Contributions from the Biological Laboratory of the U. S. Fish Commission,
Woods Hole, Massachusetts.

A NEW ISOPOD PARASITIC ON THE HERMIT CRAB.

By MILLETT T. THOMPSON.

While at Woods Hole, in the summer of 1897, studying the small hermit crab (*Pagurus longicarpus* Say), I found parasitic upon this crustacean a hitherto undescribed Bopyrid, allied to *Phryxus resupinatus* Müller, and apparently representing a new genus. About 1.5 per cent of the crabs at Great Harbor were thus infested (1898), and from 3 to 4 per cent of those at Hadley Harbor. A single specimen was taken at Edgartown in 1898, and another at Warwick, Rhode Island, in 1900. In the channels where there is a swift current the percentage of infested crabs is low, due probably to the more effectual dispersal of the free-swimming larvæ.

The female parasite occurs on the abdomen of the hermit, to which it is attached, back downward, by its mandibles and legs. The male is found on the posterior part of the marsupium of the female, usually lying to the right (apparent left) of the median line, the head directed anteriorly. The presence of the parasite does not effect any alteration in the case of the secondary sexual characters of its host. On the average the infested crabs seem quite as resistant to adverse conditions as the uninfested ones.

Stegophryxus hyptius, genus et species nov.

ADULT FEMALE (PLATES 9 AND 10).

Broad in proportion to length, marsupium very large, abdomen about half the length of thorax, distinct from it, 6-jointed, with five pair of triramous pleopoda and a pair of oval uropoda. Length, about 9.1 mm. Color, yellowish-white, opaque. Ovaries, when full of ripe eggs, orange-yellow.

Head (pl. 9, figs. 5 and 6), from the dorsal side appears as an oblong elevation ending anteriorly in a blunt lobe, which represents the median portion of the much-reduced front (*Fr*). As the lateral portions of the front are almost wholly obsolete, appearing only as two inconspicuous lobes, the greater part of the antennules, antennae, and tip of rostrum, is visible dorsally. The antennules are 3-jointed and consist of a large globose basal joint, surmounted by a small cylindrical second and a minute third joint; outer joints bristle-tipped. Each antenna (A_2) arises along the side of rostrum as a columnar ridge, whose distal end is visible dorsally (fig. 7, A_2). From this ridge a 4-jointed flagellum arises, its proximal joint stout, the three distal joints slender; all the joints bristle-tipped. Ventral surface of head broader than dorsal surface and sharply elevated at posterior border, giving a strong antero-dorsal slope so that the erect hypopharynx points almost anteriorly. At sides of posterior border three curved processes arise (fig. 7, *Pro*), and in the midline are two thin foliaceous plates (fig. 7, *Fp*). Rostrum conical. Mandibles (*Mnd*) slender, with expanded tips, the edges of which are incurved so that, pressed together, they form a sucking-tube. Near the bases of mandibles appear the oval maxillulæ (Mx_1). Hypopharynx (fig. 7) erect, highly keeled, and plays no part in formation of rostrum. Maxillipeds (fig. 5) large; each consists of a foliaceous anterior and a somewhat thicker posterior blade; during life these organs keep up a rapid fanning motion. There is no trace of a palpus.

The thorax (pl. 9) is concealed ventrally by an enormous marsupium, built up of five pairs of

thin brood-plates, each strengthened by a median chitinous rod. The posterior or fifth pair (fig. 4, Bp_5) lie externally to the others and form the major part of marsupium; they are attached along the border of fifth and sixth thoracic segments. The posterior angle of each forms a shallow pouch (fig. 4, *Po*). Nearly concealed by these plates, and almost closing the marsupium anteriorly, are the third and fourth pairs of plates, similar to each other in shape (fig. 2, Bp_3) and having an oval ventral and a rounded dorsal portion (fig. 3, Dbp_3 and Dbp_4). This dorsal part conceals the legs of the parasite. The second pair of plates are oblong and are hidden under the others (fig. 2, Bp_2). The first pair consists of a rather oval anterior and a triangular posterior blade. The latter (fig. 2, Plp_1) is strengthened along its outer (longest) border and across its base by a chitinous rod. The anterior blades (fig. 2, Alp_1), in company with the dorsal portions of the third pair of plates, form the funnel-like anterior end of the marsupium.

