FISH EGGS AND LARVAE FROM THE JAVA SEA.

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11. The genus Trichiurus [1]

(with 19 figures)

In his 13th contribution to the knowledge of the ichthyological fauna of Borneo BLEEKER [2]) gives us an historical survey of our knowledge of the genus *Trichiurus* and an enumeration of the species known then, being nine in number.

Of these nine species, one of which appears dubious (*T. glossodon* BLKR. might prove to be identical with *T. intermedius* GRAY), six only occur in the Indo-Australian seas. Of these six species, however, there were two known from one single specimen only, viz. *Trichiurus lajor*, closely related to the common *T. haumela* and represented in BLEEKER's collection by one young specimen only, and *T. Roelandti*, related to *T. savala* and *japonicus* and represented in BLEEKER's collection by one specimen from Borneo.

Trichiurus Roelandti, as Dr. DE BEAUFORT informed me, is thus far known from this one specimen only.

Trichiurus lajor has been found again by KNER (Novara-Reise, Fische, p. 141) from Manilla. He says : "Scheint in der That eine von der vorigen (*Tr. haumela* BL. SCHN.) verschiedene Art, da die Länge des Kopfes weniger als 1/8 der Gesammtlänge beträgt und auch die Schnauze kürzer als bei *haumela* ist, nämlich nicht die Länge von zwei Augendurchmessern erreicht, übrigens stehen sich beide Arten jedenfalls sehr nahe. Länge 10 bis über 11".

Prof. WEBER identified a specimen from the market at Makassar in 1888 as *lajor*, but in the Results of the Siboga Expedition he suggests that *lajor* is identical with *haumela*.

A few more *Trichiurus*-species have been described by KLUNZINGER [3]) from the Red Sea.

The remaining four species are better known and more common. It is with these four only that I have got acquainted during my residence here.

Best known is the large *Trichiurus haumela* which is frequently met with at the Pasar ikan of Batavia. At certain periods, especially at the beginning of

[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.

[2]) BLEEKER, P., 1860, Dertiende bijdrage tot de kennis der vischfauna van Borneo. Verhandelingen der Kon. Natuurk. Ver. in Ned. Indië, Deel VIII.

[3]) KLUNZINGER, C. B., 1884, Die Fische des Rothen Meeres

the East monsoon, great quantities are brought to the pasar which are caught in the sero's. It appears to be a peculiarity of this species that at certain times it may approach the coast in dense crowds and frequent quite shallow water for some time, being caught there in enormous quantities. After a few days it disappears as suddenly as it had appeared.

I found just such an invasion of lajur when visiting Labuan (Sunda-strait) in the beginning of April, 1924. The whole fleet was busily engaged in catching enormous numbers of lajur, quite near the coast in very shallow water. Every time the pajang- net was cast out it was hauled in again quite filled with lajur, and a number of anglers at work somewhat more to the north likewise did not catch anything but lajur.

A few months later a similar invasion could be noticed at Batavia and in the beginning of September I got information from Pelabuan Ratu (south coast of Java) that lajur had appeared there in great quantities, together with bawal (*Stromateus niger*).

It would be worth while making a closer study of these migrations of *Tr. haumela* and their possible relation to hydrographical circumstances. As I hope to show below, they appear to have nothing to do with spawning.

The smallest of the four species of *Trichiurus* mentioned above are *Tr. glossodon* and *savala*. I found them both regularly in the catches of the "djermals", Chinese fishery installations near Bagan Si Api Api (East Coast of Sumatra) in the mouth of the Rokan River. So they appear to prefer the troubled, brackish water of river mouths. One of them, *Tr. glossodon*, easy to recognize by its purely silvery colour and the absence of pigment, is not rare near Batavia either, as has been mentioned already by BLEEKER who says: "in aquis fluvio-marinis". *Tr. savala*, on the contrary, is less common there.

Trichiurus muticus, finally, whose colour is rightly characterized by DAY as "burnished silver", also seems to frequent the river mouths.

As regards the eggs of Trichiurids we know only those of the Atlantic and Mediterranean *Lepidopus caudatus* EUPHR. which have been described by RAFFAELE [1]) from the Bay of Naples. They were caught from 0 to 60 meters below the surface and are described as being of medium size, 1,6 — 1,7 mm. in diameter, with a reddish (salmon-coloured) oil-globule, 0,4 mm. in diameter. They hatched after 7 — 8 days only and RAFFAELE shows a larva 4 — 5 days old in which the eyes have not yet become black. RAFFAELE's figures of the egg and the larva are reproduced by STRUBBERG [2]) in his report on the pelagic larvae of Trichiuridae from the Danish Expeditons in 1908 — 1910 to the Mediterranean, together with a number of older stages giving a fairly complete synopsis of the development of this Trichiurid. The larva can easily be identified by the great number of myotomic segments which amounts to more than 100.

