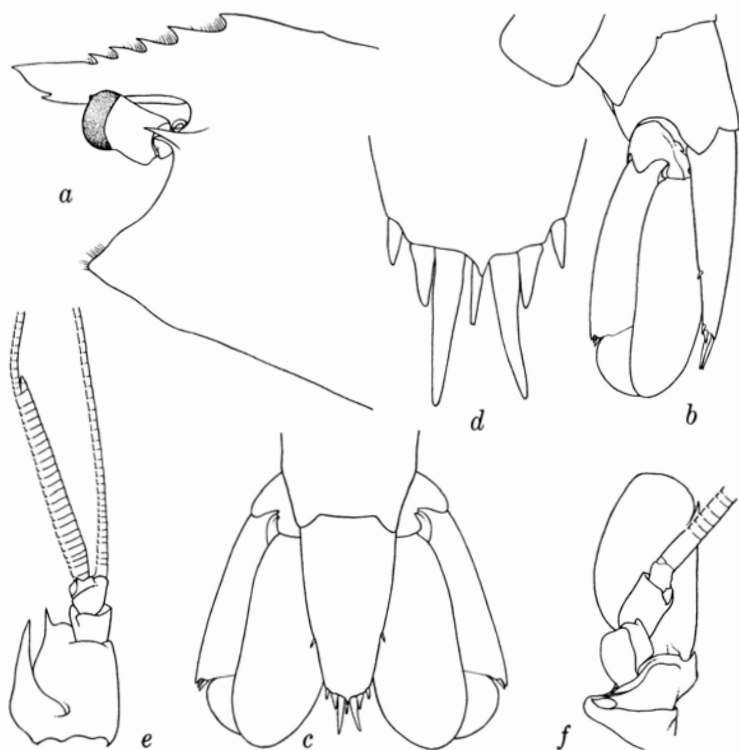


FIG. 2. *Gnathophyllum splendens* new species, male holotype. *a*, anterior region. *b*, telson and uropods, lateral view. *c*, same, dorsal view (telson slightly foreshortened). *d*, tip of telson. *e*, left antennule. *f*, left antenna. (*a-c*, *e*, *f*, $\times 6.5$; *d*, $\times 27$.)

Eye (Fig. 2*a*) robust, cornea considerably shorter than stalk and bearing distinct papilla on distal surface.

Antennular peduncle (Fig. 2*e*) with stylocerite tapering to sharp tip, overreaching midlength of second segment; basal segment fully as broad as long not including spinose lateral lobe, distolateral spine slightly overreaching stylocerite, distinct tooth on ventromesial surface. Antennular flagella subequal, slightly shorter than carapace; dorsolateral flagellum with about 24 articles in thickened, setigerous basal portion; accessory flagellum composed of two indistinct articles.

Antennal scale (Fig. 2*f*) broad, little more than one and three-fourths times as long as broad; lateral margin nearly straight, distal tooth sharp, falling far short of faintly angulate distal margin of blade. Antennal