The details of the thoracic segments are shown in fig. 3. The first five are crowded together, their fleshy lateral portions strongly bent toward the head. The lateral parts of first four segments end in a small roughened boss or cushion, on which the roughened third joint of the pereiopod impinges. This cushion (*Cu*) may represent a modified epimeron. Internally to this cushion is a flat shield-shaped area which comes in contact with the abdomen of the host (fig. 6, *Sh*). The lateral portions of fifth segment end in a sharp crest, and there is no "shield." The sixth segment is very long; it narrows posteriorly, has a fleshy median keel and only slightly developed lateral portions. The seventh segment is short, fleshy, about as wide as sixth and similar to it except that it is not keeled. Ventral surface of thoracic segment fleshy, posterior borders of sixth and seventh modified into complex elevated keels (fig. 8). (In the plate it will be noted that the first serrated keel belongs to segment 6, the second to segment 7, the third (*X*) to the first abdominal segment.) Pereiopoda of the sixth and seventh segments are alike and quite simple in construction (pl. 10, fig. 7); those of the other five segments are modified, the last three joints being twisted to one side (pl. 10, fig. 6). Extensor muscles enormously developed.

The abdomen (pl. 9) consists of six fleshy segments, five of which bear a pair of pleopoda. Each pleopod has three oval blades arising from a short common base. Two of these are subequal and extend in a lateral direction; the third is smaller and points ventrally. This ventral ramus is broadly expanded in the pleopoda of the first abdominal segment, especially on the right side (fig. 4, Vpl_1). The first segment has ventral keels, similar to those on the last thoracic segments. Between the oval uropoda of the sixth segment (*Ur*) is a minute conical prominence.

Description of Adult Male. (Plate 10.)

Three and two-thirds longer than broad. Abdomen unsegmented, about a third of entire length. Color dull yellowish. Around the heart in the abdomen is an orange-colored area and a narrow streak of same color runs forward along the mid-dorsal line. Sometimes splashes of black occur on the sides of the head and thorax. Length about 3 mm.

Head (pl. 10, figs. 1 and 2) oval, elevated in center, the margin entire and not inflexed. Eyes minute (fig. 1, *E*). On the under side is a shallow central depression, in front of which arise the short 3-jointed antennulæ (A_1). From the depression the 8-jointed antennæ (A_2) and the conical rostrum take their origin. First joint of antennæ elbowed, the others cylindrical, the distal ones bristle-tipped. Sixth, seventh, and eighth joints very small, together scarcely equaling the fifth in length. Rostrum prominent, built up dorsally by the labrum (*La*) and ventrally by the hypopharynx. Apex of latter conceals tips of mandibles and median part of labrum. Mandibles (*Mnd*) slender with thick bases and sharp chitinous tips. I have not found maxillulæ. Between the maxillæ, and extending forward from a transverse ridge, are the 3-jointed (?) maxillipeds (*Mxp*). The thorax consists of seven fleshy segments. It narrows slightly posteriorly and is moderately convex. Sides subparallel, somewhat deflexed, epimera not distinct. First segment notched for reception of head. Seven pairs of pereiopoda, whose structure and musculature can be understood by reference to the plate (pl. 10, fig. 8). Abdomen ovoid or sometimes pear-shaped, shows no signs of segmentation, and has no traces of appendages.

Description of Immature Forms.

I. The development of the youngest female specimen taken (pl. 10, figs. 9 and 10) was a little more advanced than the stage which Giard has called the "phryxoid" stage. It may be termed the metaphryxoid stage. More slender than adult; nearly three times longer than broad. Lateral portions of the thorax distinct from and scarcely wider than median part. Marsupium present but

rudimentary. Abdomen as long as thorax. Length, 5 mm. Head short. Front (*Fr*) prominent, transverse, with a straight, entire, uninflexed margin, which conceals the mouth parts, antennules, and the basal joints of antennæ. Mouth parts much like those of adult, but the hypopharynx is flatter and less erect and the mandibles are stout and have sharp tips (*Mnd*). Inflexed border of labrum narrow, maxillipeds small and not inflated at base. They consist of an oblong-oval posterior and a smaller rounded anterior blade. No palpus. The rostrum points anteriorly, rather than, as in the adult, dorso-anteriorly. Thorax narrow and not quite as long as abdomen. Segments subequal, fleshy, with the median and lateral parts of nearly same width (fig. 9). Sixth and seventh segments narrower than the rest, distinct from them, and have only rudiments of ventral keels. Epimera (?) of thorax distinct (*Ep*), no "cushions" or "shields." Pereiopoda like those of adult. Brood-plates small and flat; those of third and fourth pairs are without dorsal portion, those of fifth pair lack pouches at posterior angles. The abdomen is like that of adult in form, except that the ventral rami of first pair of pleopoda are not expanded (Vpl_1).

