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INFANT CANNIBALISM AMONG ANIMALS.

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In a paper which I read to the Royal Society (Sect. IV) in May last I dealt with the two series of phenomena grouped under the somewhat forbidding titles, polyembryony and pædophagy. They may be regarded as the two opposite extremes of embryonic evolution and the survival of the fittest. In the former (polyembryony) we find that a few eggs give origin to an excessive number of young, while, in the latter, very few young result from a large number of eggs. Biologists have generally accepted the late Dr. W. B. Carpenter's definition of an individual animal as the total product of a single ovum, but our ideas of the potentialities of the egg will require revision with the foregoing phenomena before us, and in my Royal Society paper I ventured on some suggestions as to the significance of recent observations, very curious ones, made by certain biologists, Dr. Gilchrist, Dr. Sylvestri, Marchal, and others, which I intend to publish with plates ere long, but in the present brief article I shall deal only with pædophagy, avoiding technical terms as far as possible.

Fifty years ago Dr. Carpenter, one of the profoundest and most philosophical physiologists and morphologists of the 19th century, discovered that, from the numerous eggs (500 or 600 at least being produced by one parent each season), of that common sea-shore mollusk, the dog whelk (*Purpura lapillus*), not more than thirteen to twenty embryos finally emerged into the open water. To quote the succint description of Carl Claus, "The Prosobranchs enclose their ova in capsules.. attached....to each other or to foreign substances. Each nidamental capsule of the group shows an aperture, and contains a certain number of vitelline globes or eggs, floating in clear jelly-like albumen. Only a portion of these develop into embryos. One only may,

in an extreme case, finally quit the ovigerous capsule."* Koren and Danielsson in 1857 studied the eggs of the large whelk (*Buccinum*) and decided that many eggs united to form one large embryo, the remaining eggs dying and breaking up; but, immediately after the publication of the Danish observers' views, Dr. Carpenter gave the correct account of the strange phenomenon, an account supported by the later researches of Dr. Dyster. Part of the eggs are fertilized and part are not fertilized but are devoured by the former while still contained in the capsule. Long before the infant mollusks become active "veligers." or free-swimming larvæ, with a crown of waving cilia, they turn cannibal. Dr. Carpenter noticed that some larvæ did not devour their fellows; but depended for nutriment upon their own stock of yolk-macromeres. These became stunted, and many died. The macromeres, it is hardly necessary to say, are the large segments at one side of the egg, as distinguished from the micromeres at the other side, the latter forming the germ. Selenka confirmed Dr. Carpenter's results but held that the cleavage of the early unfertilized egg was not true segmentation, and inferred that, while the minute features of the yolk, in both kinds of eggs, appeared to be the same, there was no nucleus discoverable in the unfertilized eggs. In the Gastropod *Tergipes ansea* he found that when this irregular segmentation took place, portions of the yolk were thrown off, developed cilia, and became independent moving "cosmellæ," as Von Nordmann called them, and they have been regarded as parasitic in nature. Edouard Claparede, again, from his study of *Neritina fluviatilis* was able to further confirm Carpenter, and Blochmann discovered, in the same small fresh-water shellfish, that one embryo only may survive out of 70 or 80 contained originally in one capsule. Dr. W. K. Brooks announced, more recently, that in the egg-case of *Urosalpinx*, containing six to twenty ova, many of them are devoured by the others both in the earlier and the later stages of embryonic development. Professor J. P. McMurrich, of Toronto, has confirmed these last results by a study of *Crepidula* and *Purpura floridana*, finding that a number of eggs always break down or disintegrate to serve as food for their surviving brethren. In *Fasciolaria tulipa*, one of the Muricidæ, he noted that four, or five, or six, embryos may ultimately emerge from one nidamental capsule, which originally contains about two hundred eggs. But not only in

*Haacke has stated that in certain Australian Rays (Tryogorhina and Rhinobatis) more than one ovum is contained in one horny capsule, and Dr. Otto Klotz, of Ottawa, brought the same fact to my attention in the huge British Columbia skate (*Raia cooperi*, Gir.)

mollusks has this curious fact of pædophagy long been known it has been noticed among the Crustacea. Thus in *Daphnia*, the delicate water-flea, while the eggs are still in the tubular ovary, the ovigerous cell may divide into four, one of which becomes an ovum and increases in size by devouring the other three. In the Phyllopod *Apus*, the egg when first distinguishable, is not a single cell, but a group of four cells each with a large nucleus. The nucleus in one assumes a different character, becomes clearer, and more rotund, exhibiting two or more large granules or germinal spots, while the three others show a mass of granules in the nucleus. These three nuclei grow rapidly, elaborate food, and feed the fourth cell so that it survives, while they themselves disintegrate. No doubt this strange phenomenon of cannibalism, in the earliest stages of development, may be more widespread than is at present supposed. Botanists have long been familiar with a parallel condition in certain plants. Thus, in the Mistletoe (*Viscum album*), one seed may contain two or three embryo plants. Some years ago Dr. Beard, of Edinburgh, boldly compared the embryo of the highest Vertebrates to a parasite receiving nutriment by a placental arrangement from its parent. About the same time Professor McIntosh, of St. Andrews, published an account of the remarkable features of the ovary in *Zoarces viviparus*, the viviparous blenny, the ovarian walls being complexly folded and richly vascular so that the young fish inside are bathed in a nutritive serum until far advanced in larval life. In making sections of the ovary, and contained young, of that species over a quarter of a century ago, I found what appeared to me to be particles of yolk in the alimentary canal which I had difficulty in tracing to the so-called absorption or inclusion of the yolk-sac. Dr. Scharff, of the Royal Museum, Dublin, was at the same time making a study of the early egg in *Zoarces* and other fishes, and the number of eggs present in the ovary of the viviparous blenny struck me as remarkable if only 12 or 15 young were ultimately produced. Could it be that in some way the non-developing eggs served as food to nourish the rapidly growing larvæ emerging from a limited number of ova? The question presented itself to me. It appeared possible but hardly probable.

