

The embryo develops in the middle of the endosperm tissue (Fig. 6) and finally displaces it.

The formation of two-celled glandular hairs on the ovule after fertilisation has been noticed in this species. These glandular hairs persist for a long time during endosperm development.

In conclusion, the author wishes to record his sincere thanks to Dr. M. A. Sampathkumaran, Professor of Botany, for his kind criticisms.

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<sup>1</sup> Schnarf, K., *Vergleichende Embryologie der Angiospermen*, Berlin, 1931.

<sup>2</sup> Ruttle, M., "Cytological and Embryological Studie on the Genus *Mentha*," *Gartenbauwiss.*, 1931, 4, 428.

<sup>3</sup> Carlson, E. M., and Stuart, B. C., *New Phytologist*, 1936, 35, No. 1, 68.

<sup>4</sup> Junell, S., *Sartryck ur Svensk Botanisk Tidskrift*, 1937, Bd. 31, Hft. I.

<sup>5</sup> Narasimha Murthy, S., "Studies in the Labiate, I" *Journal of the Mysore University*, 1940, 1, Part 10, 97.

ON TWO KINDS OF FISH EGGS  
HATCHED OUT IN THE LABORATORY  
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THE occurrence of two types of fish eggs, namely, those of *Anodontostoma chacunda*\* and of *Caranx crumenophthalmus* in the plankton obtained from a depth of 4 fathoms at a distance of 2 miles from the shore, opposite the Marine Biological Station, in January 1940, aroused fresh interest in the study of fish eggs which is one of the routine items of work in the Biological Station. Both fishes are economically important. The horse mackerel is more abundant than the other in the West Coast and on an average about 55,000 maunds of fish valued at Rs. 52,000 are landed every year. In the year 1938-39 this fishery yielded a maximum of 229,257 maunds valued at Rs. 1,70,416.

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I. ANODONTOSTOMA CHACUNDA

Five batches of eggs of this fish came under observation in January 1940 on the 15th, 16th, 17th, 24th and 29th respectively. They were isolated from the inshore plankton off West Hill. As this fish was practically absent in the catches made by the fishermen in January, one is led to conclude that they were spawning off shore beyond the reach of the fishermen. By special efforts, two specimens of this fish were obtained through the assistance of the hook and line fishermen† from the off shore 10 miles away. Both happened to be females with ripe ovaries. The ova were transparent. Needless to say, artificial fertilization could not be tried in the circumstances.

8 A.M. The eggs were identified as those of *Anodontostoma chacunda* with the help of Delsman's description.<sup>2</sup> The eggs found in the morning plankton were fairly advanced in development, suggesting that they might have been laid the previous night, as is well known in the case of most of the fishes in tropical waters. The eggs are of a slightly yellow colour but the oil-globules are colourless. The embryo is formed showing the head-fold and the tail-fold. The diameter of the entire egg is about 0.82 mm. The number of oil globules is 6.

9 A.M. After the lapse of one hour, the egg swells a little, evidently through the absorption of water, for its diameter has now increased to 1.05 mm. The number of oil-globules is 12. It could not be ascertained if this increase in number was due to a division of the original oil-globules or to the addition of oil-globules which rose *de novo*. The head of the embryo is differentiated; optic vesicles are formed and the tail becomes a little curved at the other end, thus showing the progress in the growth made by the embryo. The chromatophores make their appearance in the middle portion of the embryo.

11 A.M. At the end of 3 hours the curved embryo has embraced the yolk completely, the diameter of the egg being 1.14 mm. and there are 20 oil-globules. These are no longer distributed over the yolk mass but are crowded

together at the region corresponding to the middle of the future larva and the posterior portion of its yolk-sac.

About 1 p.m. the larvæ generally hatch out. Their average length is 2.66 mm. The eyes are well developed. The auditory vesicles are formed. The contraction of the heart is evident. The oil-globules are collected at the posterior region of the yolk-sac. The anus is at a distance 1.88 mm. from the tip of the head. There are 35 myotomes in front of the anus and 12 behind it. The chromatophores make their appearance along the dorsal region of myotomes and are also found in the head region above the auditory vesicle.

In twenty-six hours, the larva has grown to a length of about 4.28 mm.

The larvæ that hatched out on 29-1-1940 lived for 36 hours. Their length was 4.35 mm. The heart was slightly bent in the shape of 'S' and its contractions can be seen clearly. The eyes have become deeply pigmented. The yolk has been completely absorbed. The pectoral fins make their first appearance as lobes. There are now 25 myotomes in front of and 22 behind the anus. According to Delsman there are 41 myotomes in the larva corresponding to the 41 vertebræ in the adult. But the larvæ in question had 47 myotomes. Further investigation appears to be necessary to reconcile this difference.

The phenomenon of the forward movement of the anus and the consequent reduction in the length of the trunk and increase in the length of the tail well known in the development of certain fishes is also seen here.

There are not many differences between the eggs described by Delsman and the eggs described by us. The fish according to the observation of Delsman spawned in the sea off Batavia in March where the water had a salinity of 29<sup>0</sup>/<sub>00</sub>. He had also collected the fish eggs near Labuan, in September, where the salinity was 33<sup>0</sup>/<sub>00</sub>. The salinity of the water off West Hill where we got these fish eggs was about 33<sup>0</sup>/<sub>00</sub>. The fact that these fish eggs were also found in the plankton off West Hill

from November 1939 till the end of February 1940 suggests that the spawning season of this fish extended from November to February during the period under our observation.