II. Three cryptoniscid-stage larvæ, probably males, were taken from the female just described. One was in the marsupium; the others were clinging to the appendages (pl. 10, figs. 3, 4, and 5). Abdomen proportionally longer than in adult and consisting of 6 segments. Pleopoda and uropoda present. Epimera distinct. Color white with black blotches. Length about 0.7 mm. Margin of head narrow, inflexed at sides and in front. Rostrum prominent. Antennules complex in structure and provided with long bristles (fig. 4, An_1). Antennæ 8-jointed and very long and slender. Thorax of 7 smooth segments, with distinct strongly deflexed epimera (*Ep*); 7 pairs of pereiopoda similar in form to those of adult, but more delicate and slender. The abdomen consists of 6 segments, is highly convex, the first 5 segments having deflexed epimera. Five pairs of flat biramous pleopoda (fig. 5), the blades standing with their faces at right angles to the long axis of body. Uropoda (fig. 3, *Ur*) biramous, consisting of a cylindrical protopodite, a cylindrical exopodite, and a shorter cylindrical endopodite. Each endopodite and exopodite bears one long bristle and a tuft of short hairs.

III (not figured). Several females, of a stage considerably more advanced than the one described above, were taken. In all cases they had a male of about 2 mm. in length, of adult form, clinging to them. Length varying from 6 mm. to 7 mm. Appearance much like fig. 9 of plate 10, but the whole thorax is wider. Lateral parts slightly broader than median portion. The head is adult in length, but the front is still rather wide, very fleshy, and trilobed, the lateral lobes being larger than the median. Tip of rostrum and distal portions of antennulæ and antennæ visible dorsally; otherwise the head and mouth parts are adult in structure. Thorax narrow and as long as abdomen. Dorsal segments fleshy, though less so than in preceding stage, and the first five segments have begun to crowd anteriorly. Sixth segment fleshy, not keeled, scarcely longer than fifth or seventh. Ventrally the transverse keels on sixth and seventh segments are rudimentary, but more developed than in metaphryxoid stage; marsupium larger, though the brood-plates are still quite rudimentary. Brood-plates of third and fourth pair have developed the dorsal portion; first pair nearly adult in shape, and the funnel under the head has begun to form. Tips of first brood-plates and maxillipeds are visible from dorsal side, much as in adult. The pereiopoda are adult in form, and "cushions" and "shields" are present. Abdomen like that of the metaphryxoid stage.

IV (not figured). One specimen of a female nearly mature was taken. In this the abdomen was nearly as long as the thorax, sixth thoracic segment not yet of adult proportions. Length, 10 mm.

As mentioned above, the nearest relative of this species is *Bopyrus* (*Phryxus*) *resupinatus* Müller, described in 1870 from a small hermit-crab at Desterro, South America. This parasite was attached, in its early larval stage at least, at the roots of *Succulina purpurea*, or less frequently *Peltogaster socialis*, both of which Cirripeds were extremely common on the hermit-crab mentioned, the name of which is not given. This is strikingly unlike the condition in regard to *Stegophryxus hyptius*, for I have never taken the latter in association with any other parasite. I have examined several thousand specimens of *Pagurus longicarpus* from the vicinity of Woods Hole, but have never found any external parasite other than the Bopyrid. The proportions and structure of body of the Desterro species are also different from those of *Hyptius*, as far as can be judged from the very imperfect knowledge of the anatomy of *resupinatus* at our disposal. Hence I consider the two forms to be distinct, though the likeness of the Woods Hole form to Müller's species suggested the name *hyptius* (ὕπτιος=*resupinatus*).

