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A NEW CANADIAN CIRRIPEDE, PARASITIC ON A SHRIMP.

(Resumé of Mr. F. A. Potts' research at B. C. Biological Station).

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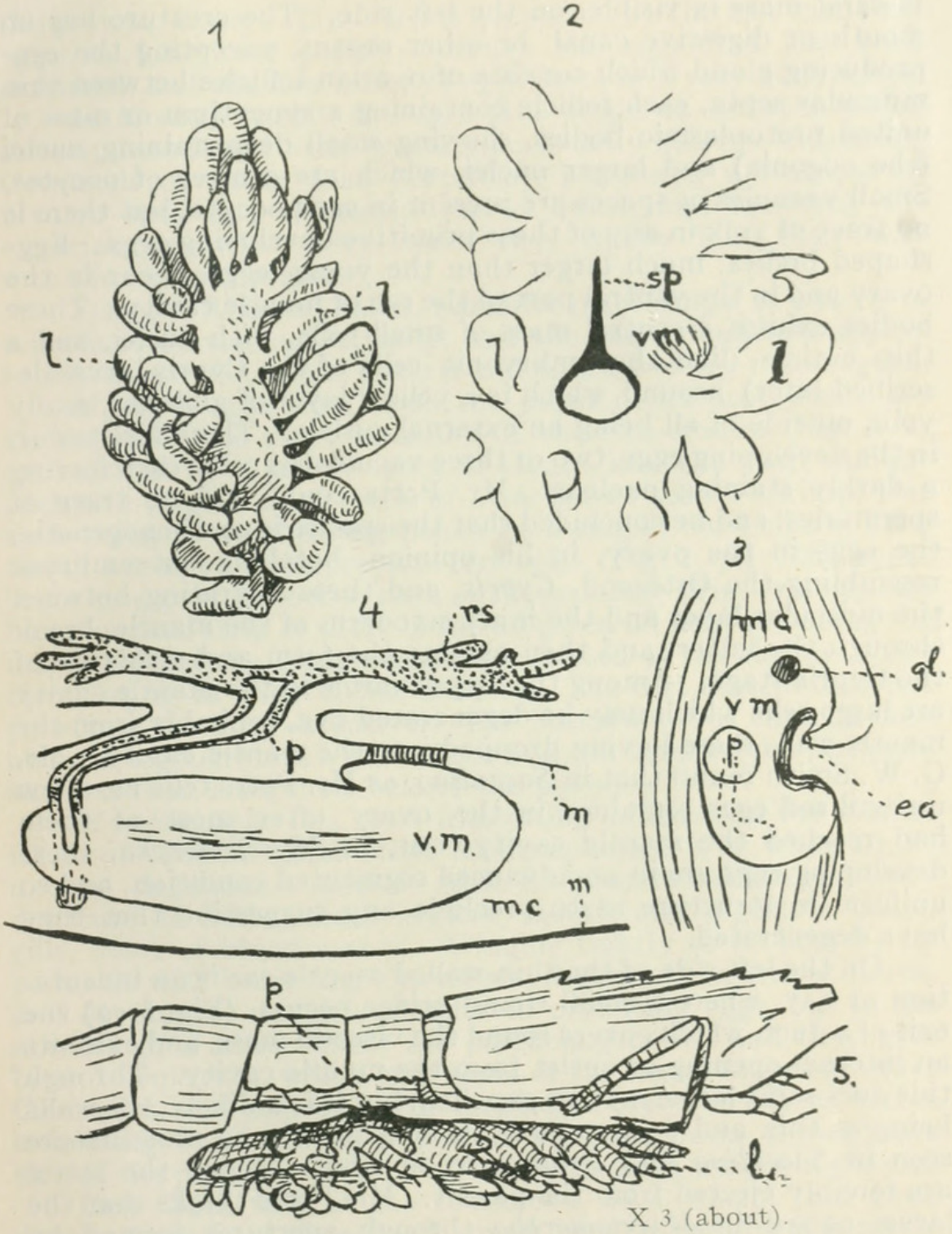
The naturalist who spends hours on the sea-shore, now and then finds specimens of shore crabs, on the under-side of which is attached a yellowish brown mass, resembling a small potato. This soft rounded lump is really the mature stage of a parasitic crustacean. Just as a pug and a greyhound show dissimilarities, though a child knows that both are dogs, so this sac-like parasite is a crustacean, a member of the Order Cirripedia or Barnacles, which Order, Dr. Starr Jordan says, furnishes an example of "degeneration through quiescence . . . the barnacles being most nearly related to the crabs and shrimps." Charles Darwin gained early fame by his studies of the Cirripedes, and his monograph on the Order is a classic of zoological science. In early life each passes through one or more active stages, and later becomes fixed and wondrously transformed. The transformation is one of degeneration, but while the barnacle (Fam. Balanidæ) is strange enough in its changes, the sub-order Rhizocephala furnish us with the most extraordinary examples. The sac-like parasite referred to above is rightly called *Sacculina*. It comes from the egg as a minute water-flea called a Nauplius, and changes into the more complex Metanauplius, and after swimming about freely it attaches itself to a crab, penetrates the crab's shell with one of its hollow antennæ. Now follows one of the most marvellous circumstances in the entire range of biology. The whole of the soft contents of the Cirripede's body is squeezed through the hollow tube or antenna into the body of the crab, rather recalling a cat squeezing its way through a small drain pipe. Soon it works its way to the intestine of the host, but later pushes to the exterior, hanging on as a sac, below the crab by a short peduncle. The top of this neck shows branching roots, which penetrate the organs of the crab,