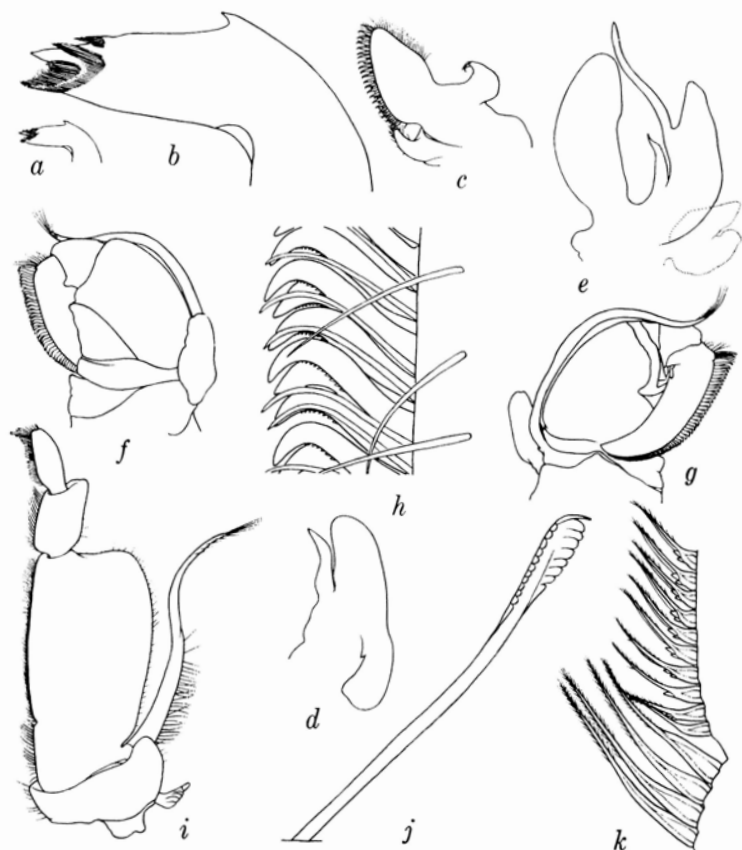


FIG. 3. *Gnathophyllum splendens* new species, male holotype. *a*, left mandible. *b*, same. *c*, left first maxilla, *d*, left second maxilla. *e*, left first maxilliped. *f*, left second maxilliped, posterior surface. *g*, same, anterior surface. *h*, same, portion of extensor margin of terminal segment. *i*, left third maxilliped. *j*, same, spoon-tipped seta from mesial margin of terminal segment. *k*, same, setae near notch in mesial margin of antepenultimate segment. (*a*, *c*-*g*, *i*, $\times 6.5$; *b*, $\times 27$; *h*, *k*, $\times 68$; *j*, $\times 280$.)

peduncle robust and short, reaching about midlength of scale; basal segment with sharp tooth below base of scale.

Mandible (Figs. 3*a*, *b*) much reduced in comparison with other mouth parts, incisor process represented by sharp toothlike lobe. First maxilla (Fig. 3*c*) with characteristically enlarged distal endite armed with double row of stout spines; palp bearing two curved spines distally.

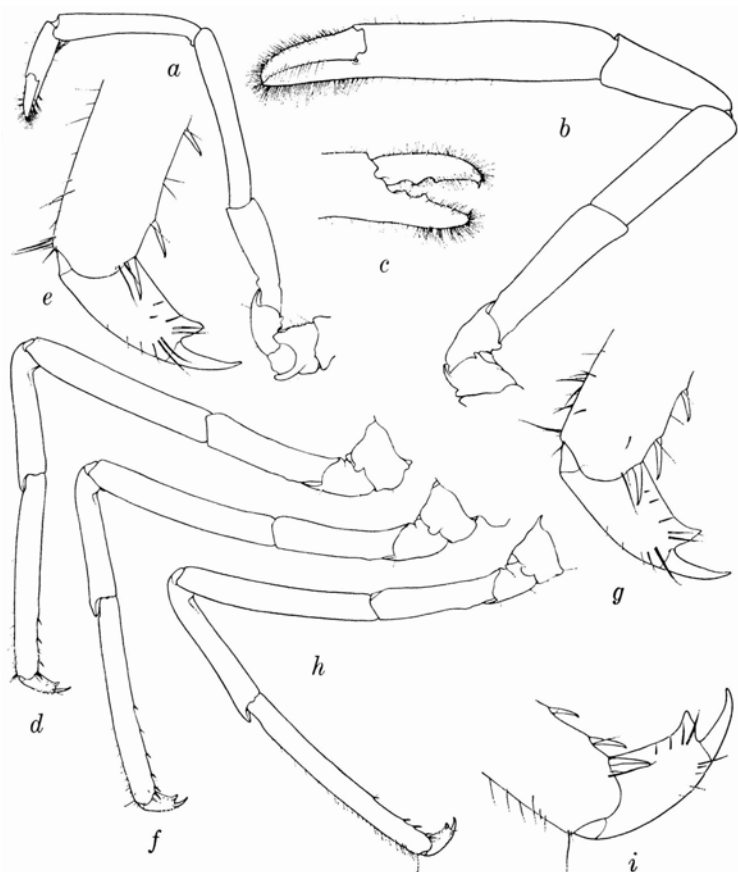


FIG. 4. *Gnathophyllum splendens* new species, male holotype. *a*, left first pereiopod. *b*, left second pereiopod. *c*, same, fingers in lateral view. *d*, left third pereiopod. *e*, same, dactyl. *f*, left fourth pereiopod. *g*, same, dactyl. *h*, left fifth pereiopod. *i*, same, dactyl. (*a-d*, *f*, *h*, $\times 6.1$; *e*, *g*, *i*, $\times 25$.)