[1]) RAFFAELE, F. 1888, Le uove galleggianti e le larve dei Teleostei nel Golfo di Napoli, in: Mitth. Zool. Station Neapel, Bd. 8.

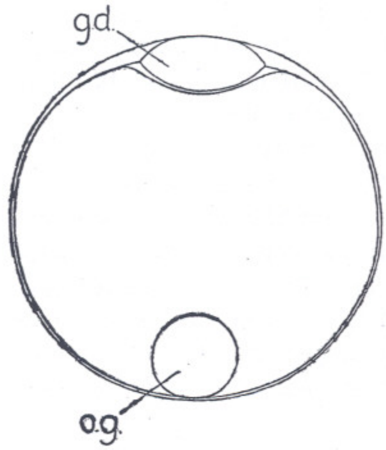
[2]) Report on the Danish Oceanographical Expeditions 1908—1910 to the Mediterranean and adjacent Seas, No. 4, Vol. II, A 6, 1918.

In studying the pelagic eggs of the Java Sea I equally could easely identify those belonging to the genus *Trichiurus* by the enormous number of myotomes in the larvae hatching from them.

Thus far I have found some 6 different kinds of these eggs.

They all have a fairly large diameter, they contain an oil-globule of considerable size and the larvae hatching from them show a great similarity. It is, therefore, difficult to make out the exact species to which each of these eggs belongs. For the sake of convenience we will provisionally designate them as *a, b, c, d, e* and *f*.

By far the largest is the egg *a* which I have thus far caught only on two occasions, viz. near the isle of Durian (Riouw Archipelago), November 10th and 11th, 1923, and a few days later near Bagan Si Api Api (East Coast of Sumatra), November 15th.



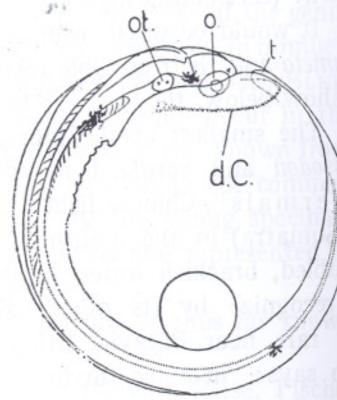


Fig. 1. The egg *a*, morning of the first day, × 19
***g.d.* germinal disc, *o.g.* oil globule (the natural position is with the oil-globule up and the germinal disc down).**

Fig. 2. Egg *a*, with embryo, × 19
***d.C.* rudiment of the ductus Cuvieri, *o* eye, *ot* otocyst, *t* tip of the tail.**

November 10th I caught in four consecutive hauls in the course of the morning some 30 of these eggs which were in different stages of development. The diameter was 2,4 — 2,45 mm., that of the slightly yellowish oil-globule 0,65 mm., the latter thus being slightly larger than the whole egg of *Caranx macrosoma* described in nr. 5 of this series and only slightly smaller than the egg of the l a j a n g. Those caught early in the morning all showed an embryo encircling slightly less than 360° of the egg circumference (fig. 2). In later catches of that morning, however, a few eggs were also found with a small germinal disc, evidently from the preceding night. Such an egg, drawn at 10 a.m., is shown in fig. 1. At 6.30 p.m. the yolk had been halfway grown round by the germinal disc. The first rudiment of the embryo was visible, the head-end reaching far short ot the centre of the germinal disc. About midnight I found the embryo to have reached a length of nearly 180° and the next morning the development had not yet proceeded so far as in the eggs caught the foregoing morning, as shown in fig. 2 which, however, was made at 10.30 a.m. only. From this we may conclude that the latter eggs were at least $1\frac{1}{2}$ days old.

As is the rule with similar eggs, the egg shown in fig. 1 floats with the oil globule up and the germinal disc down. In the same way the egg of fig. 2 floats with the head down.

Characteristic of *Trichiurus*-eggs in the latter stage are a few black pigment-spots and the absence af any other pigment. There are paired pigment spots 1° near the olfactory organ, 2° between eye and ear-vesicle, 3° behind the latter, where the pectoral fins will afterwards appear and 4° on the tail, under the myotomes. On the slightly yellowish oil-globule too a few finely branched pigment cells are present. In front of the head there is the rudiment of a circular blood vessel, a cell-ring running in front of the head from behind the statocyst of the one side to that of the other side (cf. figures 2, 5 etc.). It is the rudiment of the *ductus Cuvieri* which we have formerly also seen in the *Hemirhamphus*-egg [1]) and described there as the "lateral vessels". The heart lies on the left side of the head (cf. fig. 12), in later stages it beats and pushes the blood in the direction of the head.

Hatching occurred in the evening, beginning at 4 p.m., and during the night, so that the next morning not all had come out as yet. Perhaps this retardation was due to unnatural circumstances, the eggs being kept, as usually, in a glass with seawater. Perhaps, however, it was due to the fact that these eggs did not show such a perfect mutual agreement in their stages of development as is so often found in pelagic eggs of one species and which makes us suggest that spawning has occurred at one definite hour of the night. Evidently in this case, spawning had not been limited to one definite time. We may, however, safely conclude that the incubation period of the egg is about 2×24 hours.

