FISH EGGS AND LARVAE FROM THE JAVA SEA [1])

by

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21. Eel eggs.

Eel eggs are fairly common in the surface catches with the egg-net. They may be recognized at once by their big size, the segmented yolk and the very spacious egg membrane. Most numerous are those without an oil-globule and which probably belong for the greater part to the many species of *Muraena* inhabiting especially the coral reefs. According to the size I first thought that three species might be distinguished among these eggs, one with a diameter of 4 mm, one with a diameter of 3.4 mm and one with a diameter of 2¾ mm. But if we look at the larvae hatching from them and especially at the numbers of the trunk- and tail-myotomes, we get the impression that they include more than three species. The number of trunk myotomes e.g. may vary between 54 and 100, showing maxima around 54, 63, 74, 83, 93 and 99. Figs. 1 - 3 relate to an egg of the smallest type, having a diameter of about 2¾ mm. and producing a larva with about 74 trunk myotomes and about 70 tail myotomes (sometimes up to 80 - 90).

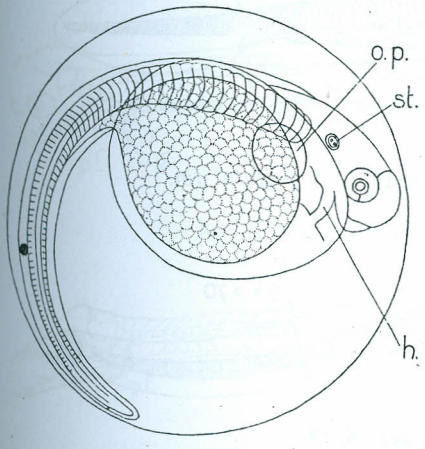

Fig. 1. Eel egg without oil globule, fished near Labuan (Sunda Strait), June 26th, 1924, 8.30 a.m. × 19. h, *heart*, o.p. *oesophageal pouch*, st. *statocyst*.

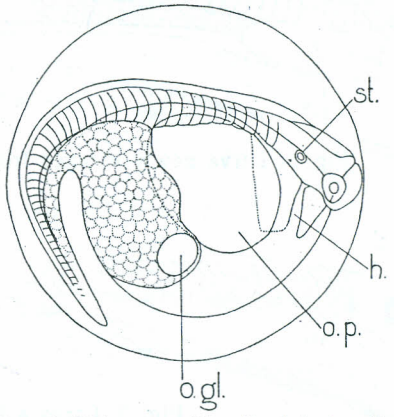

Fig. 4. Eel egg with oil-globule, diameter 2,4 mm, fished in Sunda Strait June 25 th, 1924, 7.30 a.m. × 19.

[1]) Cf. Treubia Vol. II, p. 97, Vol. III, p. 38, Vol. V, p. 408, Vol. VI, p. 297, Vol. VIII, p. 199 and p. 389, Vol. IX, p. 338, Vol. XI, p. 275, Vol. XII, p. 37 and p. 367, Vol. XIII, p. 217 and p. 401; Vol. XIV, p. 109.

We will, however, mainly deal in this article with a few kinds of Apode-eggs which contain one or more oil-globules. The development of this type of egg has been described first in 1888 by RAFFAELE [1]) in Napels and has been studied afterwards, in 1900, by EIGENMANN [2]) in Woods Hole. RAEFFAELE mentions five different kinds of eel eggs from the Bay of Napels, one of which has no oil-globule. He did not go further than alluding to the possibility that these eggs might belong to Muraenoids. This was soon after confirmed by GRASSI and CALANDRUCCIO who showed that the newly hatched larvae described by RAFFAELE have essentially the characters of the Leptocephali which have been identified by the former authors as eel-larvae.

EIGENMANN traced the development of an egg of this type containing one or a few light-yellow oil-globules and evidently closely allied to if not identical with nr. 6 of RAFFAELE. The larvae hatching from it also show the same series of black pigment patches along the gut as those reared by RAFFAELE from this egg. EIGENMANN supposes the egg studied by him belongs to the conger eel and as such it is mentioned also in EHRENBAUM's Eier und Larven von Fischen (Nordisches Plankton). This identification has not been confirmed by later investigations. The series of black pigment patches are found again in *Leptocephalus kefersteini* KAUP and this was shown by GRASSI and CALANDRUCCIO to comprise the larvae of different species of Ophichthyids. SCHMIDT [3]), 1912, distinguished three different kinds of

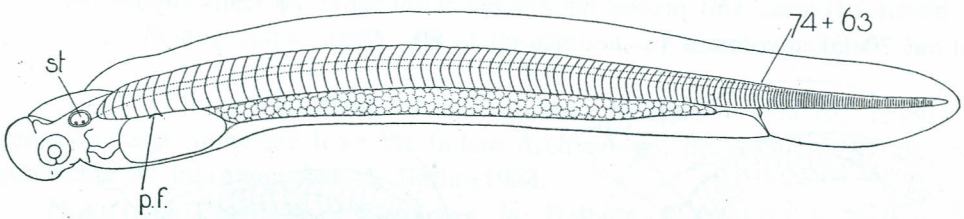

Fig. 2. Larva newly hatched from egg 1, × 19. p. f. *pectoral fin.*

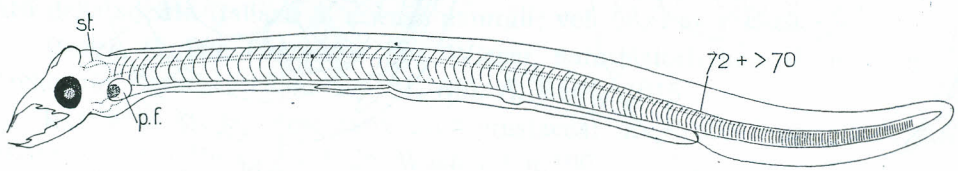

Fig. 3. Larva a few days older. × 16.

[1]) FED. RAFFAELE, 1888, Le uova galleggianti e le larve dei Teleosti nel golfo di Napoli. Mitth. Zoöl. Station Neapel, Bd. 8.
[2]) C. H. EIGENMANN, 1902, The egg and development of the Conger eel. Bulletin U. S. Fish Commission, Vol. 21.
[3]) JOHS. SCHMIDT, 1913, On the Identification of Muraenoid Larvae in their early stages. Meddelelser fra Kommissionen for Havundersögelser Serie: Fiskeri, Bd. 4.

these larvae which he attributes to *Ophichthys serpens* (= *Ophisurus serpens* LINN.), *Ophichthys hispanus* BELLOTI (= *Centrurophis remicaudus* KAUP) and *Ophichthys imberbis* (= *Sphagebranchus imberbis* DE LA ROCHE) resp.