Second maxilla (Fig. 3*d*) without endites. Maxillipeds (Figs. 3*e-i*) typical of genus; extensor margin of distal segment of second maxilliped armed with partially double row of S-shaped, denticulate spines and curved setae (Fig. 3*h*); terminal segment of third maxilliped bearing variably spoon-tipped setae (Fig. 3*j*) on mesial margin, antepenultimate segment bearing broad-based, denticulate setae (Fig. 3*k*) on mesial margin.

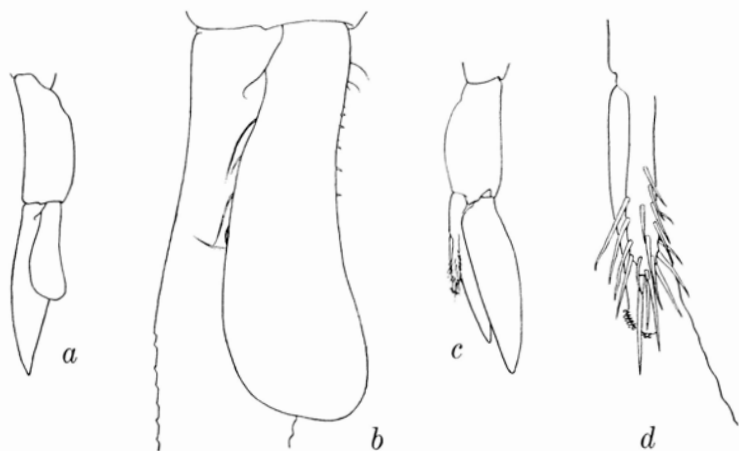


FIG. 5. *Gnathophyllum splendens* new species, male holotype. *a*, left first pleopod. *b*, same, endopod. *c*, left second pleopod. *d*, appendix masculina. (*a*, *c*, $\times 7$; *b*, *d*, $\times 29$.)

First pereiopod (Fig. 4*a*) overreaching antennal scale by length of chela and two-thirds of carpus; fingers slightly shorter than palm; carpus nearly one and two-fifths times as long as chela and about four-fifths as long as merus. Second pereiopod (Fig. 4*b*) also overreaching antennal scale by length of chela and two-thirds of carpus; fingers (Fig. 4*c*) about two-fifths as long as palm, each armed with two prominent teeth; carpus little more than one-third as long as chela and slightly shorter than merus; ischium slightly longer than merus. Third pereiopod (Fig. 4*d*) overreaching antennal scale by dactyl, propodus, and one-third of carpus; dactyl (Fig. 4*e*) with accessory tooth on flexor margin forming broadly acute triangle; propodus little more than seven and one-half times as long as wide, more than three and three-fourths times as long as dactyl, nearly one and one-third times as long as carpus, and slightly shorter than merus. Fourth pereiopod (Figs. 4*f*, *g*) similar to third, overreaching antennal scale by dactyl and nearly entire propodus. Fifth pereiopod (Figs. 4*h*, *i*) overreaching antennal scale by dactyl and at least three-fourths of propodus; propodus about nine and one-half times as long as wide, four and two-thirds times as long as dactyl, one and one-third times as long as carpus, and one-tenth longer than merus.

Endopod of first pleopod (Figs. 5*a*, *b*) more than half as long as exopod, broadest near distal end, bare except for few setae on proximal halves of both margins. Appendix masculina on endopod of second pleopod (Figs. 5*c*, *d*) shorter than appendix interna, bearing about 20 spinelike setae in distal half. Lateral branch of uropod (Fig. 2*c*) with one or two movable spines mesial to distal tooth of lateral margin.