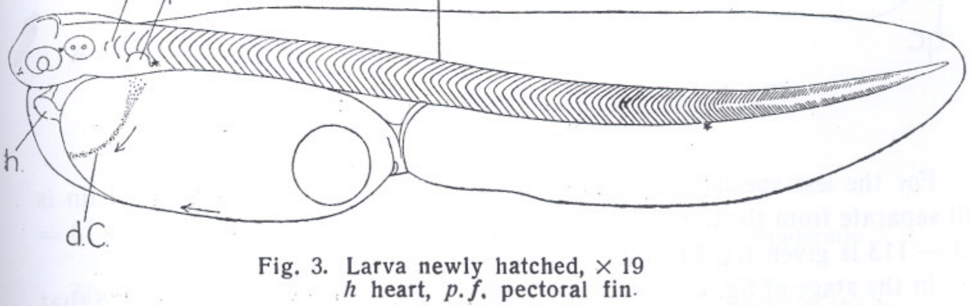


Fig. 3. Larva newly hatched, × 19
***h* heart, *p.f.* pectoral fin.**

The newly hatched larva is shown in fig. 3. It is in a slightly further advanced stage of development than e.g. newly hatched larvae of herring-like fishes, as is shown by the fact that the rudiment of the pectoral fin has already appeared, under the 3rd and the 4th myotomes. In the *ductus Cuvieri* the blood circulates

[1]). cf. Treubia V p. 411.

from under the rudiment of the pectoral fins to the *sinus venosus* of the heart just as is the case with the *Hemirhamphus*-larva. Also a median ventral yolk vena could now be observed, the *vena vitellina media*, just as with the *Hemirhamphus*-embryo. The blood can be distinctly seen circulating backward through the *aorta dorsalis* to the end of the tail and forwards again through the *vena caudalis* and the *vena vitellina media.*

The large oil globule lies at the hinder end of the yolk. The pigmentation is restricted to the four paired black pigment spots mentioned above, and a few scattered cells on the oil-globule.

The number of myotomes is very great. In front of the anus 32 could be counted, behind it I counted up to 149, incl. the unsegmented terminal part. Thus 32 + 149 = 181 myotomes. In the embryo shown in fig. 4 I counted 29 + 136 = 165. The myotomes near the tail-end growing less and less distinct, the number of tail myotomes can be determined only approximately.

For the number of vertebrae in the four species of *Trichiurus* mentioned above I found :

Trichiurus	*haumela*	38 + 129 = 167
„	*muticus*	40 + 115 = 155
„	*savala*	34 + 126 = 160
„	*glossodon*	30 + 131 = 161

From this it is evident that the numbers of myotomes within the genus *Trichiurus*, however large, yet fluctuate between relatively narrow limits only, the total numbers e.g. between 155 and 167.

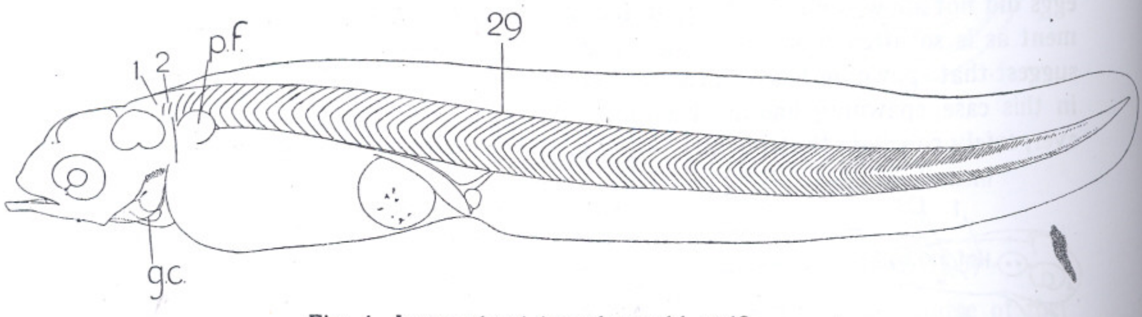


Fig. 4. Larva about two days old, × 19
***g.c.* gill cover.**

For the less specialized *Lepidopus caudatus* — in which e.g. the tail fin is still separate from the dorsal and the anal fins — a number of 41 + 70 — 73 = 110 — 113 is given (cf. STRUBBERG, p. 8).

