STUDIES ON THE LARVAL DEVELOPMENT OF BRACHYURA
I. THE EARLY AND POST LARVAL DEVELOPMENT OF *DOTILLA BLANFORDI* ALCOCK.

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Introduction.

Except for Ramadan's (1940) account of the first zoea of *Dotilla sulcatus* no other information is available on the development of this genus. Hence, during the course of the extensive study of the development of Brachyura, when an opportunity provided itself, the following observations on the early and post larval development of *D. blanfordi* were recorded and reported below.

Material.

On the 8th April, 1954, an ovigerous *Dotilla blanfordi* of carapace length 3 mm. and breadth 5·5 mm. was collected in the low tide region of the Maharanipeta Beach, Visakhapatnam in a burrow of 3·9 cm. diameter in width and 10·4 cm. in depth and about 3·74 metres distant from the water edge.

In the laboratory the crab spent all the time from the 8th April, 1954 to the 16th April, 1954, buried in sand.

In this and the papers to follow under this series the different stages described are defined as follows :—*Early* eggs are of uniform coloration. Blastomeres are from a few to many but no differentiation can be seen. *Late eggs* are those in which the larvæ are well developed and ready for hatching. Prezoea is the early first zoea covered over by the prezoeal membrane, the maxillipedes being free from the body but covered by a thin prezoeal membrane. The first zoea has been studied under two heads :—

Early first zoea is one in which the natatory setæ of the first and the second maxillipedes are not extended or one in which the rudimentary setæ of the above appendages are covered with prezoeal membranes. The carapace spines are free. The dorsal carapace spine is either bent backwards or remains in normal position. *Late first zoea* is characterised by the extended nature of the swimming setæ of the exopods of the maxillipedes with the complete absence of the prezoeal membrane. All the Brachyuran zoeæ of the local forms with the exception of those of *Calappa lophos* were found to swim only in the late first zoea stage unlike the Plymouth Brachyuran zoeæ which have been seen by Lebour (1927, 1928) to swim at the prezoea stage. Measurements of the larvæ are based on preserved material. In the case of every species the measurements of five zoeæ as well as their appendages etc., are taken and the average is struck. The body length of the zoea is measured from the

front of the head to the tip of the telson fork. The colour schemes of the zoeæ and their adults are those observed in live specimens.

Observations.

The eggs were at the time of collection in an advanced stage of development and were dark brown in colour and of diameter 260–300 μ. However, in spite of this apparent stage of advancement the larvæ were not visible when the ova were examined under the microscope. On the 14th April, 1954 when the crab was taken out and the eggs examined the larvæ were then very well developed and could be clearly seen through the transparent egg membranes. On the 16th April, 1954 the crab liberated the larvæ during the night and this was confirmed by the fact that the egg membranes were found still adhering to the pleopods of the mother when examined only the next morning. The liberated swimming larvæ were in late first zoea stage.

It is not exactly known at what stage the eggs hatch and the stage at which the larvæ are liberated by the mother.

On the 14th of April 1954 a number of megalopae of *D. blanfordi* were collected from burrows which were roughly about 3·74 metres to 4·68 metres from the water's edge during low tide of Maharanipeta Beach, Visakhapatnam. These burrows were in general 10·4 cm. deep. The megalopae were grey coloured with black eyes. Two days later two of the megalopae moulted to the first crab stages. One of them was fixed and an attempt was made to rear the other to first crab stage but it survived for only two days and died without moulting.

Late first zoea. The zoea has the dorsal and the rostral carapace spines. The lateral carapace spines are absent unlike that of *D. sulcata* (Ramadan, 1940).