Color and pattern in life (Fig. 1): Color absent from anterior half of rostrum, tips of pleura of fourth and fifth abdominal somites, most of sixth somite, and tail fan. Remainder of body brilliant orange, with superimposed cream-colored spots outlined in dark brown or black. Spots arranged rather symmetrically on each side of body except that anterodorsal spot on right side of third abdominal tergite not duplicated on left side, and orange spot on right pleuron of fourth somite cream-colored on left. Spots in dorsal midline numbering one on cardiac region of carapace, one each on first, second, fourth, fifth, and sixth abdominal terga, and two on third. Three spots adjacent to margins of pleura of first and second somites with reddish centers, hence tricolored. Spots somewhat lighter cream dorsally than ventrolaterally. Cornea of eye not very dark. Antennular peduncle with dark-ringed spot on dorsal surface of basal segment, stylocerite mostly orange, remainder without color. Color pattern continuing onto basal segments of antennal peduncle and proximal third of antennal scale. Antepenultimate segment of third maxilliped conspicuously colored with two and one-half spots on orange background. Orange color extending onto first pereopod as far as median third of merus, on second pereopod to base of merus, on third to distal end of ischium, and on fourth and fifth to near end of ischium.

Size: Carapace length from orbital margin 7.0 mm.

Remarks: There is little doubt that this species is most closely related to *G. circellum* Manning, 1963, from the Florida Keys and the Bahamas, the only other species of the genus marked with rings on the carapace and abdomen. In that species, however, both the background color and the ringed spots are uniformly brown, with the rings darker brown. *Gnathophyllum splendens* has the background color bright orange and the spots light colored and more numerous, but it may be significant that most of the spots that are duplicated in the two species are similarly positioned. For that reason, we would be most reluctant to consider the Puerto Rico specimen distinct were it not for the much less slender pereopods.

The specimen has been compared with the male holotype of *G. circellum*, which has a carapace length of 5.6 mm, with a smaller male paratype having a carapace length of 3.6 mm, and with an ovigerous female paratype, in which the carapace measures 7.2 mm. The most striking differences in the proportions of the pereopods are indicated in the following tabulation of the propodal length-width ratios:

	Pereopods			
	2	3	4	5
<i>G. splendens</i> , ♂ holotype	5.3	7.6	7.8	9.5
<i>G. circellum</i> , ♂ holotype	7.4	12.6	14.3	16.9
<i>G. circellum</i> , ♂ paratype	6.6	—	15.3	14.4
<i>G. circellum</i> , ovigerous ♀ paratype	—	—	—	14.4