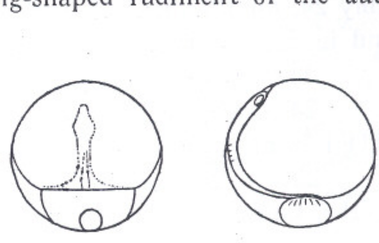
In the stage of fig. 4 the shape of the head already shows a likeness to that of the full-grown *Trichiurus*, especially as a consequence of the protruding underjaw. I regret I cannot show as yet any further advanced stages, with the exception of such as already show all the characteristics of the adult form. Thus the transition of the larva into the latter form could not be traced with equal completeness as STRUBBERG could for the mediterranean *Lepidopus caudatus.*

The other kinds of *Trichiurus*-eggs are all smaller than the one described above.

Two kinds were found mixed together in front of the mouth of the Rokan-river (near Bagan Si Api Api) on November 13th, 1923, the exact place being 100° 49′ E. 2° $43^1/_2$′ N. Of each there were some 10 specimens. They differed slightly in size, the one, which I will call *b*, having a diameter of 1,96 — 2,04 mm (fig. 5), the other, *c*, of 1,75 — 1,88 mm (fig. 6). Among the eggs *b* I also found a particularly small one, with a diameter of 1,8 mm only. On the whole, however, these two kinds of eggs might be readily distinguished from each other by this difference in size and further by the fact that in the larger one the oil globule, having a diameter of 0,40 — 0,45 mm, wes yellow, whereas in the smaller one the oil-globule, having a diameter of 0,4 mm, was colourless.

Fig. 5. The egg *b*, with embryo, × 19
Fig. 6. The egg *c*, with embryo, × 19.

Both kinds of eggs showed the same characteristics as *a*, viz. a colourless embryo with only a few pairs of black pigment spots on the head, one or two unpaired ones on the tail, and a few branched cells on the surface of the oil-globule ; further the ring-shaped rudiment of the *ductus Cuvieri* like a halo round the head.



a. *b*

Fig 7. Gastrulation stages of the egg *c*. In stage *b* 3 mesodermic segments could be counted.

The eggs shown in the figures 5 and 6 were both fixed early in the morning of November 14th. Evidently the smaller one was then slightly further advanced in development than the larger one, the embryo in the former measuring nearly 360° of the circumference of the egg, whereas in the latter this was estimated by me to be no more than 280°.

The smaller ones, *c*, accordingly hatched in the course of the day already, whereas the eggs *b* began to hatch at 8.30 p.m. only. Thus in these eggs too development seems to take some two days or slightly less.

A peculiarity observed during the gastrulation of the egg *c* is shown in fig. 7. A mighty yolk plug protrudes through the rapidly contracting opening of the yolk blastopore and is drawn in only at the completion of the gastrulation.

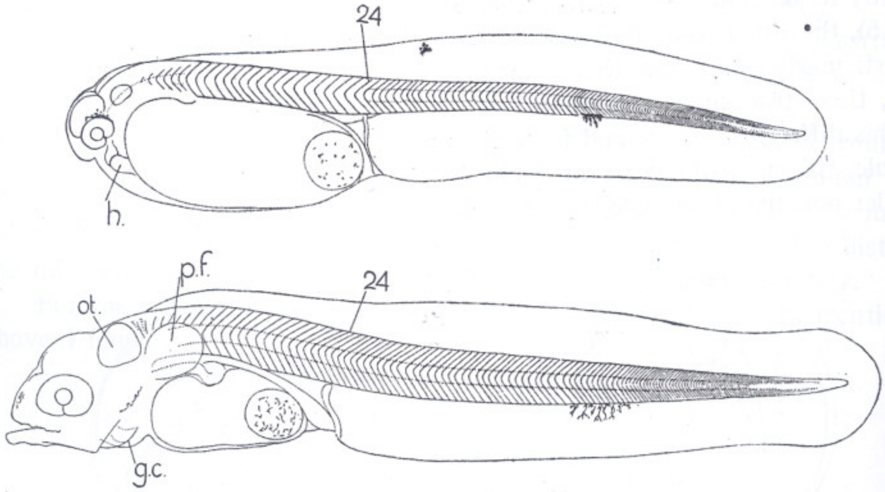


Fig. 8. Larva newly hatched from the egg *b*, × 19.
Fig. 9. Larva about $1^1/_2$ days old, × 19
***g.c.* gill cover, *ot.* otocyst, *p.f.* pectoral fin.**

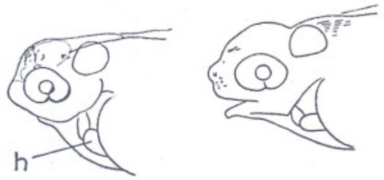
The larvae hatching from the eggs *b* and *c* closely resemble those from the egg *a*. Fig. 8 shows a newly hatched larva, with the earliest rudiment of the pectoral fin, fig. 9 shows a larva nearly two days old, where the lower-jaw reaches to in front of the upper-jaw. The growing out of the lower-jaw is shown in fig. 10 *a* and *b*. The number of trunk myotomes in these larvae (figs. 8, 9, 10 a, 10 b) was invariably 24, for the number of tail myotomes I found in the larva of fig. 8 144 and in that of fig. 9 138. Thus:

$$24 + 144 = 168$$
$$24 + 138 = 162$$

For the larva *c* (fig. 11) I found

$$23 + 132 = 155$$

and in another larva of the same kind I likewise counted 23 myotomes in front of the anus.



a. *b*.