extend into its jointed limbs, and thus form a most elaborate network for absorbing the fluid nutriment from its host. The bunch of roots may form a compact matted mass in *Peltogaster*. The crab, though apparently incommoded by this fleshy bag attached to its body beneath, seems not to suffer greatly, but it does not grow much, as moulting of the hard shell is arrested. "Fortunately," says Dr. Arthur Shipley, "*Sacculina* appears to live only three years, and when it dies the crab resumes its growth," but some recent researches by Mr. C. G. Robson point to the death of the crab in some cases, owing to starvation; the fatty materials left being insufficient for its necessities. Professor Giard found in the helmet crab (*Stenorhynchus*) that the penetration of the cirripede-parasite caused the destruction of the ovaries and the spermaries. In the latter event, the male crab assumes some of the features of the female and exhibits a broader tail and smaller pincer claws; but in the female crab, the abdominal feet become smaller in size as in the normal male. The studies of Dr. Geoffrey Smith show, on the other hand, that more yolk-forming material (as in a female crab about to spawn) results in a crab with *Sacculina* attached; and Mr. Robson found an excessive production of fat in the liver and blood in affected crabs of both sexes, resembling the condition of the male when about to cast his shell; or, in the female, resembling her condition when maturing her eggs before depositing them.

It has been reserved for Mr. Potts, a Fellow of Trinity Hall, Cambridge, who came over from England, early in 1911, to pursue marine researches at the Dominion Biological Laboratory, Departure Bay, near Nanaimo, B.C., to discover a new Cirripede, which surpasses all previously described species in its strange structure and life history.* Mr. Potts' main purpose was the study of the Annelids of the Pacific, and his investigation of this new parasitic Cirripede was a subsidiary piece of work, and abundantly shows what interesting original discoveries await biological students who will spend a season or two at any of the Biological Stations of Canada.

Called by Mr. Potts *Mycetomorpha vancouverensis*, this new species, for which indeed a new genus Mycetomorpha had to be established, appears as a fungus-like sac on the under-side of a Pacific shrimp (*Crangon communis*, Rathb.), close to the basal joints of the abdominal limbs. (Figs. 1 and 5). In form it is an elongated sac, $\frac{2}{3}$ in. long and $\frac{3}{5}$ in. wide, and beset along the margin by crowded club-shaped lobes, over fifty in number. (Fig. 1 *l*.) The sac is very thin-walled, a delicate muscle-layer being indicated by faint striations, through which the round

* See Mr. Potts' paper in Spengel's Zoologisch, Jahrb. 1912, pp. 575-594, 2 Pls.



X 3 (about).

Fig. 1. *Mycetomorpha* viewed from the ventral, lower side.
Fig. 2. *Myce.omorpha* upper or dorsal side, showing chitinous ring around the peduncle, and anterior spike.
Fig. 3. Diagram showing position of some organs, and bay on one side where mantle duct opens (ea).
Fig. 4. Diagram of visceral mass, peduncle and roots in section.
Fig. 5. Diagram of side view of *Mycetomorpha* attached to the shrimp.

ea. external aperture of duct
gl. modified colleterial gland
l. lobes of *Mycetomorpha*
m. mantle
mc. mantle cavity
p. peduncle of attachment
rs. root-system
sp. chitinous spike
vm. visceral mass.

