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THE CRAB PARASITE, SACCULINA.

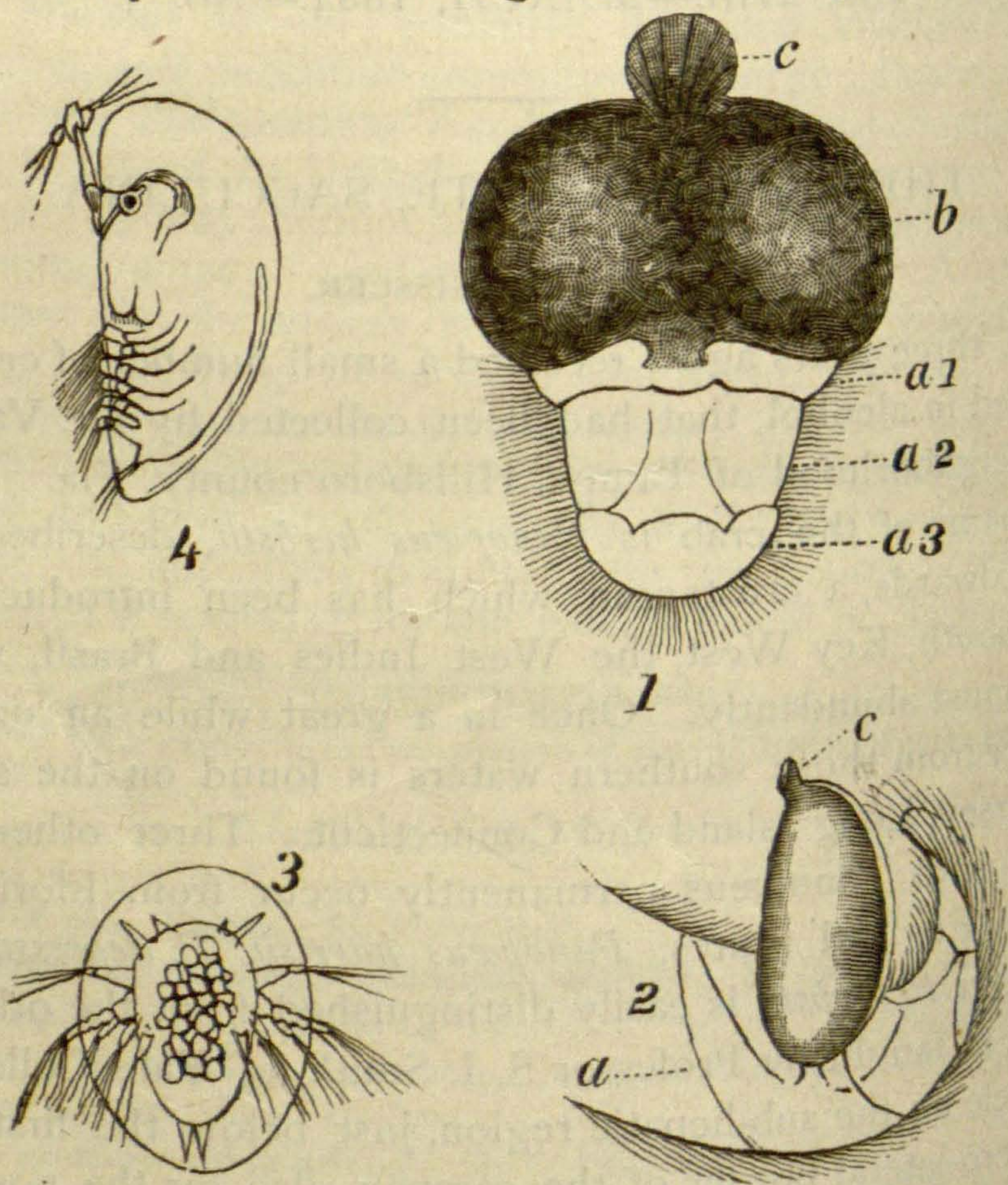
BY CARL F. GISSLER.