Fig. 10. Heads of intermediate stages showing the growing out of the lower jaw. *h* heart.

The larvae *b* and *c* both showed in the tail a similar paired pigment-spot, situated ventrally of the myotomes, as with the larva *a*.

I am inclined to consider these two kinds of eggs which so much resemble each other and were caught together near Bagan Si Api Api, as belonging to the two kinds of *Trichiurus* regularly caught together in the "jermals", the Chinese fishing installations in the mouth of the Rokan river, and which also show a great similarity in size and habitus, viz. *Trichiurus savala* and *glossodon.*

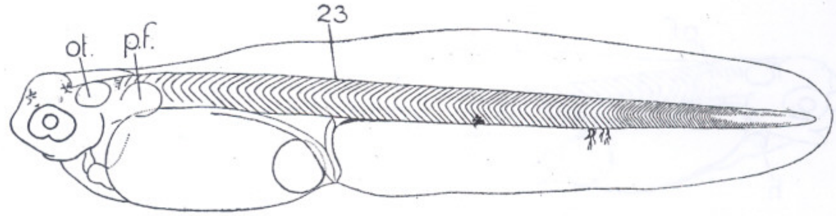


Fig. 11. Larva newly hatched from the egg *c*, × 19.

Assuming that this supposition is right, it seems impossible to make out which of the two eggs belongs to which of the two species by comparing the numbers of myotomes and of vertebrae. For the latter we found :

Trichiurus savala 34 + 126 = 160
" *glossodon* 30 + 131 = 161

The differences are too slight to allow us to separate the two kinds by this characteristic. It seems evident only that during the further development of the larvae into the adult form a backward movement of the anus occurs, contrary to what we have found to be the rule with herring-like fishes (cf. the former articles of this series, e.g. Treubia, Vol. VIII, p. 391).

During my cruises, I have more than once found a *Trichiurus*-egg closely resembling the egg *c*, but with a slightly smaller diameter, in the neighbourhood of the Thousand Islands, near Batavia and in Sunda Strait. The diameter varied from 1,55 to 1,65 mm. I will call these eggs *d*. They regularly hatched in the evening of the second day and the larvae again show a great similarity to those of *c*. The number of myotomes in front of the anus was found to vary between 25 and 20, the higher numbers being found in newly hatched larvae, the lower ones in those of one and two days, so that one gets the impression that a slight forward movement of the anus precedes the considerable backward movement following of afterwards. This tallies with what we see in comparing figs. 3 and 4 (egg *a*).

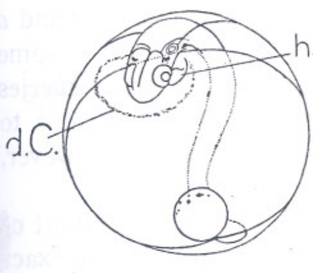


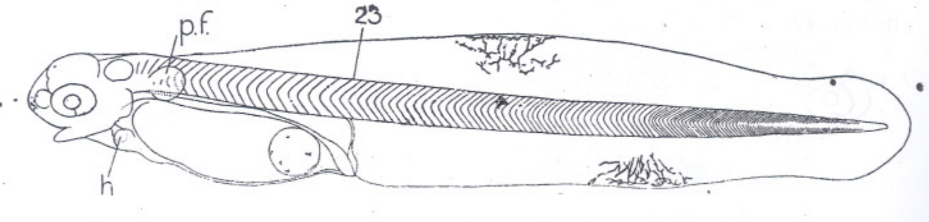
Fig. 12. The egg *d* with embryo × 19, from Sunda Strait (6° 15½′ S 105° 37′ E, half-way Labuan-Krakatau), 22 Juli, 1924. *d.C.* ductus Cuvieri.

In the larvae I counted the following total numbers of myotomes :

25 + 128 = 153
24 + ... = ...
23 + 129 = 152
20 + 138 = 158
20 + 140 = 160

These numbers neither differ much from what we found in the larvae from the egg *c*.

As to the pigmentation, I regularly found in the larvae two typical pigment spots on the unpaired fin fold of the tail, one dorsally and one ventrally, the former in front of the latter, and both situated near the border of the fin fold.



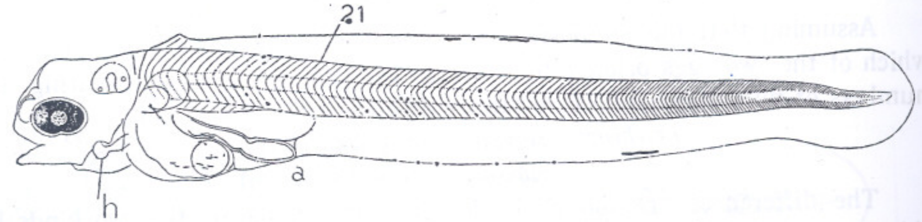


Fig. 13. Larva hatched from similar egg from the Thousand Islands (5° 43′ S 106° 32′ E) × 19.