In the surface catches made in the Java Sea similar eggs, provided with a yellow oil-globule and producing a larva with serial black pigment sports, are not rare. I have got the impression that near Java they are most numerous in and near the Straits Sunda and Bali. Two varieties may be readily distinguished, the one slightly smaller than the other.

In appearance and development they show the closest possible agreement with the eggs described by RAFFAELE and EIGENMANN This will be evident at once when looking at the figures 4 - 7. They have been made after eggs which were caught in considerable quantity on July 27th and 28th, 1921, between the southernmost Thousand Islands (north of Batavia). The diameter of the egg membrane is about 2.35- 2.45 mm., the diameter of the egg itself 1.4 mm. The yolk is segmented and contains a yellow oil-globule with a diameter of 0.3 mm. The eggs float with the oil-globule up and the embryo down.

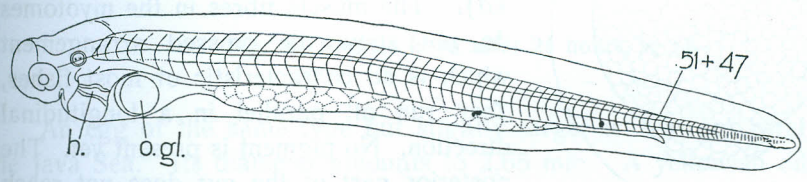

Fig. 5. Larva newly hatched from similar egg. o. gl. *oil-globule.* × 19.

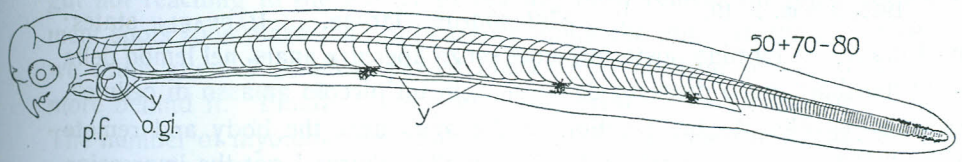

Fig. 6. Larva after 38 hours. y. *rest of yolk* × 17.

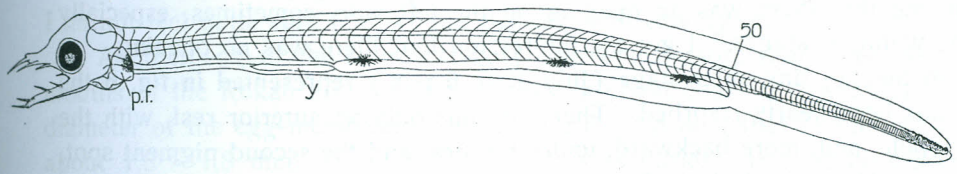

Fig. 7. Larva after 5 days. × 14.

A conspicuous feature of the embryo is the development of a voluminous, empty endodermal pouch between the pericard and the yolk-sac, the „borsa stomacale" of RAFFAELE. It is mentioned, besides bij RAFFAELE, also

by EIGENMANN who calls it the „oesophageal pouch". After the hatching of the larva it flattens out and becomes less conspicuous.

In fig. 4 we see it strongly developed. The heart in this embryo was beating at a rate of 180 pulsations per minute.

I cannot say, how long hatching takes, as the eggs fished were fairly far advanced already. Only in one of my catches did I find a similar egg with a young germinal disc (cf. fig. 8). This catch was made at 9 p.m. so that one feels inclined to suppose that spawning had taken place in the afternoon or at dawn. As this egg was found in a catch which had been fixed as a whole, it could not be reared up to make out how long development takes. At hatching the yolk assumes a much more elongated shape as shown by fig. 5. The oil-globule is always found in the most anterior part of it which is separated by a slight constriction from the rest.

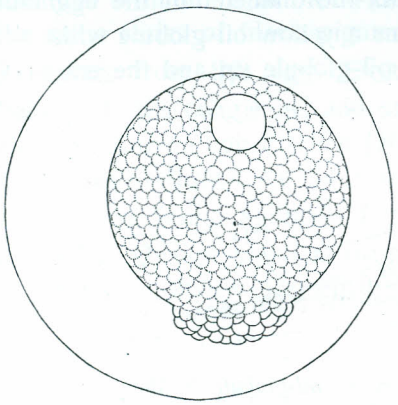

Fig. 8. Egg from station I, March 9th, 1921, 9 p.m. × 19.

In the newly hatched larva (July 29th, 6 a.m.), represented in fig. 5, I counted 51 myotomes in front of the anus and some 47 behind it (the terminal unsegmented part of the mesodern included). The muscle fibres in the myotomes do not show the crossed arrangement which is so characteristic of most fishes, they run all parallel in a longitudinal direction. No pigment is present yet. The posterior part of the gut does not reach to the border of the unpaired fin fold. We have found something similar in certain *Stolephorus* larvae. RAFFAELE states: „L'intestino ..... termina posteriormente senza apertura anale, nel lembo della pinna primordiale, poco discosto del tronco, in un piccolo amasso di cellule". EIGENMANN speaks of „the position of the anus near the body and remote from the margin of the ventral fin fold". In *Stolephorus* I got the impression that there is indeed an opening, situated laterally on the fin fold. With our eel larvae I could not come to a conclusion in this respect. Sometimes it seemed to me that there was an opening on the left side, sometimes, especially in the youngest stages. I got the impression that there was no opening.

In the 1½ day older stage (July 30th, 6 p.m.) represented in fig. 6 the yolk has been nearly resorbed. There remains only an anterior rest, with the oil-globule, and, more backward, under the first and the second pigment spot, a thin stroke situated along the gut. I counted 49 myotomes in front of the anus, whereas the number of post-anal myotomes had increased to 70-80. In the larvae of about 56 days represented in fig. 7 the number of prae-anal myotomes proved to be 50 again, the number of tail myotomes was not determined.

Three paired black pigment spots are characteristic of these older larvae. Also the tip of the tail contains some black pigment.

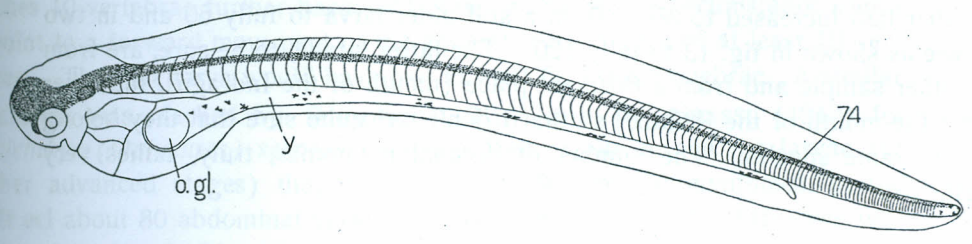

Fig. 9. Newly hatched larva from bigger egg (diameter 2,65 mm). The egg was fished east of the southern Thousand Islands, March 3rd, 1921, and hatched at 11 a.m. × 18.