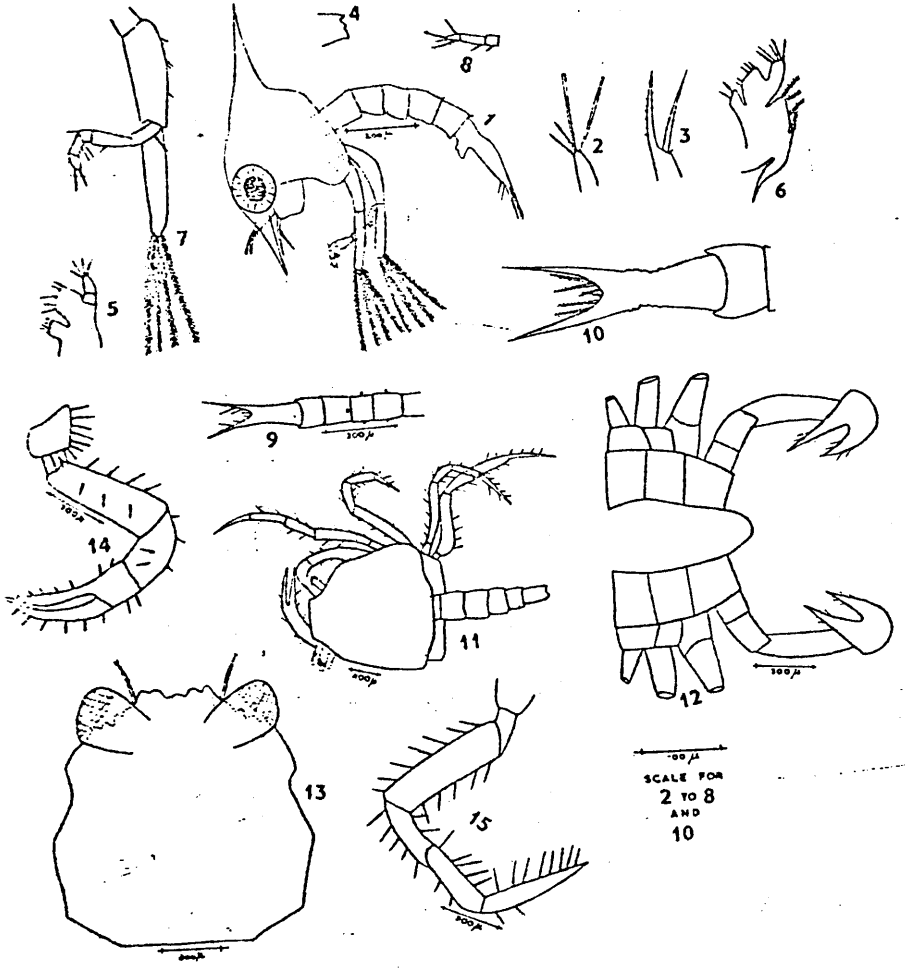
The *abdomen* consists of five segments excluding the telson. The second and the third segments each bear a pair of lateral knobs. The last abdominal segment is slightly bulging. The fourth and the last abdominal segments have small knobs at the postero-lateral corners. The telson is almost half the length of the abdomen ; each lateral margin has four to five slight median elevations ; between the forks there are six plumose setæ (figs. 9 and 10).

The *eye* is sessile. The *first antenna* is a conical process with, at the apex, two long equal aesthetes and two short equal spines (fig. 2). The *second antenna* has the exopod and the spiny process of equal length ; the exopod is pointed with a seta at its base (fig. 3). The cutting edge of the *mandible* bears a few teeth (fig. 4). The coxa and the basis of the *first maxilla* have four and five setæ respectively. The endopod is two segmented, the distal is long bearing four setæ (fig. 5). The coxa and the basis of the second maxilla bear two and two-three setæ respectively. The endopod is not segmented and has five simple apical setæ whereas the exopod has four plumose marginal setæ (fig. 6).

The coxa of the *first maxillipede* is short and devoid of setæ whereas the long basis has on the inner side two–two–one setæ. The endopod

s five segmented bearing one–one–one–two–three setæ from the proximal o the distal segments ; the exopod is tipped with four long natatory setæ (fig. 7). The *second maxillipede* is similar to the first maxillipede in every respect except that the endopod is three segmented instead of ive and has one–one–four setæ from the proximal to the distal segments ig. 8).

Figs. 1–15.



Dotilla blanfordi Alcock.