As will be noted, the male is similar to the male of *Athelges* (Hesse), *Pleurocrypta* (Hesse), and *Phryxus* (Räthke), and on this basis apparently some authors have grouped the species of these three genera under *Phryxus*. *Phryxus* thus defined will of course admit *hyptius* and *resupinatus*, but when we

consider how little is really known about these genera, and how dissimilar the females are, it seems better to retain them as distinct genera until detailed knowledge of the anatomy of the various species furnishes the basis for more accurate classification. Sars in his "Account of the Crustacea of Norway" has thus regarded them.

Hyptius is more closely allied to the members of *Athelges* than to those of either of the other genera, but its female presents characters, especially in the uropoda and pleopoda, which seem to prohibit its reference to that genus as defined at present. As writers on this family prefer to institute tentative or even undefined genera for new species where there is doubt as to their exact position, I suggest that *resupinatus* and *hyptius* be placed in the following tentative genus, having the characters given below as its probable limits.

STEGOPHRYXUS, nov. gen.

Male, abdomen ovoid, without appendages or traces of segmentation. Antennulæ 3-jointed, antennæ 8-jointed. Female, abdomen distinct from thorax, 6-jointed, with five pairs of triramous pleopoda and a pair of oval uropoda. Legs modified for clasping dorsalward. First five segments of thorax crowded anteriorly. Nearly symmetrical.

στεγειν=to roof or cover (in allusion to marsupium covering the parasite when on host).

BIBLIOGRAPHY.

1. BATE. Spence & Westwood. History of British Sessile-eyed Crustacea, vol. II, pp. 232–250, 1868.
2. GIARD. "Sur la Phylogénie des Bopyriens." Compt. Rendus, tome 104, 1887.
3. HESSE. Annales Science Naturelles, sér. 4, XV, pp. 112–115, 1861; sér. 5, III, pp. 226–242, 1865.
4. MÜLLER. Jenaische Zeitschrift, VI, pp. 57–60, 1870.
5. SARS. Account of Crustacea of Norway, II, pts. 3–8. 1897.

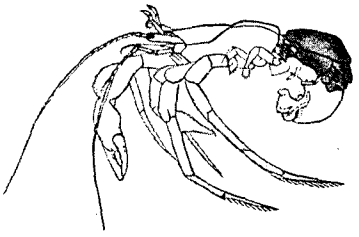
DESCRIPTION OF PLATES.

PLATE 9.

Fig. 1. *Hermit crab with parasite attached.* Natural size.
2. *Anterior portion of adult female, ventral, somewhat diagrammatic.* On the right side, all the brood-plates except the first, and on the left the fourth (Bp_4) and fifth have been cut away. The third (Bp_3) is reflexed to show the second (Bp_2).) Abp_1, Pbp_1 = the anterior and posterior blades of first brood plates. Pr_1, Pr_2 = pereiopoda of first and second pairs, respectively. Dbp_3 = dorsal portion of the third brood plate.
3. *Adult female with marsupium distended with eggs. Dorsal.* ×8. Bp_1 = funnel formed by first brood-plates. Dbp_3, Dbp_4 = dorsal portions of third and fourth plates, respectively. Bp_5 = the distended fifth brood-plate with the pouch (*Po*) at its posterior angle. Pr_6, Pr_6, and Pr_7 = Pereiopoda of fifth, sixth, and seventh segments, respectively. Pl_1, Rami of first pleopod. *Ur* = Uropoda.
4. (The dotted outline shows the position occupied by the male.) *Adult female with empty marsupium. Ventral.* ×7. Bp_1, Bp_3, Bp_5 = brood plates of first, third, and fifth pairs, respectively. *Po* = pouch at angle of fifth pair. Vpl_1 = enlarged ventral ramus of the first pleopod. Vpl_2 = ventral ramus of second pleopod.
5. *Left maxilliped of adult female. Ventral (outer) surface.* ×15. *Ab* = anterior blade. *P b* = posterior blade. *X* = point of attachment. (Two of the processes at the side of the head are shown.)
6. *Head of the adult female. Dorsal.* ×17. *Fr* = median part of front. *Mnd* = mandibles. *La* = dorsal part of labrum. *Mxp* = maxillipeds. Dbp_3 = dorsal part of third brood plate. A_2 = antenna. *Cu* = "cushion." *Sh* = "shield." *E* = eye
7. *Head of adult female. Antero-ventral.* Free-hand. (The posterior brood plates are removed, and the first pair with the maxillipeds are reflexed to show the ventral surface of the head, etc. The base of the right maxilliped is cut away to show the processes at border of head (*Pro*).) A_1 = antennula. A_2 = ridge which forms the basal joint of the antenna. *La* = inflexed margins of labrum. Mx_1 = maxillula. Mx_2 = maxilla. *Mxp* = maxilliped. *Fpl* = leaf-like platen at median posterior border of head.
8. *Abdomen and posterior part of thorax of the same. Ventral.* × 8. (All the brood plates except the pouch-like posterior angle (*Po*) of the fifth plate have been removed.) *X* = keel of the first abdominal segment (see page 54). Pl_1, Pl_3 = pleopoda of first and third segments, respectively.