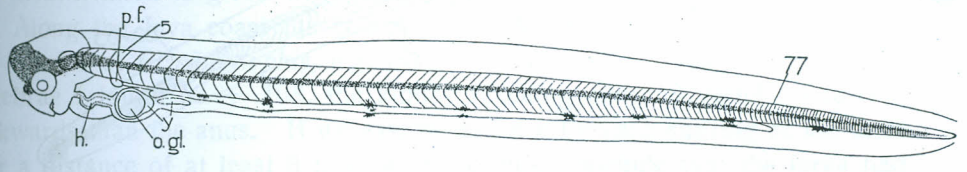

Fig. 10. Similar larva after 24 hours, × 14.

An egg of the same type but slightly larger is also not rarely found in the Java Sea. Its diameter amounts to 2,65 mm. A yellowish oil-globule is present in the segmented yolk. The larvae hatching from these eggs are shown in figs. 9 and 10. Here again we see the posterior extremity of the gut not reaching to the border of the unpaired ventral fin fold. Black pigment spots soon make their appearance along the gut. In the larvae of fig. 9 we count about 7 of these paired black spots in front of the anus and one more behind it. Finally black pigment is present also on the tip of the tail. The number of myotomes in front of the anus was found to be 74-76. In the larva shown in fig 11 it amounts to 80, whereas 63 myotomes could be counted behind the anus.

The number of pigment spots in front of the anus is here 6 only, so that I do not feel quite sure that we are dealing with exactly the same species.

Another egg of the same category was fished more than once near the mouths of the Rokan and the Indragiri river (East coast of Sumatra). The diameter of the egg-membrane was about 2,6 - 2,8 mm, that of the egg itself about 1,6 - 1,8 mm. The yolk contains a colourless or slightly yellowish oil-globule with a diameter of about 0,4 mm.

In the larva hatching from this egg 63 - 65 myotomes could be counted in from of the end of the gut which, here again, does not reach to the border of the unpaired fin fold. In slightly older stages I counted slightly higher numbers of prae-anal myotomes, viz. 68-70. Here again I found the tail con-

tinuing to grow out and the number of tail myotomes increasing after hatching. This seems to me a notable difference from what is found with other fish larvae, e.g. with the related clupeids. In the newly hatched larva shown in fig. 11 ± 30 tail myotomes could be counted, in a slightly older larva this number had increased to 35 - 40, in a still older larva to fully 60 and in two larvae as shown in fig. 13 to fully 120. The latter larvae, to be sure, are from an other sample and from a different place (mouth of the Indragiri, the other from the mouth of the Rokan), so that I don't feel quite sure that they belong to the same species. The number of preanal myotomes, truly, tallies very well.

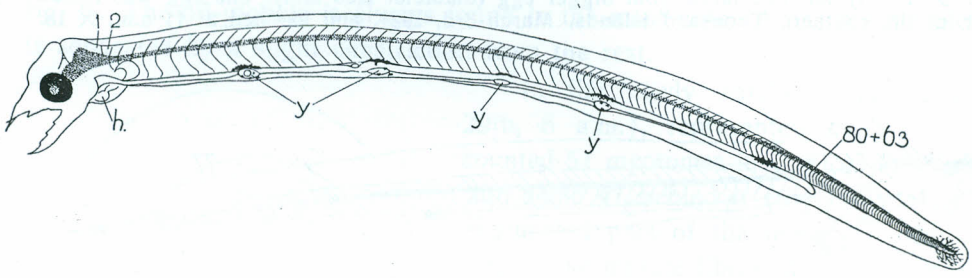

Fig. 11. Larva of two days, from a different egg catch (May 12th, 1924), × 16.

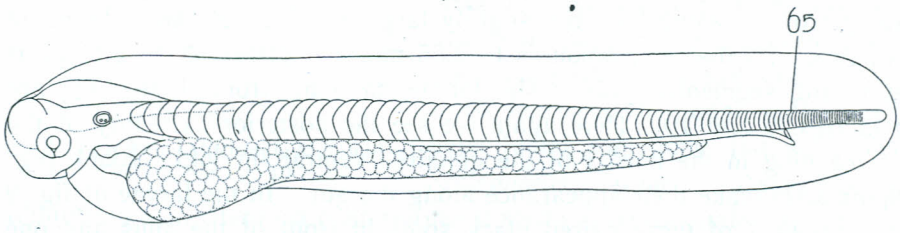

Fig. 12. Larva newly hatched from an egg with colourless oil-globule. The egg was fished near the Rokan mouth, (Sumatra) November 13th, 1923, and hatched during the night, × 19.

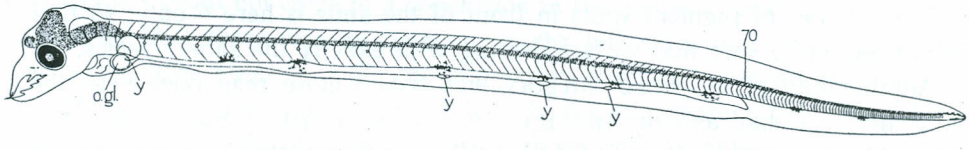

Fig. 13. Larva from similar egg fished in Amphitrite Bay (Sumatra) Sept. 27th. 1929. The larva two days after hatching, length 10 1/4 mm, × 13.

In these larvae we see again the serial black pigment spots appear which are characteristic of the larvae hatching from eel eggs with an oil-globule.

The only Ophichthyid found by my assistant Dr. HARDENBERG during

his stay at Bagan is *Ophichthys macrochir*. Besides this species only three more eels were found: two species of *Muraenesox*, and *Neenchelys buitendijki*.

In *Ophichthys macrochir* we count 50 + 94 vertebrae. The kidney reaches 10 vertebrae further backward than the gut which circumstance seems to point to a forward movement of the anus over a distance of at least 10 vertebrae. Then the larva would have had at least 60 trunk vertebrae. A similar conclusion was reached by SCHMIDT (1913) and by GRASSI (1913) for *Ophichthys (Ophisures) serpens* from the Mediterranean. In the larvae (in further advanced stages) they counted about 90 preanal myotomes, in the adult eel about 80 abdominal vertebrae. (In other species the difference was slighter but also the identification was less reliable in the latter cases).