Fig. 14. Older larva, × 19.

In fig. 11 (*c*) the distribution of the pigment is slightly different and resembles more what we see in figs. 6, 7 (egg *b*) and figs. 16 — 18 (egg *e*). The conservation of the pigment in fig 11, unfortunately, was bad and the material at my disposal very restricted.

All this makes it difficult to say whether we must consider the eggs *c* and *d* as two different kinds or, perhaps, as two slightly divergent forms of the same species, corresponding e.g. to two geographical races of one *Trichiurus*-species or even belonging to one and the same species and owing their differences to external circumstances only. Especially the different pigmentation, however, makes me hesitate to accept the latter suggestion.

Further we have the egg *e* which I caught on June 21st, 1923, in front of the mouth of the Indragiri (Amphitrite Bay, east coast of Sumatra), the exact place being 0° 1′ N. 105° 49′ E. It was ebb-tide and the water was going out. At 7.30 a m. the salinity was $29,16^0/_{00}$, at 11 a.m. $28,36^0/_{00}$ and the water was less clear. In this water (with the lower salinity) a considerable number of eggs *e* were fished and they still occurred in the haul made at noon, when the salinity had sunk to $27,16^0/_{00}$. The diameter varies between 1,7 and 1,81 mm. and the egg is characterized by a yellowish-brown oil-globule with a diameter of 0,425 mm.

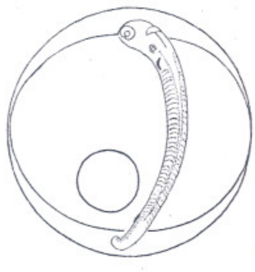


Fig. 15. The egg *e*, with embryo, × 19.

It cannot be denied that this egg shows a great similarity to the egg *b*, the difference being that the diameter is smaller and the oil-globule darker. Neither do the larvae hatching from the egg *e* (early in the morning of the third day) differ much from those hatching from the egg *b*. In the former I counted the following numbers of myotomes:

$$26 + 112 = 138$$
$$26 + 112 = 138$$
$$25 + \pm 90 = \pm 115$$
$$24 + 138 = 162$$
$$23 + 133 = 156$$

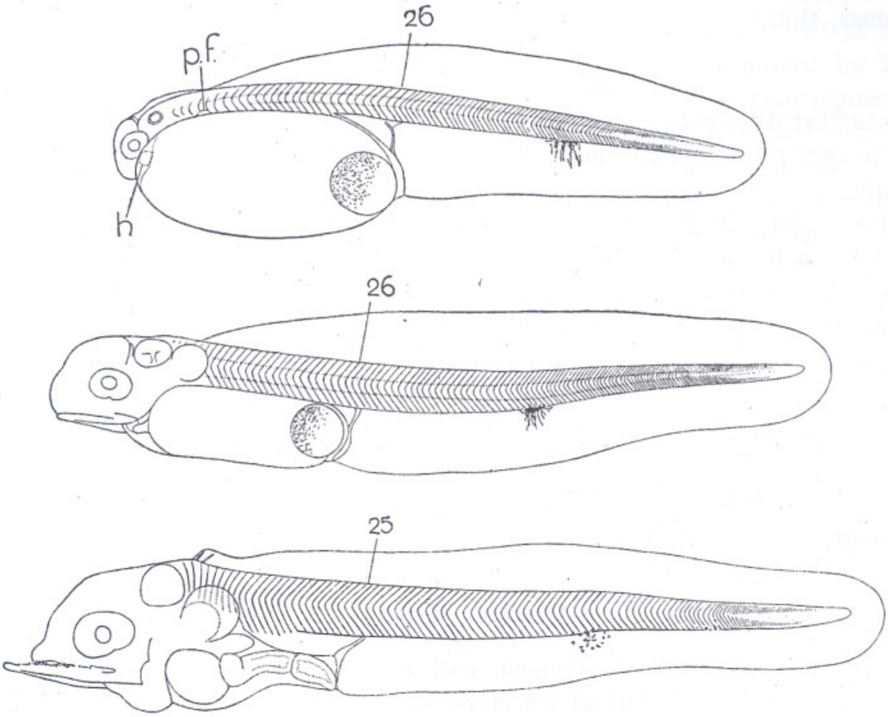


Fig. 16. Newly hatched larva, × 19.
Fig. 17. Somewhat older larva, × 19.
Fig. 18. Larva of $2^1/_2$ days, × 19.