SOME three years ago I received a small number of crabs, preserved in alcohol, that had been collected by Dr. Van Elsen in the neighborhood of Tampa, Hillsboro county, Fla. The scientific name of the crab is *Panopæus herbstii*, described by A. Milne-Edwards, a crustacean which has been introduced from farther south, Key West, the West Indies and Brazil, where it occurs most abundantly. Once in a great while an occasional straggler from those southern waters is found on the shores of New Jersey, Long Island and Connecticut. Three other species of the genus *Panopæus* permanently occur from Florida up to the New England States, *Panopæus harrisii*, *P. depressus* and *P. sayi*. Our *P. herbstii* is easily distinguished from the other three species, as taught by Professor S. I. Smith, of Yale College, "by a tubercle on the sub-hepatic region, just below the first lobe of the antero-lateral border of the carapax, also by the post-orbital tooth being separated from the second tooth of the antero-lateral margin by a rounded sinus, and by the dactylus of the larger cheliped having a stout tooth near the base within." It is well known that all these *Panopæus* species largely contribute to the food of many marine fishes.

So much for the *Panopæus*. But our *P. herbstii* does not so much interest us at present as does its enemy, which is also a crustacean, living parasitically on its host. It does, however, not parasitize in the gill-cavity of its host, as is the case with the parasite *Bopyrus* infecting the common shrimp of our shores,<sup>1</sup>

<sup>1</sup> *Scientific American*, Vol. XLV, September 3d, 1881, p. 151.

but occurs on the ventral surface of the abdomen of its host. The scientific genus-name of our parasite is *Sacculina*, and by calling it specifically *Sacculina panopæi*, we honor both parasite and host. In systematic zoölogy this *Sacculina* belongs to the family Rhizocephala, and these again are classified among the barnacles or cirripeds, which the earlier zoölogists regarded as mollusks, but which, in reality, are crustaceans and relatives of the lobster, shrimp and crab. *Sacculina* is one of the most striking examples of animal degeneration. Fig. 3 illustrates the



## EXPLANATION OF FIGURES.

FIG. 1.—*Sacculina panopæi*, female enlarged (male unknown). Ventral view. Color brownish.

*c*, abdominal, sub-segmented portion.

*b*, thoracic portion, the sac filled with eggs.

$\left. \begin{array}{l} a^1, \\ a^2, \\ a^3. \end{array} \right\}$  the last three segments of ventral surface of abdomen of *Panopæus herbstii*.

FIG. 2.—*Sacculina panopæi*, female, enlarged. Lateral view.

*a*, abdomen of *Panopæus herbstii*.

*c*, abdominal portion with sexual orifice.

FIG. 3.—Nauplius stage of *Sacculina purpurea*. (After Fritz Müller.)

FIG. 4.—Pupa stage of *Lepas australis*. (After Darwin.<sup>1</sup>)

<sup>1</sup> Chas. Darwin. A monograph of the sub-class Cirripedia, 2 Vols., London, 181-54.

youngest or so-called *Nauplius* stage of another *Sacculina*, *S. purpurea*. It is a free-swimming, active larva, has neither eyes nor mouth; its "*cypris*" and pupa stage,<sup>1</sup> differs from the same of the near allied barnacles by the absence of the paired eye on the ventral surface of the head, Fig. 4.

In another later paper<sup>2</sup> I have described and figured the "embryo" of the *Bopyrus* infecting the common prawn, calling that "embryo" the highest and most advanced stage in the development of *Bopyrus*, which, under favorable circumstances, will enter the gill-cavity of the earlier developmental stages of the prawn, where it, as the prawn advances in growth, will, when a female, lose its eyes, both antennæ, the uropods, etc.; while the pleopods will degenerate into the abdominal lobes and from the seventh free segment will bud a pair of legs. What a clumsy and helpless creature the adult female *Bopyrus* is, may be learned from the description and illustration given by me in the two journals cited. But our *Sacculina* is much more degenerate, it is the most utterly reduced parasite known. Its body is a mere sac (measures  $2\frac{2}{5}$ mm in thickness, 6mm in width and  $4\frac{3}{5}$ mm in length, figs. 1 and 2), of kidney shape, convex anteriorly, posteriorly concave in the middle and filled with a great number of minute eggs. Its lower constricted portion is securely attached by a short stem, like a barnacle, to the third last segment on the ventral surface of the abdomen of (in this case a female) *Panopæus herbstii*, which abdomen, upon dissection, exhibits a large number of branched tubes, originating from the stem of the parasite and distributing over and entangling the intestinal tract of the crab, thus endosmotically absorbing nourishment from the same. Some of these tubes terminate blind, others form delicate plexuses. At the upper constricted portion of the bag we notice a small, roundish, fleshy piece, flattened antero-posteriorly. It has some resemblance to the fog-pipe of a steamer. Its posterior surface is convex and sub-segmented into seven parts. It measures  $1\frac{2}{5}$ mm in width and  $1\frac{1}{5}$ mm in length. Its anterior surface is concave and provided at its lower half with a minute opening, the sexual orifice. The convex surface of the sac I presume to be the dorsal side, and the opposite, the concave, I take for the ventral side of the animal. The upper smaller part, resembling a fog-pipe, is the

<sup>1</sup> *Idem*.