With all this the assumption seems to be not incompatible that the egg and the larvae of figs. 12 - 13 belong to *Ophichthys macrochir*, of course, this identification is given with some reserve [1]).

Along the Java coast the commonest Ophichthyids seem to me to be a few species of *Pisoödonophis*, e.g. *Pisoödonophis moro*. For the number of vertebrae I found 63 + 108, the kidney reaching about 8 vertebrae further backwards than the anus. If we assume again a forward shifting of the anus over a distance of at least 8 myotomes we must conclude that the larva had more than 70 trunk myotomes.

This might be, then, the larva hatching from the egg nr. 2 (figs. 8-11), but that this assumption does not rest on a very firm foundation, needs hardly be emphasized, as many more species of Ophichthyids occur in Indian waters. From the Java coast e.g. I saw *Pisoödonophis cancrivorus* and *Cirrhimuraena tapeinopterus*, but no doubt there are more, mostly leading a more or less hidden, burrowing, existence. A close investigation might even reveal the presence of species thus far unknown from here.

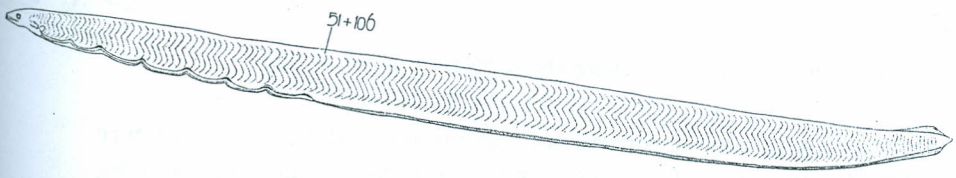

Fig. 14. Larva with beginning metamorphosis fished near Labuan (Sunda Strait), April 8 th, 1924. Length $9^1/_2$ cm.

An older *Leptocephalus* in which metamorphosis has begun, is shown in fig. 14. Numerous larvae of this kind were found among the catches made quite near the coast in shallow water by the fishermen of Labuan (Sunda Strait), April 8 th, 1924. They were mixed with „teri nassi", i.e. young,

[1]) In *Neenchelys buitendijki* Dr. HARDENBERG counted 50 + 85 — 90 vertebrae, a number hardly differing from that of *O. macrochir*.

scaleless, *Stolephorus*. The length was about 95 cm. In front of the anus 51 myotomes may be counted, some 106 behind it. The gut shows a number of constrictions by which it is divided into 7 sections. The structure of the tail is conform to what we find in the adult Ophichthyids: the tip is free. The unpaired fin fold reaches ventrally from the anus to quite near the tip of the tail. Dorsally, however, it is very imperfectly developed, being found only over a very short distance in front of the tip of the tail and rapidly decreasing in a forward direction.

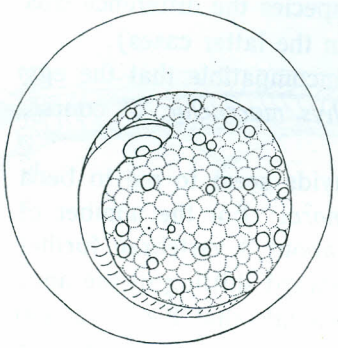

Fig. 15. Egg fished near St-Nicolaaspunt, November 24th, 1921, 8 a.m., × 19.

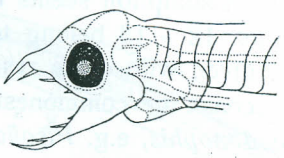

Fig. 19. Larva of 3 days, from the same sample as figs. 15 and 16, × 16.

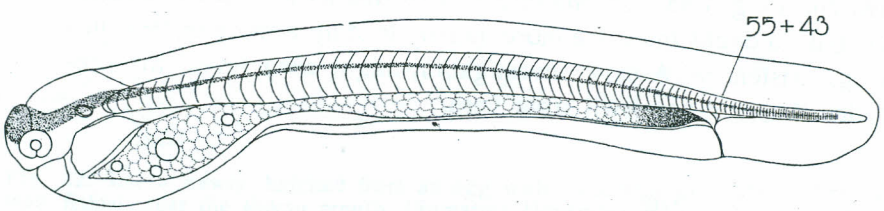

Fig. 16 Larva after hatching (Nov. 25 th, 6 a.m.), × 19.

Another larva, with similar constrictions of the gut and a similar structure of the tail, was found among the „teri nassi" at Batavia. The pigmentation, in the first mentioned larva restricted to a pigment spot over each of the constrictions of the gut (with the exception of the foremost one), is here somewhat more richly developed, scattered spots being present along the gut, the base of the anal fin and along the lateral line. The length of this larva amounted to 120 mm, in front of the anus 72 myotomes could be counted, in the tail 120. The gut was divided by constrictions into 11 sections. All these numbers are higher than in the first mentioned larva. As in the latter the dorsal fin fold is restricted to a short part of the back just in front of the tip of the tail.

Comparing these two larvae with those hatching from the two varieties of eggs described above, one is inclined to bring the former larva into relation with the smaller egg and the latter into relation with the bigger egg. The numbers of trunk myotomes tally fairly well. Those of the tail myotomes evidently increased during development. The numbers of black pigment spots and constrictions of the gut, however, do not tally unless we assume that they are not constant either and increase during development.

I will finally mention here a few other types of eel eggs found occasionally in our catches from the Java Sea.

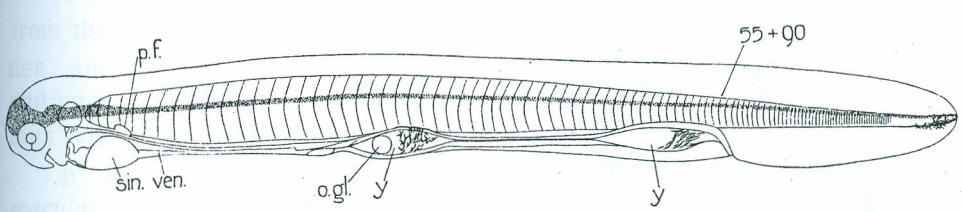

Fig. 17. Larva of 24 hours, × 15.

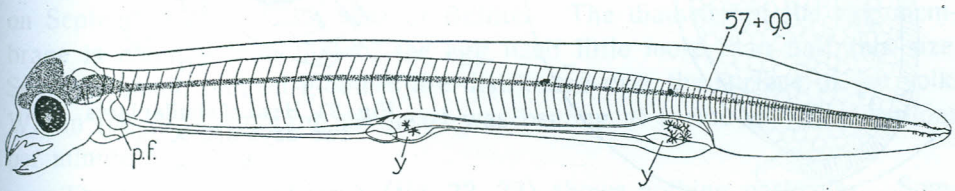

Fig. 18. Larva of fully 2 days, from an egg fished July 31th, 1921, between Pulau Kotok and P. Karang Bras. × 15.