Dr. Gilchrist, a distinguished Scottish biologist, and officially in charge of the fisheries of Cape Colony for some years, has shown that such a surmise was not far astray. He has proved it to be true in the South African *Catætyx messieri*, Günther, a fish 1 to 2 feet long, and occurring apparently at considerable depths ranging from 400 to 700 fathoms. H.M.S. "Challenger," in her famous scientific cruise, secured a male

specimen 8 inches long in Messier Straits, but Dr. Gilchrist's specimen 2 feet long obtained in September, 1903, about 40 miles north-east of Cape Point, proved to be a mature female specimen in which the ovaries were very advanced and crowded with reddish spherical eggs, numbering probably not less than 30,000.*

The eggs were formed in the hanging transverse folds of the inner ovarian surface, and later they collected on the floor of the chamber of the ovary. They flowed freely from the fish, and Dr. Gilchrist was led to regard them, at first, as ordinary demersal eggs, deposited by the fish on the bottom of the sea. To his surprise he found, on closer examination, very young fish hatching out within the parent. Eight small larval fish were curled up among the loose ova. In the mouth of one larva he found some oil-globules, and in another a mass of soft food-matter, in which were oil-globules and spots of black colour. The mass was carefully removed and turned out to be part of a young fish which was being devoured by another baby fish, and the rest of the body of the victim was found close to its devourer. Alcock had already made the important announcement that in *Saccogaster*, a deep-sea species, developing embryo fish were found inside the parent and hinted that they fed on the surrounding ova; but Dr. Gilchrist's discovery proved that some embryo fish actually swallowed and fed upon other embryos of the same brood, and thus lived and grew inside the ovarian chamber. The larger larvæ 10 mm. ($\frac{2}{5}$ of an inch) long, lived on the smaller newly-hatched young, not simply upon the surrounding eggs. These larval cannibals showed well-developed breast fins, and anal and pre-anal fin-lobes, but the tail had not any caudal fin-lobes.

Most fish, of course, produce eggs or spawn, and the young develop and hatch after they have been laid by the parent. The formation of the young inside the deposited egg of a fish, may take from 2 days to 6 or 8 months in different species, the shad being an example of rapid development (a few days), while the salmon or trout take a long period of time (many months). But in the parent forms of many viviparous fish the young may be found not only already hatched out and lively, but may be very advanced, and exhibit the almost mature form and appearance. I have frequently examined specimens of viviparous species both on the Atlantic and Pacific coasts, and can confirm Dr. Günther's description that the young, in such fish as *Zoarces*, on the Atlantic, and *Cymatogaster*, on the Pacific, coasts,

*Dr. Gilchrist had in August, 1903, secured a fine specimen 2 feet long.

are so matured at the time of their first extrusion, they swim about with the utmost agility, and Dr. Dowler's remarks on *Pœcilia multilineata* that twenty-two young were packed away in the ovarian sac of the parent, and though no ova were discovered . . . the young fish were one-half inch long, all alike, and exactly resembling the maternal form and proportions. The parent was, it may be added, only 2 inches long. In the sea-perch (*Cymatogaster*) of British Columbia, a viviparous form 6 or 8 inches long, I counted forty-three small, perfectly formed young. They were so advanced and active that when dropped into the sea, just after being extruded from the parent by pressure, they swam away with great agility. It may be that they did not long survive, but to all appearance they were able to look after themselves. Inside the parent I found them closely packed, overlapping each other in the sac, and bathed in a clear serum or fluid, no doubt of a nutrient nature. That they have solid food is very probable in the light of the recent observations just outlined, and though no loose eggs have been noticed in the sac, such eggs may form nutriment for them after their own ball of food-yolk is exhausted.

In the higher orders, the mammals for instance, ova are produced in prodigious numbers each season, even though the young developed and born be extremely few. One author records that over 70,000 primordial eggs are produced annually in a mammalian ovary though the young born may be only one to three in the course of the year.

The survival of the fittest is a principle not applicable only to the mature period of an animal's existence, but may begin with the earliest stages of embryonic and larval life. We see that it finds illustration in the first stages of an animal's life, in the most diverse forms from Mollusks up to Man.

MEETING OF THE ENTOMOLOGICAL BRANCH.

Meeting held at residence of Mr. Arthur Gibson, 9th April, 1908. Present: Messers. Harrington, Baldwin, Letourneau, Metcalfe, Young, Halkett, Fletcher, Wilson, Newman and Gibson.

Mr. Harrington exhibited 2 cases, which contained his Ottawa collection of Chrysomelidæ. Over 100 local species were represented. This collection proved of exceeding interest to all present and much discussion took place on many of the species. Mr. Harrington drew special attention to those species which are of uncommon occurrence, some of which were repre-