<sup>2</sup> AMER. NATURALIST, Vol. XVI, January, 1882, pp. 5-12.

abdominal portion, and its segments are the remainder of the swimming legs of the pupa stage. The main body, the sac, is the thoracic portion of the former pupa. The cause for so reasoning is the supposed existence, in *Sacculina*, of what is known under the name of "dorsal organ" in the young of a great many crustaceans, even if such a structure has not yet been discovered among *Rhizocephala*. The peculiar attitude of the pupa stage in barnacles in the act of permanently attaching themselves to some marine object, tends to an assumption of analogy. I have repeatedly seen the "dorsal organ" and noticed its use in the young of branchipod crustaceans (*Eubranchipus*, *Streptocephalus*, *Apus*, *Chirocephalus*, *Limnetis*, etc.) in attaching themselves to the walls of the breeding jars in which they were kept. This organ appears to be of a glandular nature, is situated in most cases in the occipital region, is strikingly large in the young of some crustaceans, and gradually degenerates in the further development, but persists in some forms. The pupa of *Sacculina* may attach itself head foremost by means of the "frontal or dorsal organ" to the abdomen of *Panopæus*, the mouth and antennæ subsequently degenerate, the intestinal tract develops into a number of cœcal appendages, the latter enter the host, and the swimming feet, or cirri, are lost. The thoracic portion, or sac, is composed of an outer very tough skin and an inner more delicate membrane. This sac presents an analogy to the "marsupium" or breeding cavity of *Bopyrus*, for in it the eggs are hatched and protected until better fit to leave the mother animal. A constant current of sea-water between these two skins may probably exist for the aëration of the young; the entrance and exit for the water must, if there is no other opening, be through the sexual orifice. May not the extraordinary mode of obtaining nourishment render both parasite and host, physiologically considered, so to speak, but one animal? May not thus a condition be effected largely contributing to an oxygenation of the circulating fluid of *Sacculina*, a mere combination, as it were, of that of *Panopæus*? The "division of labor" in circulation, respiration and nourishment may be going on, in spite of the apparent absurdity in certain more or less differentiated individuals of those appendages or tubes. The question, What is degeneration due to as exhibited in *Sacculina*? we answer it is due to two causes: first, being a near relative of the barnacles, it is due to the metamor-

phosis of the Nauplius into a pupa and subsequently into an animal of a sessile and immobile habit of life; second, it is due to parasitism (Symbiosis). An approximate stability of the present form of *Sacculina* is maintained by the important law of heredity, very slow changes in color, form, etc., will, however, make their appearance by changes of climate and immediate surroundings, *i. e.*, the host. In concluding, let me quote from E. Haeckel: "The series of forms which the individual organism passes from the egg up to the development of the adult form is but a brief and rapid recapitulation of the series of forms, which all the ancestors of this organism have passed since the beginning of the organic history of the earth down to the present day. This repetition or recapitulation is conditioned through the laws of heredity and modified through the laws of adaptation. The historical record, preserved in the developmental history of the individual, is rendered gradually obliterate, the development gradually taking a more and more direct course from the egg up to the adult, and it is also often falsified through the struggle for existence which the free-living young are subject to. The falsification of the ontogenetic product is conditioned through the law of the modified or falsified heredity."

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## MEN IGNORANT OF FIRE.

BY TITIAN R. PEALE.

IN theory, mankind differs from all other animals in the habit of cooking his food by the means of *fire*, which, in the progress of civilization, has improved so much as to become a science. Hence there are many grades of progress to be observed between the savage and the civilized man; and hence there are many facts worthy of record by the intelligent traveler, relative to the use of fire. I do not know of any but a single record where natives of a *newly* discovered country did not know the *use of fire*; that one case was on Island *Fanua Loa*, or Bowditch's island, discovered on the 29th of January, 1841, by the U. S. S. *Peacock*, commanded by Capt. W. H. Hudson, of the U. S. South Sea Surveying and Exploring Expedition (see Narrative by Ch. Wilkes, Vol. v, p. 10).

Captain Hudson relates: "The natives were at first very shy of the boats; but the Hawaiians who were in them soon induced them to approach, and to enter into trade, and finally enticed