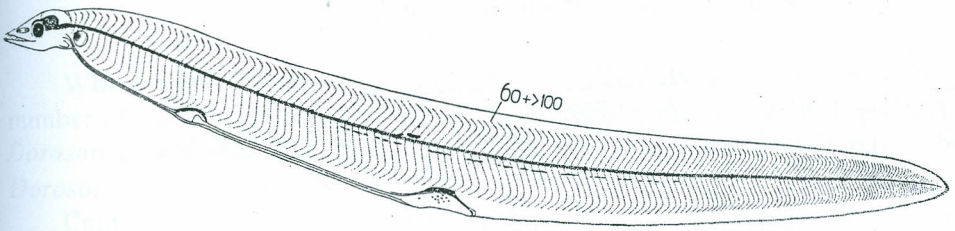

Fig. 20. Pelagic larva caught at station N, July 25th, 1919, Length 44½ mm.

The egg shown in fig. 15 was fished November 24th, 1921, near St. Nicolaaspunt (NW corner of Java) where 10 specimens were found in a haul. Diameter of the egg-membrane 2,15 - 2,35 mm. The yolk, segmented as usual, contains a great number of colourless oil-globules.

The next morning, November 25th, the eggs had evidently newly hatched. The larva is shown in fig. 16. The number of myotomes is 55 + 43. The yolk has assumed the usual elongated shape. The oil-globules, bigger

now but fewer in number, have assembled in the anterior part. The hindmost part of the yolk, near the anus, is conspicuous by not being segmented and by its opaqueness even in the living animal. A larva 24 hours older is that of fig. 17. Here 57 + 90 myotomes may be counted, so that the number of tail myotomes has increased considerably. The yolk has been for the greater part resorbed, the rest forming two thickenings of the gut with a thin connection between them. Black pigment is present on each of these thickenings and the anterior one contains an oil-globule. Behind the heart a spacious *sinus venosus* is to be seen. The eyes show a beginning of pigmentation. Some black pigment is present also on the tip of the tail.

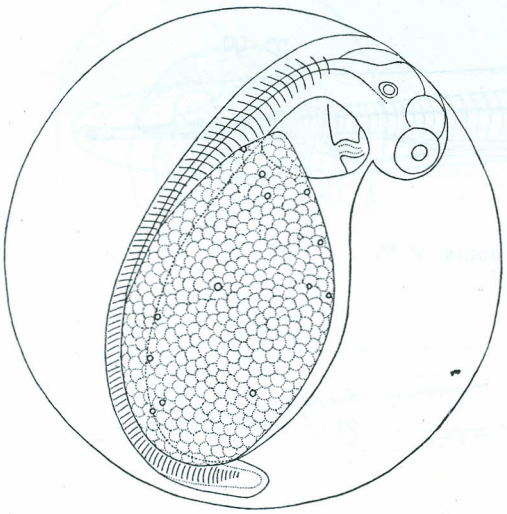

Fig. 21. Eel egg with small red oil-globules, fished on north coast of Krawang, March 19th, 1925, × 19.

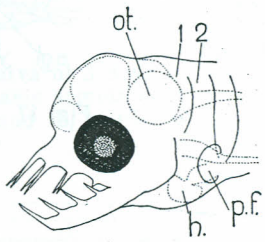

Fig. 23. Head of similar larva two days old, × 19.

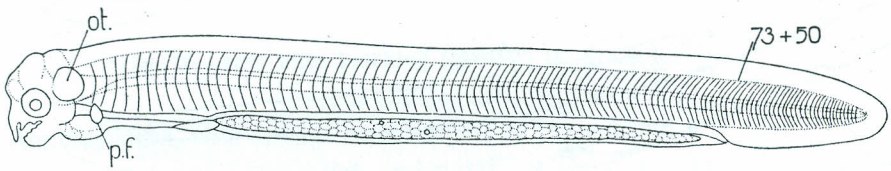

Fig. 22. Larva newly hatched from same, × 19.

The larva of fig. 18 is slightly more than one day older (fully 2 days after hatching). It hatched from an egg caught between the Thousand Islands (between Pulau Kotok and P. Karang Bras) on July 31th, 1921. The number of myotomes is 57 + 90. The remainder of the yolk consists of two small plugs above which the gut is dilated and provided with black pigment spots. The eyes are black and also the tip of the tail contains some black pigment.

The head of a larva of 3 days is shown in fig. 19. Fig. 20 shows a *Lep-*

tocephalus-larva found in a catch of station N (5°51′ S 112° 22′ E, depth 68 m) made on July 25, 1919. This larva evidently belongs to the same species, having the same two thickenings of the gut and numbers of myotomes which tally fairly well with those of the larvae described above. In front of the anus nearly 60 could be counted, behind the anus fully 100. The length of this larva amounted to 44 mm.

The two pigmented thickenings of the gut give this larva a certain likeness to one described by JOHS. SCHMIDT [1]) and which he has identified with a fair amount of certainty as belonging to *Nettastoma melanurum*. The number of myotomes in this larva is about 64 + 140.

Unfortunately there is only one representative of the Nettastomids known from the East Indian Archipelago. This is *Venefica procera*, of which WEBER and DE BEAUFORT say: „bathypelagic (325-2200 m)". Our larvae and eggs, however, were not at all caught above the deep sea. Their origin thus remains uncertain.

D' ANCONA [2]) described a few similar larvae as *Leptocephalus lateromaculatus* but cannot identify them either.

Finally I mention an egg of which two specimens were caught on March 19 th, 1925 near Tjimara (north coast of Krawang, Java) and a few more on September 21th, 1929, west of Billiton. The diameter of the egg membrane is about 4 mm, that of the egg itself little more than half this size. Some 12 small, red, oil-globules are distributed over the surface of the yolk. Within the egg-membrane the heart was beating at a rate of 150 pulsations per minute (fig. 21).

The newly hatched larva (fig. 22, 23) shows nothing particular. Some 73-76 myotomes could be counted in front of the anus, some 50 behind it.

22. Clupeoides lile (C. V.).

Whereas in nr. 7 of this series I have described the eggs and larvae of a number of *Clupea*-species, I dealt in nr. 8 with those of what I took for *Dorosoma chacunda* and of what, though hesitatingly, supposed might be *Dorosoma nasus*.