visceral mass is visible, on the left side. The creature has no mouth or digestive canal, or other organs, excepting the egg-producing gland which consists of ovarian follicles between thin muscular septa, each follicle containing a syncytium or mass of united protoplasmic bodies, showing small deep-staining nuclei (the oogonia) and larger nuclei, which are centres of oocytes. Small vacuoles or spaces are present in each oocyte, but there is no trace of yolk in any of these primitive developing eggs. Egg-shaped bodies, much larger than the young eggs, occur in the ovary and in the ventral part of the sac or mantle cavity. These bodies exhibit a central mass of small cells, with nuclei, and a thin cuticle (like the embryonic cells of the Cypris-larvæ described later) around which is a yellow layer of globules, really yolk, outside of all being an external cuticle. There also occur, in the developing eggs, two or three vacuolated cells, each having a darkly staining nucleus. Mr. Potts could find no trace of spermaries, and he concluded that the species is parthenogenetic, the eggs in the ovary, in his opinion, hatching out embryos resembling the Ostracod, *Cypris*, and these migrating between the muscular layer and the inner ectoderm of the mantle, break through the latter, and then assume the form and structure of the Cypris stage. Among the Cypris-larvæ in the mantle cavity are large cells which may be degenerated ova, probably from the mantle wall, these having dropped into the mantle cavity. Mr. G. W. Smith found that in *Sacculina*, as Mr. Potts tells us, a few unfertilized eggs remained in the ovary after most of them had reached the mantle cavity; but, in *Mycetomorpha*, these developing eggs are in an advanced segmented condition, and so uniform in structure as to preclude any suggestion that they have degenerated.

On the left side of the thin-walled mantle sac is an indentation or bay, where a small round orifice occurs, (Fig. 3 *ea*) the exit of a duct, which curves round the visceral mass, and exhibits an internal opening or outlet from the mantle cavity. Through this duct some larvæ may be expelled, but it is unlikely, the walls being so thin and delicate, and lacking the strong musculature seen in *Sacculina* and *Peltogaster*, in which species the larvæ are forcibly ejected from the parent. Mr. Potts thinks that the larvæ escape in *Mycetomorpha* through apertures formed by the thinning away of the mantle at certain points. In the two Rhizocephalans, referred to, special colleterial glands secrete tenacious matter to bind the eggs in a mass and attach them to the mantle, and in this new form two disc-like patches occur on the upper (Fig. 3 *gl.*) and lower surface of the visceral mass, which from their position, etc., appear to correspond to such glands modified, and now secreting yolk-matter and nourishing

the growing ovary. This view is supported by the fact that they were in functional activity though the eggs had just been extruded, and the new series of eggs were in a very early stage.

As already stated, the eggs give origin to embryos which develop into active little crustaceans exactly like free-swimming Ostracods or water fleas (Cypridæ), possessing a transparent bivalve shell and numerous paired limbs, and crowding the capacious mantle cavity, until they finally find their way into the external water.

Sylon, a Rhizocephalan, parasitic on shrimps, is known to reproduce parthenogenetically, and the same doubtless applies to *Mycetomorpha*, as Mr. Potts found no trace of any male organs.

Mycetomorpha lives upon the juices of its host which are sucked in by the short branches of the root-system (Fig. 4 *rs*) and carried by a hollow space or lacuna into the short oblique peduncle (Fig. 4 *p.*) or neck of attachment to the shrimp, this neck being as usual strengthened by a ring of hard chitin, from which a median spike projects forward. (Fig, 2 *sp.*) The upper branching part or root-system of the peduncle (Fig. 4 *rs*) appears like a matted strip of short branches given off laterally along the under side of the great ventral nerve cord of the shrimp, these terminating in the ventral muscles. The root-system does not penetrate the host extensively, like *Sacculina*, but extends only about a segment and a half of the body in front of the peduncle and less than a segment behind the peduncle.

Mycetomorpha is a most interesting addition to the marine fauna of Canada. Like other Rhizocephalans it is, when adult, a most degenerate animal, with its rounded shapeless body destitute of limbs, sense organs, mouth and digestive canal, gills, heart or blood-vessels. Clinging tightly to its host by its peduncle with branching extensions, it sucks the nutrient juices, and devotes its sluggish energies to producing eggs, but in the absence of a male, these are parthenogenetic, and they give birth to embryos, which skip some of the larval stages of other Cirripedes, and appear in the mantle or brood cavity as active swimming Cypris-larvæ, and seem to then burst through the skin of the parent to wander about in the open waters of the sea.

Carl Claus said of the Crustacea, as a whole, that their development from the egg is "almost never direct, for it is rarely that the young, after hatching out, possess the form which they will have when adult. Almost always there is a complicated metamorphosis, and when they are destined later to live the life of parasites, the metamorphosis is regressive." *Mycetomorpha*, in its young stages, could hardly be more unlike its adult form, and in its development and mode of life it is a remarkable illustration of degenerative evolution or regressive development.