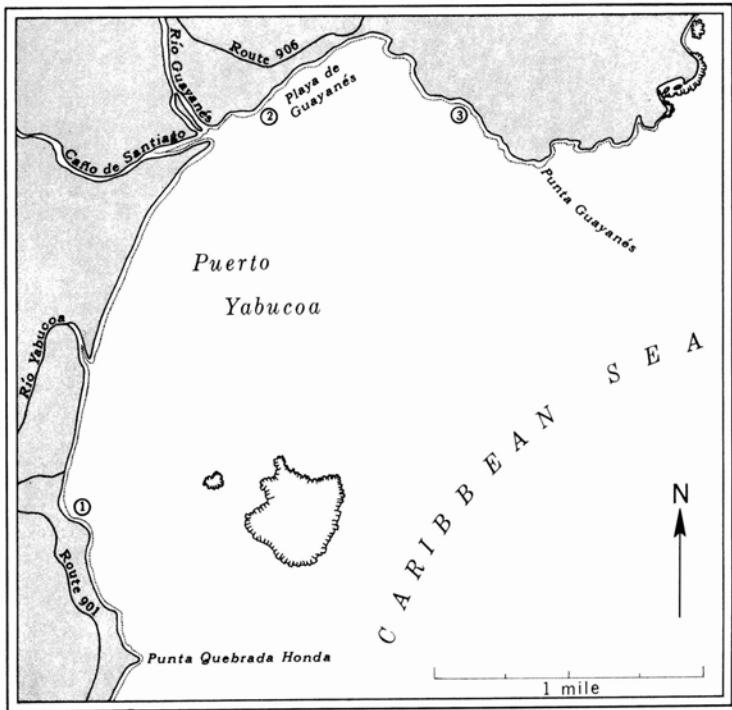


FIG. 6. Map of Puerto Yabucoa in Municipio de Yabucoa, approximately three miles east of Yabucoa, southeastern Puerto Rico, showing influent fresh-water streams, locations of coral reefs, and the three stations (circled numbers) where Philadelphia Academy of Natural Sciences macroinvertebrate collections were made. Station 3, one-half mile east of Playa de Guayanés, is the type-locality of *Gnathophyllum splendens*.

Gnathophyllum circellum differs from all other recognized species of the genus, including *G. splendens*, not only in the unusually slender pereopods but also in the more marked curvature of the propodus of the three posterior pairs and the more elongate dactyls, with the accessory tooth more narrowly acute.

The other differences noted between the Puerto Rican specimen and the type-specimens of *G. circellum* are certainly less important and probably represent only individual variations or abnormal characteristics. None of the specimens of *G. circellum* has any indication of a prominence on the middorsal carina of the carapace; all have three pairs of posterior spines on the telson, rather than having the median pair represented by

a single spine; the palp of the first maxilla is armed with one, rather than two, curved spines; and the fingers of the second pereopod are more than half as long as the palm and obscurely dentate on the opposite margins, rather than less than half as long as the palm and armed with prominent teeth.

The three species that have the body covered with innumerable light dots on a dark background—*G. elegans* (Risso, 1816) from the Mediterranean; *G. modestum* Hay, 1917, from the western Atlantic; and *G. panamense* Faxon, 1893, from the eastern Pacific—are closely related to each other and they may prove to be indistinguishable when more comparative material becomes available from the three regions. *Gnathophyllum splendens* agrees with all three in the proportions of the pereopods but differs from them, in addition to the distinctive color pattern, in at least two apparently reliable characters: (1) the first segment of the antennular peduncle is shorter and broader, so that the stylocerite reaches far beyond the articulation with the second segment, rather than falling short of that level, and (2) the posterior pair of lateral telson spines is nearly in line with the spines of the posterior margin, rather than separated from them by a variable but distinct gap.

Gnathophyllum splendens differs from *G. americanum* Guérin Méneville, 1856, from the western and eastern Atlantic and the Indo-Pacific region from the Red Sea and South Africa to Japan and Oceania, in having the posterior tooth of the rostral series situated posterior, rather than anterior, to the level of the orbital margin, as well as in having the antennal scale broader and less triangular and the posterior pair of lateral telson spines not far removed from the series of posterior spines.

The specific name is derived from *splendeo*, L., = to be bright and shining.

The type-locality of the new shrimp is located on Puerto Yabucoa, a sandy bay along the southeastern coast of Puerto Rico some three miles east of Yabucoa, the nearest town of any size. The bay is shallow in outline (Fig. 6) and in depth. The shoreline is chiefly a monotony of gently sloping beach, broken occasionally by low cliffs and scattered boulders (Fig. 7). Although true coral reef occurs in six to 10 feet of water at the mouth of Puerto Yabucoa, there is none close to shore except for limited areas facing the open sea just northeast of Punta Guayanés (Fig. 6). Macroinvertebrate collections were made in three areas (designated as Stations 1, 2, and 3 in Fig. 6), but these are all well within the bay. Only the third station—the type-locality of *Gnathophyllum splendens*—exhibits in any quantity the sorts of habitats where one might expect to encounter members of the genus, which are evidently of exclusively secretive habits.