Continued observations, however, have given me the conviction that the latter two identifications are not right and need correction.

Near Labuan, as mentioned in nr. 8, I found the two kinds of eggs mixed, and afterwards I have found them mixed again in the Bay of Batavia, e.g. on March 13th, 14th and 15th, 1930. Now *Dorosoma chacunda* is a very common fish at the Batavia fish market, but *Dorosoma nasus* is never seen

[1]) JOHS. SCHMIDT, 1913, On the Identification of Muraenoid Larvae, Meddelelser fra Komm. for Havundersögelser, Serie Fiskeri, Bind IV nr. 2.

[2]) UMBERTO D' ANCONA, 1928, Murenoidi (Apodes) del Mar Rosso e del golfo di Aden. R. Comitato thalassogr. Italiano, Memoria 146.

there and seems, indeed, to be very rare in the seas of our archipelago. This makes it more improbable than ever that the second egg might be attributed to *Dorosoma nasus*.

Yet it is evident that both kinds of eggs belong to species nearly related to the genus *Clupea*. Both have the yolk in the larva rounded off at the hinder end, as is characteristic for the latter genus, and not tapering gradually into the gut, as is the case with *Engraulis, Stolephorus, Pellona* and all the other related genera as far as I know their egg and larvae.

Now, another small clupeoid is regularly found together with *Dorosoma chacunda,* viz. *Clupeoides lile*. Both species live in shallow water near the coast. It has long been a puzzle to me that I had never found the eggs of this very common little fish which at the market of Batavia is well known as t e m b a n g p u t i h, i.e. the white tembang. This name is evidently derived from the fact that it lacks the silvery hue of the common t e m b a n g *(Clupea fimbriata)*.

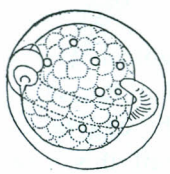

Fig. 1. Egg fished near Gresik (Grissee), drawn at 10 a.m., × 26.

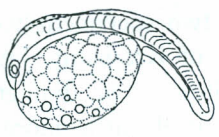

Fig. 2. Newly hatched larva 11 a.m., × 26.

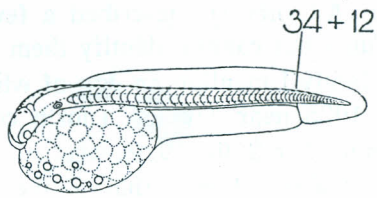

Fig. 3. Larva at 2 p.m., × 26.

The two eggs, now, described in nr. 8 evidently belong to *Dorosoma chacunda* and *Clupeoides lile*. Of these two species the latter is the smaller one and has also the lower number of trunk vertebrae. These numbers, as mentioned before (Treubia VIII p. 223), are:

Dorosoma chacunda	26 + 15 = 41
(s e l a n g e t)	25 + 16 = 41
	25 + 16 = 41
Clupeoides lile	24 + 16 = 40
(t e m b a n g p u t i h)	24 + 16 = 40
	24 + 16 = 40

The supposition, therefore, lies at hand that the smaller of the two eggs, giving rise to the larva with the lower number of trunk myotomes, belongs to *Clupeoides lile*. This is the egg and the larva formerly attributed by me to *Dorosoma chacunda*. The bigger egg then remains for *Dorosoma chacunda*. This is confirmed by observations like the following one.

Near Gresik, north of Surabaya, I found the smaller egg to be very common, together with eggs of *Coilia, Engraulis, Pellona* and a variety of *Stolephorus baganensis* (the egg mentioned in Treubia XIII. p. 239 as b from Surabaya). Here *Clupeoides lile* is a common fish whereas *Dorosoma chacunda* was not observed by us in the catches of the fishermen. Similar observations have convinced me gradually of the rightness of the interpretation given now.

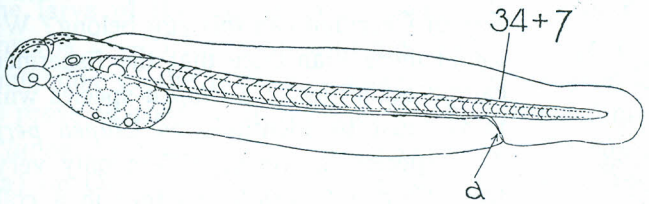

Fig. 4. Larva at the next day, 7 a.m., × 26. *a* anus, situated somewhat inside the rim of the unpaired fin fold.

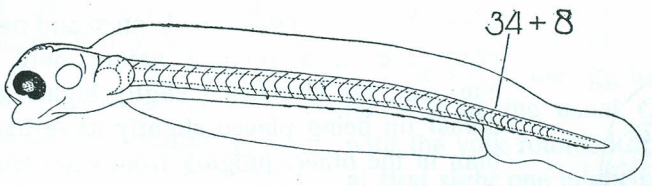

Fig. 5 Larva at the second day, 5 p.m., × 26.

The larvae hatching from the egg now ascribed by me to *Dorosoma chacunda* are much taller than those of *Clupeoides*. They even surpass in size those of *Clupea fimbriata* and equal those of *Clupea leiogaster*. The number of trunk myotomes, 37, is considerably higher than in the larva of *Clupeoides* (34). The difference (3) is greater than we might expect from a comparison of the numbers of trunk vertebrae in the adults which differ only 1-2. We come to the conclusion that in *Clupeoides* a foreward movement of the anus takes place over a distance corresponding to 10 myotomes, in *Dorosoma* over a distance corresponding to 12 myotomes. In the genus *Clupea* we found values between 9 and 11.

23. A few more Clupea-eggs.

In nr. 7 of this series I have described the eggs and larvae of a number of *Clupea*-species, i.e. those of the common t e m b a n g *(Clupea fimbriata)*. Since then I have found more than once near Cheribon eggs which make the impression of a small t e m b a n g egg and which give rise to a larva of about the same size as that of the t e m b a n g but with a lower number of trunk myotomes.

The diameter of the egg membrane does not surpass 1,1 mm, whereas for the egg of *Clupea fimbriata* I found 1,4 — 1,55 mm. It contains a similar oil-globule as the latter egg, slightly smaller, however (d = 0,075 mm), and

colourless, not yellowish. Hatching occurred about noon, sometimes as early as 11 a.m., sometimes as late as 1.30 p.m., whereas in *Clupea fimbriata* it occurred only at 6 p.m. or later (cf. Treubia, Vol. VIII. p. 225). The larva hatching from this egg is hardly smaller than that of *Clupea fimbriata* and agrees in every respect with the latter but for the number of trunk myotomes which is 37 — 38 (with *Clupea fimbriata* 40).