PLATE 10.

Fig. 1. *Adult male. Dorsal.* ×18. A_2 = Antenna. *E* = eye. *Int* = intestine. *Ht* = heart.
2. *The same. Under surface of head.* × 33. The right pereiopod has been removed; *x* marks its position. A_1 = antennules. *La* = the inflexed border of labrum. *Mnd* = basal portions of the mandibles, the median and apical parts being concealed by the labrum and hypopharynx. Mx_2 = maxilla. *Mxp* = maxillipeds.
3. *Cryptoniscid from young female. Lateral.* ×87 (?). A_1 = antennula. A_2 = antenna. *Ep* = epimeron of first thoracic segment. *Ur* = uropod. *Pl* = pleopoda.
4. *The same. Under surface of head.* ×165 (?). A_1 = Antennula. *R* = rostrum.
5. *The same. Pleopod of third abdominal segment.* ×105 (?). *Ex* = outer ramus. *En* = inner ramus.
6. *Adult female. Musculature (diagrammatic) of one of the first four thoracic pereiopoda. Lateral.* ×30. (From specimens cleared in cedar oil and from reconstructions.) *Cu* = "cushion." *Sh* = "shield." *Bp* = base of brood plate (mostly cut away). *Ex* = extensors.
7. *Adult female. Musculature (diagrammatic) of pereiopod of sixth or seventh segment. To show approach to the simpler male pereiopod. Lateral.* × 30. *Ex* = extensors.
8. *Adult male. Musculature of pereiopod. Lateral.* × 60. *Ep* = border of segment. *Fl* = flexors. *Ex* = extensors.
9. *Larval female (metaphryxoid stage). Dorsal.* × 18. (Only the thorax and part of the abdomen are shown; most of the pereiopoda are bent ventrally and are hidden by what may be the epimera (*Ep*).) *Fr* = front. A_2 = antennæ. *E* = eyes. Pr_7 = pereiopod of seventh pair. Pl_2 = pleopod of second pair.
10. *The same. Ventral.* × 10. (Showing the positions in which the three males (?) were found). ♂ = position of the one which was in the marsupium. *Mnd* = mandibles. A_1 = antennula. Bp_1, Bp_4, Bp_5 = brood plates of first, fourth, and fifth pairs. Pr_5 = pereiopod of fifth pair. Vpl_1 = ventral ramus of first pleopod. *Ur* = uropoda.



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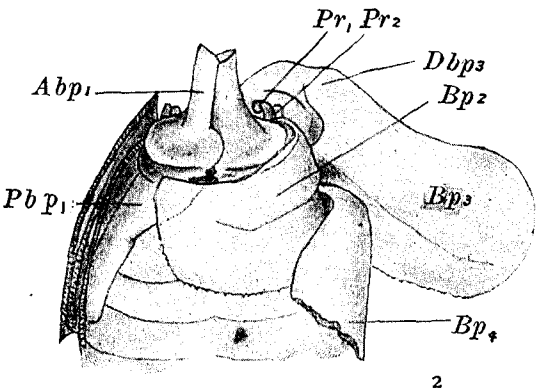