No great significance can be attributed to the numbers of tail myotomes. The number of trunk myotomes, however, does not differ much from what we found in the larvae *b* (24). A black pigment spot is present on the tail under about the 30th tail myotome, whereas in the larva *b* we find a similar pigment spot situated perhaps slightly more backwards.

I succeeded in rearing up the larvae *e* further than the larvae *b*. Fig. 18, e.g., represents a larva of $2^1/_2$ days after hatching with the under-jaw projecting very distinctly in front of the snout. Teeth have appeared, the first rays of the dorsal fin are getting faintly visible, but the eyes have not yet become dark.

After all we are again left somewhat in doubt, whether the egg is really distinct from *b* or only a variety of the latter, the difference between the two not being of much more importance than those between the eggs *c* and *d*.

Finally, during a cruise to the south coast of Java, I found in the Wijnkoopsbay repeatedly *Trichiurus*-eggs which cannot be perfectly identified with any of those described above although there are many points of convergence. Thus the diameter varied between 1,83 — 1,88 mm. and the oil-globule was colourless. In this respect these eggs *f* agree quite well with the eggs *c*. The larvae hatching from them also agree with the larva *c* by the presence of a ventral pigment-spot on the tail. The number of prae-anal myotomes, however, is slightly higher, being 26 — 27, whereas behind the anus I counted 127 — 130 myotomes, thus :

$$27 + 127 = 154$$
$$26 - 27 + 130 = 156$$

A further difference is that the eggs *c* hatched in the course of the second day, the eggs *f* always early in the morning (between 6 — 7 a.m.) of the third day only.

The caudal pigment spot seemed larger and situated more backward than in the larva *c*. In the latter it lies under myotomes 26 — 30, in the former under 36 — 48. In this respect there is more agreement with the larva *b*, where the pigment spot is found under the myotomes 35 — 45.

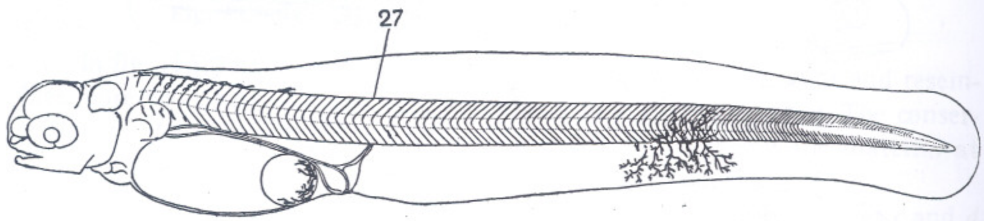


Fig. 19. Larva hatched from the egg *f*, one day after hatching, × 19.

There is also a certain agreement with the egg *e*, as well in the diameter of the egg as in the structure of the larva, especially in the number of the pre-anal myotomes which is 26 in the larva *e*. The ventral pigment spot in *e* is situated under the myotomes 30 — 36, but in the larva of fig. 9 under myotomes 36 — 46, which shows that not too much value may be attributed to this character.

In the larva *f* pigment was present dorsally along the anterior myotomes which I didnot notice in any of the other larvae. Finally the larvae *f* are decidedly longer than any of the larvae *b* — *e*.

Now there is one *Trichiurus*-species quite common along the whole south coast of Java and in the Wijnkoopsbay. This is *Trichiurus haumela*, one of the commonest fishes there, whereas I have never heard much about the occurrence of other *Trichiurus*-species in these waters. Thus the supposition lies at hand, that the egg *f* belongs to *Tr. haumela*, but I hardly need emphasize that this supposition needs further confirmation, the more so, as another suggestion seems to lie at hand also, viz. that the large egg and the large larvae *a* belong to this largest of *Trichiurus*-species.

The time of hatching of the *Trichiurus*-eggs described above is as follows:
Egg *c* in the course of the second day
„ *b* and *d* in the evening of the second day
„ *a* „ „ „ „ „ „ „ and the following night
„ *e* and *f* in the morning of the third day.

Resuming we may say that we have found thus far perhaps six different kinds of *Trichiurus* eggs, all characterized by their relatively large size, by the large oil-globule, and, in further advanced stages, by the transparent embryo with a few black pigment spots only and with the halo-like rudiment of the *ductus Cuvieri*. The newly hatched larvae may be easily recognized by the enormous number of myotomes especially in the tail and by the poor pigmentation which is restricted to a few scattered black pigment cells on the head, on the oil-globule and on the tail.

The genus thus being easely recognized, the determination of the species offers more difficulties. As a matter of fact we cannot do much more than guess at them.

In the first place we are not sure as to the number of species inhabiting Indian Seas.

In the second place we are not sure as to the number of species which may be recognized among the eggs collected until now, especially among those designated as *b* — *f*. Are they all different or must some of them be united with each other?

And to which species of *Trichiurus* does each of these eggs belong? The differences in the numbers of myotomes and vertebrae do not give conclusive evidence in this case.