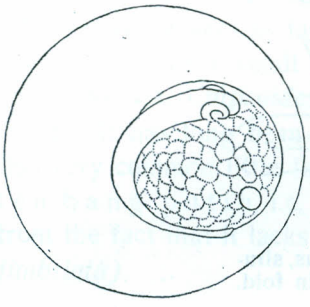

Fig. 6a

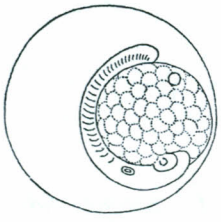

Fig. 6a and b. Eggs of *Clupea fimbriata* and of *Clupea perforata*, × 26.

To which *Clupea*-species closely related to *Clupea fimbriata* and evidently common in the Bay of Cheribon can this egg belong? We have found more than once that the fishermen here caught quantities of a *Clupea*-species which we think must be identified as *Clupea perforata*. This species, however, differs only very little from *Clupea fimbriata*, so that in a collection in which the two species were mixed, it would be difficult to separate them. The differences given by BLEEKER and by WEBER and DE BEAUFORT are of a relative nature only, in the one, e.g., the size being sligtly higher and the dorsal fin being placed slightly more backward than in the other. Judging from what we see in the larvae one might suppose that perhaps the numbers of trunk myotomes and vertebrae would afford a more effective means of distinguishing the two species. In an, evidently mixed, sample from Cheribon I counted from 26 to 31 trunk vertebrae whereas formerly (cf. Treubia VIII p. 222) I had found for *Clupea fimbriata* 29 — 31.

Now, comparing the characteristics given by WEBER and DE BEAUFORT for the two species, we find that the one looking most practicable is afforded by the difference in the number of postventral scutes, which for *Clupea perforata* is 13, for *Cl. fimbriata* 15. According to this character I divided the above sample into three groups, with 13, 14 and 15 postventral scutes resp. For the numbers of trunk myotomes I found in these 3 groups:

I	(13 scutes)	26 + 16 = 42
		27 + 16 = 43
		27 + 17 = 44
		28 + 16 = 44
II	(14 scutes)	28 + 16 = 44
III	(15 scutes)	29 + 16 = 45
		29 + 16 = 45
		29 + 16 = 45
		30 + 15 = 45

III (15 scutes) 30 + 15 = 45
30 + 15 = 45
31 + 15 = 46

The latter values correspond to what I found for *Clupea fimbriata,* whereas the numbers found for the group I seem to show that there is present a related species (or race?) corresponding to *Clupea perforata* and with 2 — 3 trunk vertebrae less than *Clupea fimbriata.* This is in agreement with what we see in the larva of the egg described here, where also the number of trunk myotomes is 2 — 3 less than with the larva of *Cl. fimbriata.* A thorough reexamination of the different Indian species or races of the genus *Clupea* might prove as useful as it has proved to be for the genus *Stolephorus.*

A big *Clupea* egg was fished in the mouth of the Indragiri (Amphitrite Bay, Sumatra) on October 24th, 1926. Fig. 10 was drawn after this egg at 1 p.m., 2 hours before its hatching. The egg membrane had a diameter of 1,5 — 1,6 mm and was surrounded by a gelatinous coat of which the outer diameter was about 2 mm. On its surface many spermatozoa adhered. The yolk is segmented as usual and contains a few oil-globules.

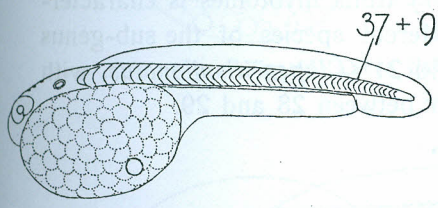

Fig. 7. Newly hatched larva of *Clupea perforata,* 2 p.m. × 26

At 3 p.m. the egg hatched. The larva is of the usual *Clupea* type, with the yolk rounded off behind. If at first sight one might have thought of a *Pellona*-egg, this view must be discarded at once as a consequence of the latter fact. In *Pellona* larvae the yolk tapers off gradually into the gut. The number of myotomes

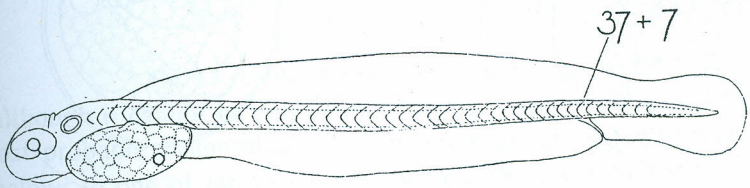

Fig. 8. A larva at the next day, 6.30 a.m., × 26.

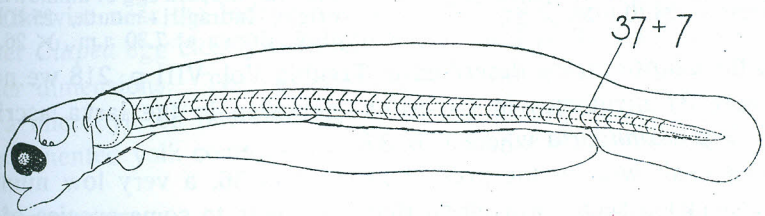

Fig. 9. A larva at the second day, 6.30 a.m., × 26.

was 36 + 6 — 7. Small black pigment spots were present on the head.

Looking for the origin of this egg one is inclined to think of a bigger *Clupea*-species with a relatively low number of myotomes and, to judge from

the oil-globules present in the yolk and from the fact that the eggs were found in water with a salinity of 2,6 — 2,8% only, a species living in brackish coast water. In this case we have to choose between *Clupea (Alosa) toli* and *Clupea (Alosa) macrura,* both known as t r u b u k and occurring near and in the river mouths of Sumatra and Borneo. The roe especially, rich of oil, is much appreciated by the consumers. These big herrings are related to the shads *(Clupea alosa, finta, sapidissima)* who shed their eggs in fresh water where they sink to the bottom.

I found the following numbers of vertebrae:

Clupea toli	26 + 16	= 42
„ „	26 + 16	= 42
„ *macrura*	26 + 18	= 44
„ „	27 + 17	= 44

For the related *Clupea (Alosa) kanagurta* — cf. Treubia Vol. VIII p. 222 — these numbers are

26 + 17 = 43

It seems, then, that a number of 26 (-27) trunk myotomes is characteristic for the sub-genus *Alosa.* For the different species of the sub-genus *Harengula* this number varies between 27 and 21 *(Clupea dispilonotus,* with 24!, excepted), for the subgenus *Amblygaster* between 28 and 29.