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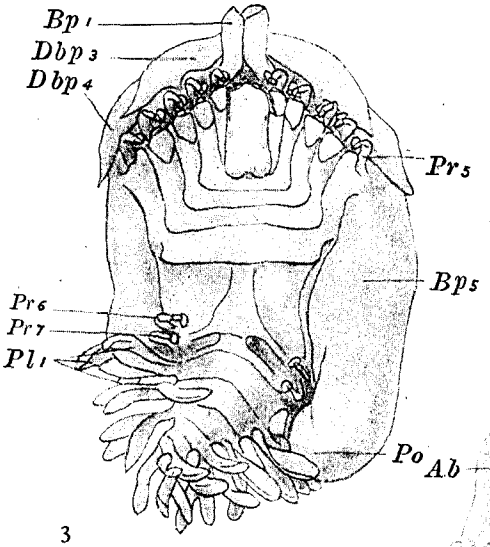

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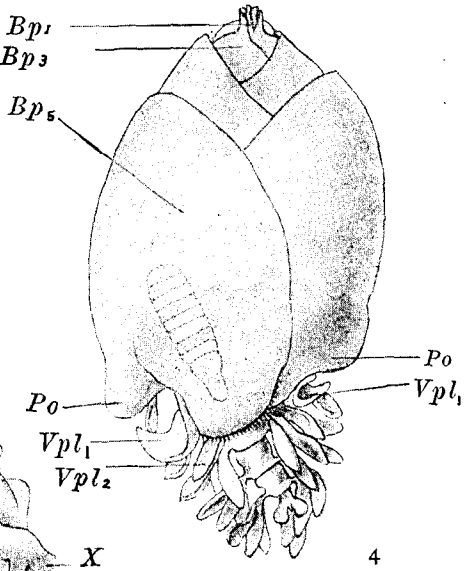

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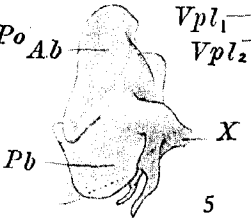

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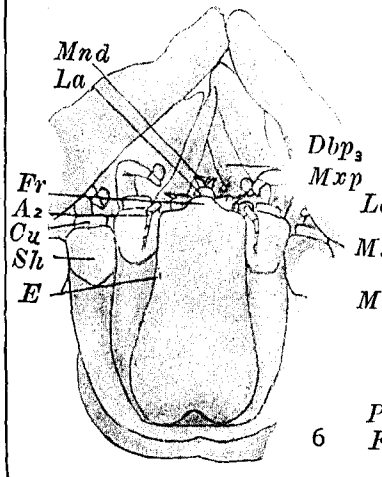

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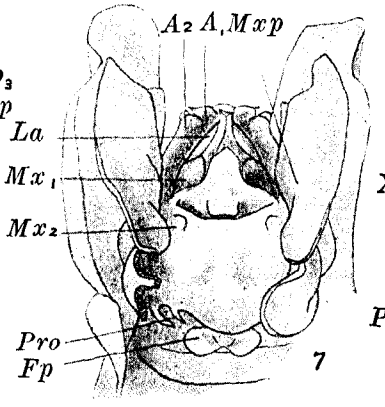

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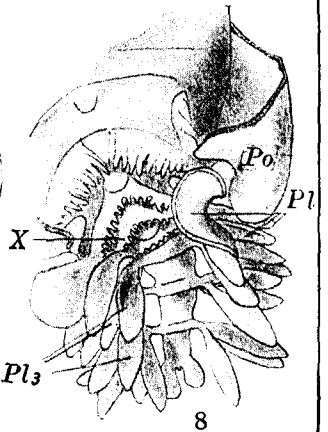