## II. *CARANX CRUMENOPHTHALMUS*

In Indian waters no less than 26 species of caranx occur according to Day and the task therefore of referring the carangoid eggs found in plankton to the particular species will be a laborious one. According to Delsman<sup>3</sup> the eggs of the genus caranx are characterised by (a) the frothy nature of the yolk mass in the egg and by (b) the presence of a single large oil-globule in the anterior part of the yolk-sac in the newly hatched larva.

In the plankton collected in the sea off West Hill, eggs of the description given by Delsman are of common occurrence. In January of 1940, a carangoid egg happened to be abundant which event facilitated hatching. Three batches of eggs were hatched on 15-1-1940, 24-1-1940 and 29-1-1940 respectively. The colour of the egg was light yellow; the diameter of the egg was about 0.78 mm.; and the single large oil-globule measured about 0.24 mm. which is nearly a third of the diameter of the egg. The yolk mass was vacuolated. It should be stated that these eggs when isolated at 9 o'clock in the mornings, were in a state of advanced development. The embryo has been differentiated, the head and tail being prominent. This naturally leads one to believe that they must have been laid during the previous night. The oil-globule showed brownish red pigment-spots. This character distinguishes the eggs of carangoids from those of clupeoids which is the only other group of fishes that possesses eggs having vacuolated yolk.

Most of the eggs isolated in the laboratory hatched out at about 1-30 p.m. The length of the newly hatched larva is 1.35 mm. The oil-globule is in the anterior portion of the yolk-sac. The length of the tail is 0.75 mm. and the diameter of the oil-globule 0.15 mm. There are 7 myotomes in front of and 17 behind the anus. As regards the number of

myotomes, Delsman (3, p. 209) observed as follows:

"For the number of trunk myotomes I found as a rule 12 sometimes 11 or 13, for those of the tail some 14, although in quite young larvae, newly hatched, this number might amount to 16 or 17, besides the unsegmented part of the mesoderm corresponding to the urostyle. From this it is evident that the number of trunk myotomes as well as that of the tail myotomes decreases slightly during development. As stated above, the number of vertebrae in both species is 10 plus 14 (the urostyle included)."

Our observation does not support Debanan in this respect. The total number of myotomes was 24 in the larva corresponding to the 24 vertebrae of the adult carangoid.

These larvae as soon as they hatch out were found swimming at the bottom of the vessel and not coming up to the surface. This perhaps indicates that in the sea the larvae as soon as they hatch out descend down seeking the lower strata of the sea. The length of the larva, 20 hours after hatching is 1.95 mm. and the diameter of the oil-globule 0.1 mm.; the latter shows a reduction in size due to the oil being used up. There are 7 myotomes in front of and 17 behind the anus. A larger portion of the yolk-sac is absorbed. There are three distinct patches of chromatophores along the ventral side of the myotomes posterior to the anus. The head is slightly opaque. Two dark patches of melanophores are found in the anterior portion of the head.

In the next stage examined, i.e., 44 hours after hatching, the length of the larva is 2.4 mm. There are 10 myotomes in front of and 14 behind the anus. The anus has shifted backward a process just the opposite to what was observed in the case of the larva of *Anodontostoma chacunda*. The eyes have almost turned black with a silvery eyelid. Chromatophores make their appearance along the dorsal portion of the myotomes in three patches. When the larva is 64 hours old, the yolk is completely absorbed. The eyes have become very dark and the auditory vesicles are well developed.

Debanan<sup>2</sup> has found the eggs of *Caranx crumenophthalmus* in plankton collected in May and June in the Java Sea. This perhaps indicates that this horse-mackerel has a different spawning season in the Arabian Sea. It is also interesting to note that generally this horse-mackerel locally called "Chamban" in Malabar is very rarely caught by the fishermen during the months of January and February. This fish is landed in plenty from July to November.

In the case of eggs of both the fishes described above, it is highly interesting to note that they are fairly common in the plankton during the months when the parent fishes are rarely caught. The inference, therefore, that during the spawning season these fishes seek breeding grounds far away from the shore beyond the fishing zone of the fishermen does not seem to be unreasonable.

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\* We have adopted this name from C. Tate Regan (5) Day's name for this fish is *Chatoxyrus chacunda*.

† These fishermen go beyond the zone usually fished by net fishermen.

<sup>1</sup> Day, F., *Fauna of British India: Fishes*, 1 & 2.

<sup>2</sup> Debanan, H. C., *Fish eggs and larvae from the Java Sea*, 1926, No. 8, p. 380.

<sup>3</sup> —, *Ibid.*, No. 5, p. 100.

<sup>4</sup> —, *Ibid.*, No. 6, 7.

<sup>5</sup> Regan, C. T., *Ann. Mag. Nat. Hist. English Series*, 19, No. 112, p. 316.

## MICRO-ESTIMATION OF NITROGEN BY OXIDATIVE DIGESTION

OXIDATIVE digestion<sup>1</sup> has been successfully applied to the rapid micro-estimation of total nitrogen in biological materials. The procedure is simple and rapid and may be outlined as follows:—

An aqueous solution or suspension (1 ml.) of the material is pipetted into a micro-Kjeldahl flask and treated with 2 ml. of