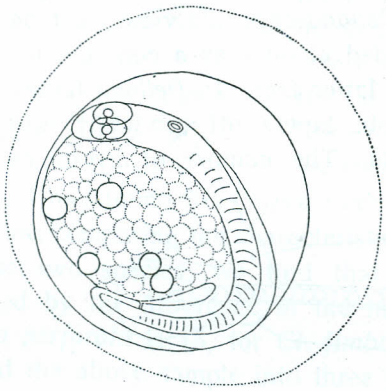

Fig. 10. Egg of t r u b u k? Amphitrite-bay (Sumatra), 24.10.1926, × 26.

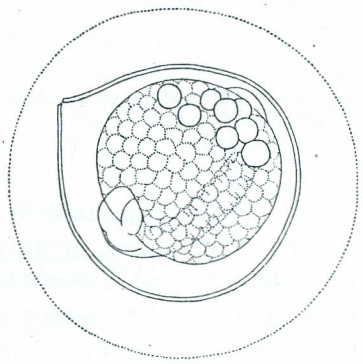

Fig. 12. Clupeid egg of unknown origin, Indragiri - mouth, 25.10. 1926, drawn at 7.30 a.m., × 26.

Now in the *Clupea* larvae described in Treubia Vol. VIII p. 218 we never found less than 37 myotomes in the trunk, not even in the larva ascribed to *Clupea (Alosa) kanagurta* where it is 37.

The larva dealt with in the present article has 36, a very low number, so that the conclusion seems warranted that it belongs to some species of the sub-genus *Alosa,* presumably to one of the trubuks.

If, however, we compare the egg with those of the shads, we do not exactly find the agreement we might expect.

According to RYDER [1]) and LEACH [2]) the egg of the American shad *(Alosa sapidissima)* has a single spacious egg-membrane with a diameter of about 3,3 mm and a yolk sac without oil-globule. According to EHRENBAUM [3]) the egg membrane is still more spacious with the European *Clupea finta,* where it attains a diameter of 4,25 — 4,6 mm, i.e. 2½ × that of the egg itself. This does not tally with what we find in the above egg. A look at the ovarial eggs of the t r u b u k, however, is sufficient to show that the yolk here is not devoid of oil but, on the contrary, contains a great amount of colourless oil-globules. The kippered ovaries of the t r u b u k are especially appreciated for their oil-contents.

In quite ripe *Clupea macrura* I found for the diameter of the ovarial egg slightly less than 1 mm.

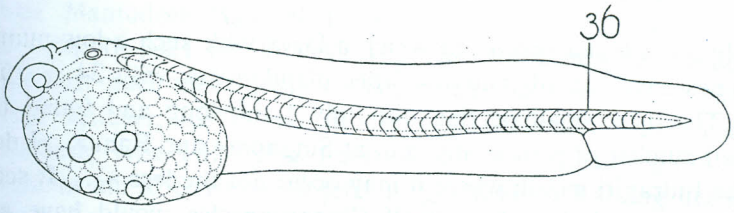

Fig. 11. Larva hatched from this egg, × 26.

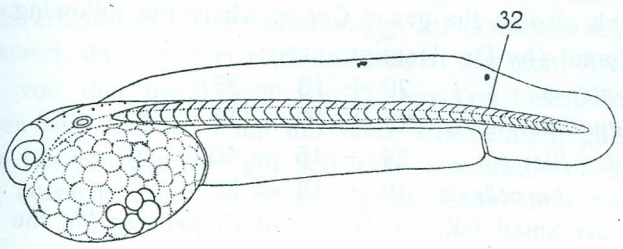

Fig. 13. Larva, evening of the same day, × 26.

Although it cannot be denied that there remains a moment of uncertainty, the most probable assumption seems to me that the egg and larva described here belong to one of the t r u b u k s which, then, would not spawn in fresh water, like the shads, but in brackish water.

Likewise near the Indragiri mouth, and at nearly the same date, I found another *Clupea* egg closely resembling the one described above and of sligthly smaller dimensions. The egg membrane in this case shows a double lining, with a micropyle on one side. It is surrounded again by a gelatinous coat. The segmented yolk contains a number of colourless oil-globules.

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[1]) J. A. RYDER, 1887, On the development of osseous fishes. Report of the U. S. Commissioner of Fish and Fisheries for 1885.

[2]) GLEN C. LEACH, 1925, Artificial propagation of shad. Appendix VIII to the Report of the U. S. Commissioner of Fisheries for 1924.

[3]) E. EHRENBAUM, 1894, Beiträge zur Naturgeschichte einiger Elbfische. Wiss. Meeresuntersuchungen Helgoland N. F. I.

These eggs hatched in the course of the afternoon. Fig. 13 shows a larva in the evening, fig. 14 one of the next morning. The rounded hind border of the yolk shows at once that evidently we are dealing with a *Clupea* species. The number of trunk myotomes however is exceedingly low, viz. 31 — 32.

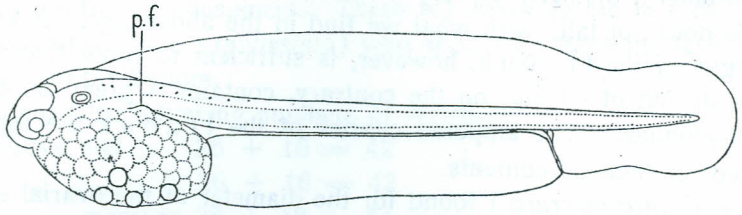

Fig. 14. Larva at the next day, 9 a.m., × 26, p. f. *rudiment of pectoral fin.*

I know only one *Clupea* species to which a larva with such a low number of trunk myotomes could be attributed: *Clupea dispilonotus,* with 24 + 15 = 39 vertebrae. This is a small herring not fully 1 dm long and found thus far in a restricted number of places only, a.o. at Singapore and Banka. I don't know it from the Indragiri mouth where it may occur not the less [1]). It seems little strange, however, that such a small *Clupea* species would have such relatively big eggs.

One might think also of the genus *Corica* where the following numbers of vertebrae were found (by Dr. HARDENBERG)!

Corica pseudopterus	20 + 18 = 38
„ *goniognathus*	23 + 16 ± 39
or of *Clupeoides lile*	24 + 16 = 40
„ *borneënsis*	19 + 18 = 37

But these too are small fishes only and of *Clupeoides lile* the eggs are known already (cf. p. 248). They are much smaller.

Provisionally, then, it seems not possible to make out with any certainty or probability to wich species the last mentioned egg belongs.

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[1]) Recently one specimen was found by Dr. HARDENBERG at the fish market of Batavia.