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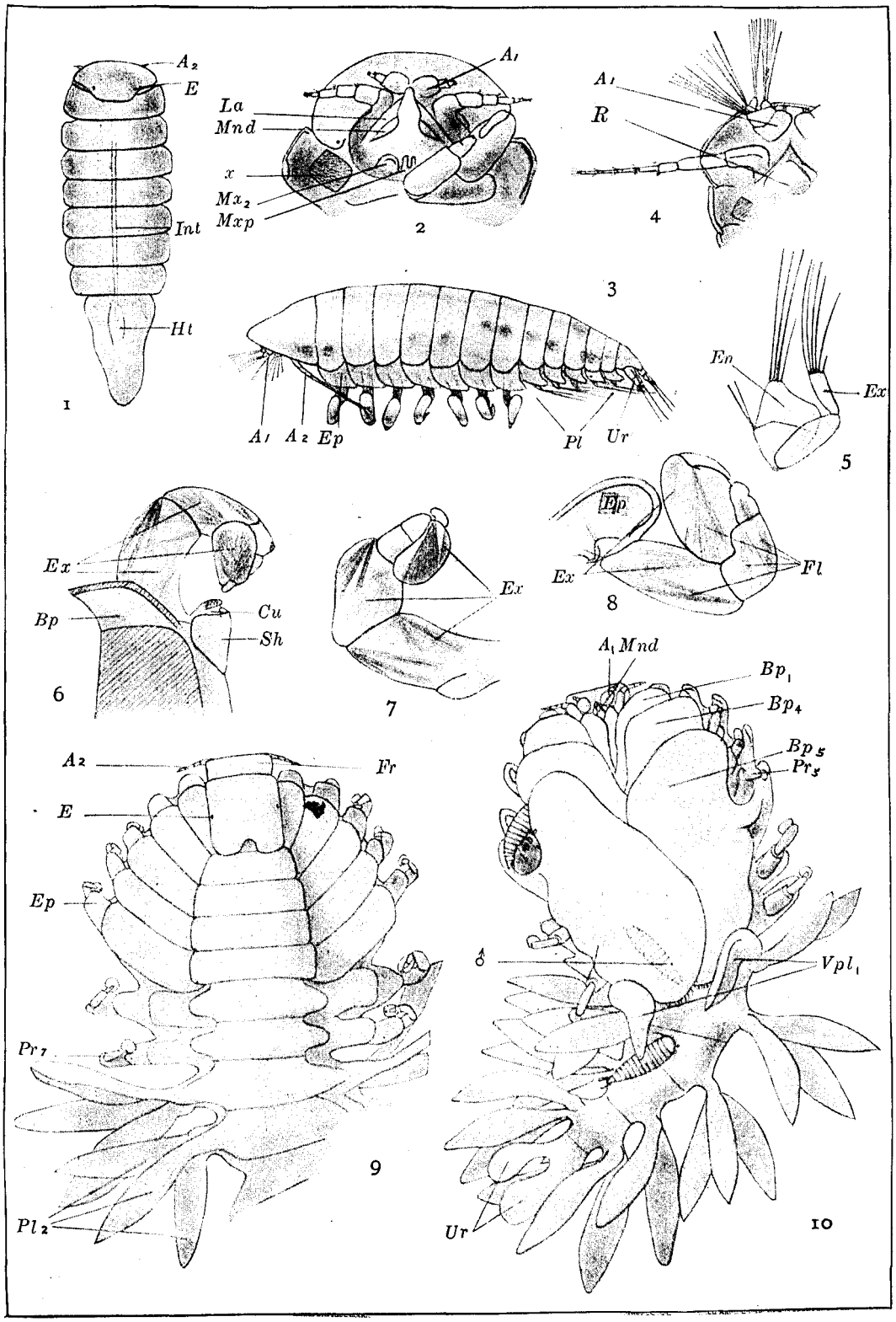

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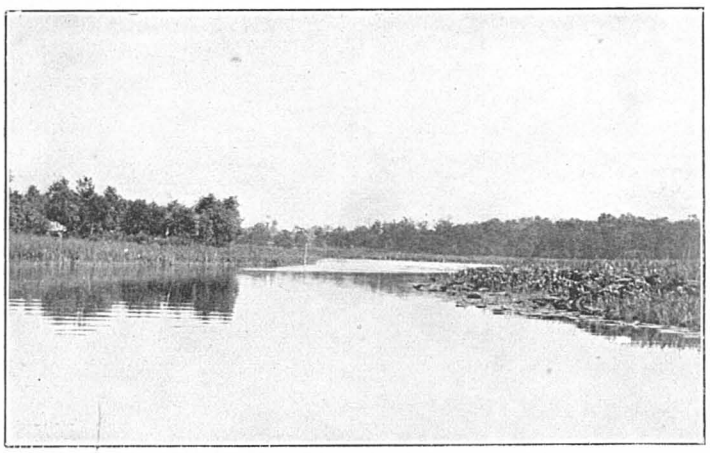
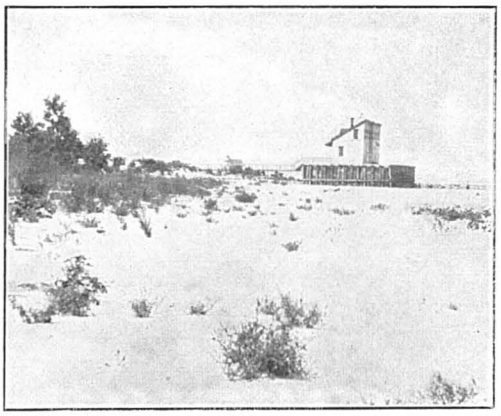