At any rate we can state that in this genus the number of trunk myotomes increases during the larval development, unlike what we have seen in the herring-like fishes. Thus I found for the number of trunk-myotomes in the larvae from the egg:

a	32 + 149 = 181	myotomes
	29 + 136 = 165	„
b	24 + 144 = 168	„
	24 + 138 = 162	„
c	26 + 112 = 138	„
	26 + 112 = 138	„
	25 + 90 = 115	„
	24 + 138 = 162	„
	23 + 133 = 156	„
d	23 + 132 = 155	„
e	25 + 128 = 153	„
	24 + ... = ...	„
	23 + 129 = 152	„
	20 + 138 = 158	„
	20 + 140 = 160	„

f 27 + 127 = 154 myotomes
26 + 130 = 156 "

and for the number of vertebrae in the adult of

Trichiurus haumela		38 + 129 = 167
"	*muticus*	40 + 115 = 155
"	*savala*	34 + 126 = 160
"	*glossodon*	30 + 131 = 161

Comparing these numbers we see at once that during the development the number of trunk myotomes increases, that of the tail myotomes decreases, so that a backward movement of the anus must be assumed. Indeed, when comparing the newly hatched larvae with those two or three days old we get the impression that at first there is a slight decrease in the number of trunk myotomes, the anus evidently moving forward over a distance of 2 or 3 myotomes. But afterwards this slight forward movement must be replaced by a backward one of greater significance, covering about 10 myotomes.

During the development of *Lepidopus caudatus* a similar backward shifting of the anus has been observed by STRUBBERG, according to his statements even from under the myotomes 12 to under the myotome 41 ! By studying a series of transitional stages he could even trace this backward movement step by step.

Evidently this ontogenetic backward movement of the anus corresponds to the phylogenetic backward movement of the pelvic fins and bones signalized in the Scombriformes by TATE REGAN[1]). He found that the pelvic bones in the Trichiurids, if present, are remote from the cleithra (clavicles) — unlike in other Acanthopterygii — but connected with them by a long ligament.

Thus, as DOLLO has worked out especially, we can distinguish two opposite movements of the pelvic fins in Teleostiï. From their original abdominal position in the Malacopterygii they move forward to a thoracic position and a connection with the shoulder girdle — or even to a so-called jugular position, in front of the shoulder girdle, and a connection with the throat — in Acanthopterygii. The forward movement of the anus during the post-larval development of clupeid fishes seems to be a first indication of this tendency. Secondarily, however, the pelvic girdle may move backward again in certain Acanthopterygii. Then it remains attached to the shoulder girdle by a ligament. Besides in Trichiurids this is e.g. the case with the Atherinidae.

The ontogenetic backward shifting of the anus is evidently connected with this phylogenetic secondary backward movement of the pelvic girdle and fins.

Reverting, however, to the question of the identification of the *Trichiurus*-eggs, we must state, that we can only guess with a greater or lesser degree of probability.

Thus the supposition lies at hand that the very large egg *a*, and the large larvae hatching from it, belong to the large species *Trichiurus haumela*. The

[1]) On the Anatomy and Classification of the Scombroid Fishes. Annals and Magazine of Natural History (8) Vol. 3, 1909.
The Classification of Teleostean Fishes, ibid.

relatively high number of trunk myotomes in the larvae is not in contradiction with our assumption, it tallies quite well with the relatively high number of trunk vertebrae in the adult. But further evidence cannot be produced, as at the place and at the time they were caught, there was no fishing being done at all so that there is not the slightest indication as to which *Trichiurus*-species was especially abundant there. And from what we found in the Wijnkoopsbay one might be inclined to the conclusion that the egg *f* belongs to *Trichiurus haumela*.

In the case of the eggs *b* and *c* we were more fortunate in this respect and there is good reason to believe that they belong to the two common species of the Rokan mouth, viz. *Trichiurus savala* and *glossodon*. The lower numbers of trunk myotomes found in these larvae tally well with the lower numbers of trunk vertebrae in the adults.

As to *Trichiurus muticus*, with the highest number of pre-anal myotomes, one might be inclined to think of the egg *e*, or even, if indeed *f* must be attributed to *Trichiurus haumela*, of the large *a*. But all these suppositions are more or less vague. Perhaps further investigations will throw more light upon these questions.

As regards the further development of the young larva into the adult fish no data are available as yet. Probably it will show a great likeness to what STRUBBERG has found for *Lepidopus*. The transformation proves to be quite a gradual one.

A peculiar feature in the latter is the strong development of the anterior ray of the dorsal fin in very young stages, showing some resemblance to what is sometimes found in very young stages of flatfishes. It gets a considerable length, but only quite transitorily.

Now, in the older larvae of *Trichiurus*, as represented in figs. 14 and 18, we also see a precocious appearance of two or three anterior dorsal fin rays, reminding us of what we have found in the larvae of *Caranx gallichthys* (cf. nr. 6 of this series) and evidently connected with a similar strong development of these rays as noted in the latter species.