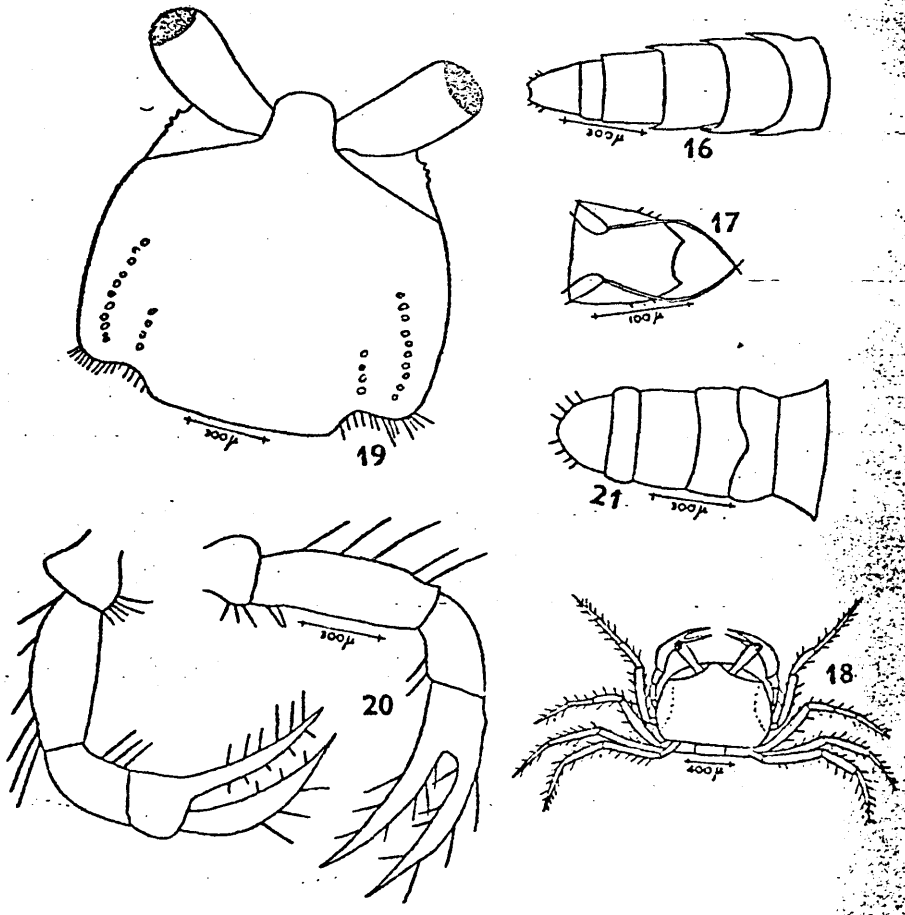
. Late first zoea. 2. First antenna of the late first zoea. 3. Second antenna of the late first zoea. 4. Mandible of the late first zoea. 5. First maxilla of the late first zoea. 6. Second maxilla of the late first zoea. 7. First maxillipede of the late first zoea. 8. Endopod of the second maxillipede of the late first zoea. 9. Abdomen of the late first zoea. 10. Last abdominal segment and telson of the late first zoea. 11. Dorsal view of the megalopa (moulted skin). 12. Ventral view of the sternum and the commencement of the appendages of the megalopa. 13. Carapace of the megalopa with eyes. 14. Cheliped of the megalopa. 15. Last leg of the megalopa.

Measurements of the late first zoea—

Body length	972 μ
Length from the rostral to the dorsal spine	761 μ
Length of the rostral spine	175 μ
Length of the dorsal spine	216 μ
Lenth of the spiny process of the second antenna	102 μ
Length of the exopod of the second antenna	102 μ
Length of the abdomen to the tip of the telson fork	660 μ

Coloration. The sessile eyes are jet black. The mouth region is greyish black. The general colour of the cephalothorax is green. The dorsal

Figs. 16–21.



Dotilla blanfordi Alcock.

16. Abdomen of the megalopa. 17. Last pair of the pleopods and telson. 18. First crab stage from the megalopa. 19. Carapace of the first crab stage with eyes. 20. Chelae of the first crab stage. 21. Abdomen of the first crab stage.

spine has black and vermilion chromatophores, the latter being partly diffused. From the second to the fifth abdominal segments the colour is diffused pale vermilion.

Remarks.