1. VIEW IN EAST HARBOR SWAMP.



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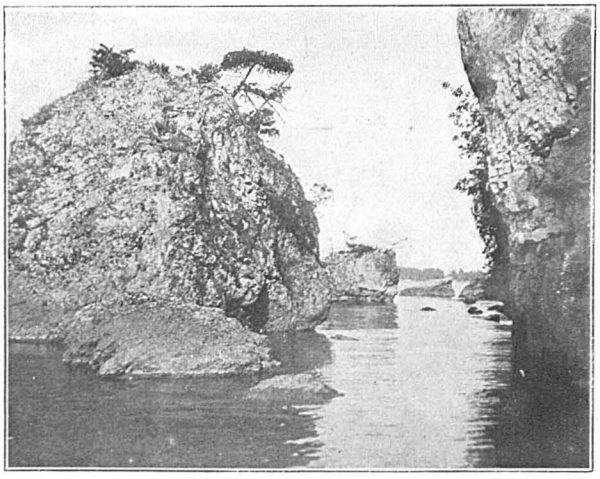
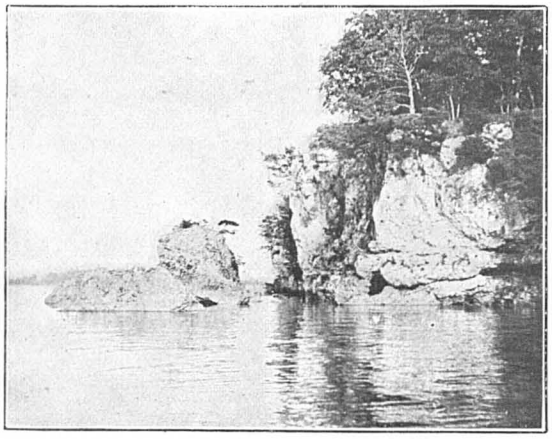
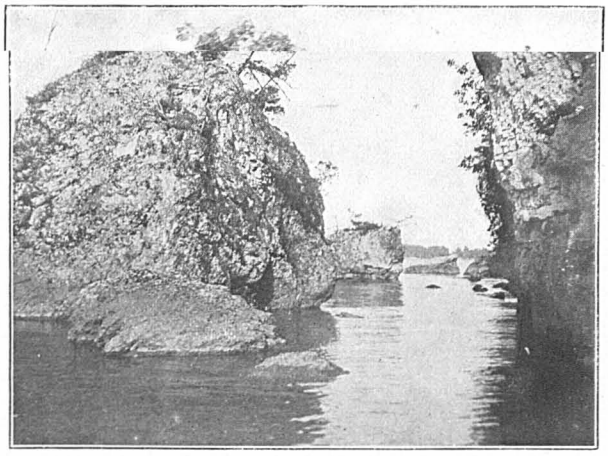


3. LICHEN-GROWN ROCKS NEAR GIBRALTAR ISLAND.



4 ROCKY SHORE OF SOUTH BASS ISLAND.



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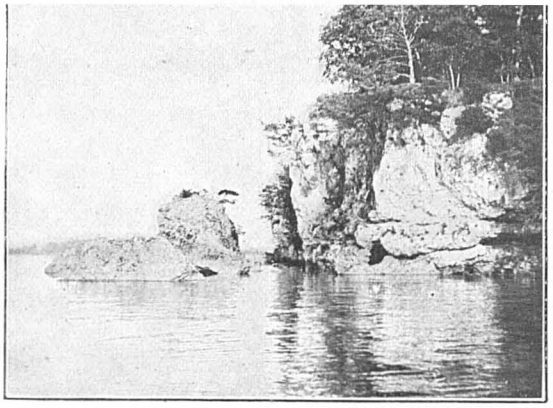

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