Manning (1963) states that species of *Gnathophyllum* and of allied genera are thought to frequent the innermost recesses of coral heads and are known to be in some manner symbiotic with sea urchins and, possibly, with certain sponges and coelenterates (especially sea anemones,

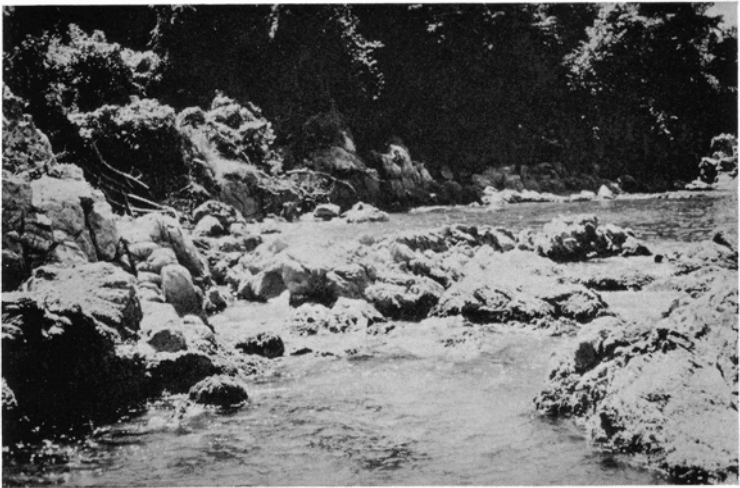
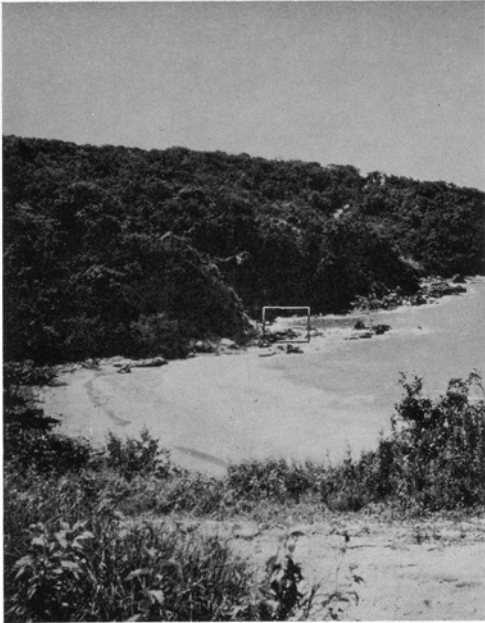


FIG. 7. Upper, Station 3 (see Fig. 6).—lower, enlargement of rectangle in upper photograph, showing rocky pools where holotype of *Gnathophyllum splendens* was taken.

Anthozoa: Actiniaria). The lone specimen of *G. splendens* was secured in the wake of fish poisoning in the area of tide pools shown in Fig. 7. Here there is an abundance of anemones, urchins, and sponges living among pockets in the friable rock that extends bayward some 20 to 40 feet from shore.

Neither physical habitats of these types nor extensive opportunities for symbiotic life are available to *Gnathophyllum* at the other two stations set on Puerto Yabucoa. Moreover, riverine influence is conspicuous in those areas. Station 2 receives sugar-refinery wastes from the confluence of Río Guayanés and Caño de Santiago. A tiny fishing village contributes additional organic refuse at Station 1, where the coliform count was twice the levels elsewhere in the bay. At both stations, the silicon concentrations were twice the level at Station 3; turbidity, conductivity, and other physical and chemical qualities of the water were often very different from those at the type-locality. No fewer than four fresh-water streams serve to lower salinities in the western portion of Yabucoa Bay (Fig. 6).

The specific compositions of the macroinvertebrate faunas at Stations 1 and 2 reflect these differences. The first is the best sheltered of the three areas, and, despite the heavy organic load, its fauna is numerically comparable to the species total at the type-locality. The second station, on the other hand, is directly exposed to rollers from the open sea and suffers an impoverished habitat diversity: its fauna comprises only one half of the number of species recorded elsewhere. In spite of fish poisoning and exhaustive search, no species of *Gnathophyllum* was taken at these two stations. A combination of physical, chemical, and biological factors appears to have excluded the new species, which possibly prefers sheltered waters that are relatively free of mechanical and chemical pollutants.

The type-locality is a truly marine environment (the average salinity was 36.7 ppm), with a healthy pH (8.5) and dissolved oxygen concentration (6.4 ppm). However, the quantities of certain elements (such as potassium and phosphorus) were atypical of ordinary marine values, and riverine influence from the western shore of the bay is apparent.

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