Ramadan's description of the first zoea of *Dotilla sulcata* is very brief but it is accompanied by good illustrations. The first zoea of *D. blanfordi* differs from that of *D. sulcata* very markedly in the form of the abdomen and telson (cf. figs. 9 and 10 with Ramadan, 1940, fig. 2). In *D. blanfordi* the abdomen is, in dorsal aspect, long and slender and the last segment is only slightly produced at the postero-lateral angles; in *D. sulcata* the abdomen is shorter, its distal segments are much broadened, and the postero-lateral angles of the last one are in the form of large rather pointed lobes. The telson in *D. blanfordi* is also long and narrow, constricted in the middle, with some lateral knobs at this part; the apex is deeply forked and the three pairs of apical setæ are situated *within* the emargination. In *D. sulcata* the telson is broadly oval, with the apex truncated and only slightly emarginate in the centre; the three pairs of apical setæ are situated on the truncate portions *on either side of the* emargination. Moreover, in *D. blanfordi* the pair of lateral spines on the carapace is missing; Ramadan says that the second antenna is vestigial but he has not figured it in detail.

Megalopa. The carapace length is 330 μ and carapace breadth 330–360 μ. There are five lobes on the frontal border of the carapace. The pereiopods bear a good growth of setæ (figs. 11, 12 and 13). The *eyes* are stalked (fig. 13). Both the *chelipeds* are alike. As in the young form the pincer claws are flattened (fig. 14). The three feelers or sensory setæ on the terminal segment of the *last leg* are not observed, possibly while burrowing they might have been affected as in the case of most of the megalopae of *O. platytarsis* and *O. cordimana* which were collected in burrows. In the case of the megalopae of *O. platytarsis* and the *O. cordimana* which were captured during the high tide just as they were attempting to burrow into the watery sand, the feelers on the dactyls of the last pair of legs were intact (Raja-Bai, 1954). But, as the megalopae of *D. blanfordi* could not be secured under similar conditions, it cannot categorically be said that the missing feelers do exist in the unaffected megalopae (fig. 15).

The *abdomen* consists of five segments excluding the telson. The first, second and the third abdominal segments have their postero-lateral corners drawn out into spines. The *telson* is pointed at the postero-lateral corners and the posterior border is concave. The telson has three short spines on each of its lateral borders. The last pleopod has one long terminal seta (figs. 16 and 17).

First crab stage. The general colour is pale brown with black dots on the carapace and black eyes. Both the first crab stages were of carapace length 330 μ and carapace breadth 390 μ. The pereiopods bear a fair number of setæ (figs. 18 and 19). Both the pincer claws of the

chelipeds are alike and flattened (fig. 20). The *abdomen* consists of five segments excluding the telson. At this stage the overlapping of the fourth over the fifth segment does not occur as seen in the adult stage. Also the brush of hair at the distal ends of the fourth segment has not developed. The posterior border of the telson is ellipsoidal with setæ (fig. 21).

The first crab stage spent the time in the laboratory buried in sand covered with water. The moment water was removed, the little *Dotilla* came out and like the adult began to feed on the micro-organic food matter from the sand, which was then rejected in the form of pellets.

Discussion.

The early and post larval developments of *Dotilla blanfordi* are worked out for the first time. The megalopa and the first crab stage (got from the megalopa) of the genus *Dotilla* are also described for the first time.

The first zoea of *Dotilla sulcata* according to Ramadan (1940) is similar to that of the Pinnotherid *Pinnixa* (Faxon, 1879) in general shape of body, shape of fifth abdominal segment and telson. This expanded form of the fifth abdominal segment is not known to exist in any other genera except *Dotilla*, *Pinnixa* and *Elamena* (Gurney, 1938 a). The zoea of the local species resembles that of *D. sulcata* in having laterally bulging fifth abdominal segment but in other respects it is advanced over the latter in having a well developed second antenna and a forked telson. The general shape of the body resembles closely that of the other genera of the family Ocypodidae.

The resemblance with the zoea of the *Pinnixa* particularly in the bulging fifth abdominal segment points out its close relationship with the family Pinnotheridae.

Since the larvae of the only two species of *Dotilla* studied so far show such marked differences, Gurney's (1938 a) idea of removing the family Hymenosomatidae from the Oxyrhyncha and placing it near the family Pinnotheridae among the catometopa on the strength of the similarity between the larva of *Elamena* (family Hymenosomatidae) and *Pinnixa* (family Pinnotheridae) may be deferred until more information is available about the larval features of other species of the concerned genera.

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