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BREEDING HABITS AND EARLY DEVELOPMENT OF TWO BLENNIID FISHES *OMOBRANCHUS JAPONICUS* (BLEEKER) AND *CRUANTUS SMITHI* VISWESWARA RAO FROM GODAVARI ESTUARY

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Five species of blenniids, *Omobranchus bhattacharyae* (Chaudhuri), *O. japonicus* (Bleeker), *O. bipunctatus* (Day), *Cruantus smithi* Visweswara Rao and *C. dealmeida* (Smith) occur in Godavari estuary. All the species inhabit the holes made in the mangrove stems and roots by wood-boring molluscs (Dutt & Visweswara Rao 1961, Visweswara Rao—MS). Not much work has been done on the development of these species. Bhattacharya (1917) described three stages in the life history of *O. bhattacharyae* from Chilka Lake and Jones (1937) described the eggs and development of the same species from brackish waters at Adayar. Bal and Pradhan (1951) described the larvae of *O. bhattacharyae* and *O. punctatus* from Bombay waters. Dutt and Visweswara Rao (1961) gave an account of the breeding habits and early developmental stages of *O. bipunctatus* from Godavari estuary. The present paper deals with the breeding habits and development of *O. japonicus* and *C. smithi*.

Breeding Habits

Blenniids have been observed to lay their eggs in crevices of rocks, empty bivalve shells or attached to sea weeds or algae and inside the holes of mangrove stems (Thomson & Bennet 1953, Munro 1955, Dutt & Visweswara Rao 1961). Inside the mangrove stems the eggs are laid in a single layer in a gelatinous matrix attached to the inner surface of the hole. The area on which the eggs are laid varies from about 20 mm. to 70 mm. in length, the width varies greatly, at times encircling the entire hole. Since a greater part of the stems and roots which the blenniids inhabit generally remains exposed during low tide, the eggs are laid in the lower part of the stem to avoid much exposure.

The stems and roots infested by the wood-boring molluscs were brought to the laboratory in a bucket of water where they were split and examined for eggs. Generally eggs could be collected from December to April, indicating a prolonged breeding season. An examination of these egg patches in each hole (representing the eggs laid by a single female) under a microscope revealed them to be in different stages of embryonic development (Table I) which suggests that the eggs are laid in batches (Munro 1955, Quasim 1957).

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Parental Care

Parental care is common among blenniids, either the male or female or both guard the eggs. In Godavari estuary, both male and female were invariably found

Table I

Number of eggs in different stages of development in O. japonicus, O. bhattacharyae and C. smithi

Stage of development of eggs	*O. japonicus* No. of observations			*O. bhattacharyae* No. of observations		*C. smithi* No. of observations	
	1	2	3	1	2	1	2
Unfertilized eggs ..	—	—	—	121	—	28	5
Embryo with Blastodermal cap ..	17	4	38	—	—	—	—
,, Embryonic ridge ..	23	12	31	—	—	—	—
,, 5 myotomes ..	12	42	10	—	—	—	—
,, 7 ,,	—	—	—	—	—	7	23
,, 16 ,,	59	82	102	—	—	—	—
,, 28 ,,	67	13	54	—	—	15	58
Eggs 6 days before hatching ..	—	—	—	28	9	—	—
,, 4 ,, ,, ,,	—	—	—	49	37	92	67
,, 3 ,, ,, ,,	21	19	10	—	—	—	—
,, 2 ,, ,, ,,	30	52	18	—	—	19	81
,, 1 ,, ,, ,,	—	—	—	61	88	26	38
,, about to hatch ..	48	23	6	32	18	—	—
Larvae ..	—	—	—	—	—	8	22
Empty egg cases ..	—	—	—	—	39	—	—
Total number of eggs etc. ..	277	247	269	291	191	195	294

to guard the eggs, the female generally hovering over the eggs, which serves a dual purpose of guarding them from enemy and also to protect them from desiccation during low tide when they are not generally submerged under water; the male usually keeps watch at the entrance of the hole. Thomson and Bennet (1953) and Munro (1955) observed that the parents guarding the eggs to create a current to gently pass over the eggs. Such a phenomenon has not been observed in the case of Godavari estuarine blenniids.

Development

The eggs were carefully stripped from the gelatinous bed and sorted out into different finger bowls according to the stage of their development. Out of these few eggs in the earliest stage of development were selected for observing further stages, rest of the eggs were also observed at regular intervals and the time taken for each of them to hatch was noted.

Due to the presence of gelatinous matrix and putrifying wood, ciliate menance was found to be much. However, due to the presence of tough egg membrane there was no immediate danger of destruction by ciliates. Three to four water changes were found to be enough during 24 hours.

Development of *O. japonicus*

(Plate I, Figs. 1-21)

Structure of egg more or less same in both species, hemispherical and dome-shaped in side view, spherical when viewed from top. Ovarian eggs almost spherical, the dome shape might be due to nature of attachment (Jones 1937). Gelatinous material extends up to lower third of egg, vitelline space narrow, yolk granular, bright orange, one large oil globule of about 1/3 egg diameter, 8-10 minute indistinct oil globules (Fig. 1).

Germinal disc (blastodisc) in formation in the earliest stage kept for observation. Streaming movements of protoplasm (Ryder 1882) towards animal pole not visible. First cleavage initiated 5 minutes after the formation of germinal disc, 10 minutes later two blastomeres formed (Fig. 2) ; second cleavage begins 15 minutes after the first, results in 4-cell stage 35 minutes after first division; 8-cell stage formed 40 minutes after the 4-cell stage (Fig. 3). First and second cleavages meridional, at right angles to each other, third cleavage accomplished by formation of two lateral furrows on either side of, and parallel to the first plane of cleavage (Nelson 1953).

Sixteen-cell stage (Fig. 4) formed 25 minutes after 8-cell stage. Further divisions complicated, result in the formation of blastoderm 15½ hours after the formation of germinal disc. At 19 hours blastoderm composed of a cluster of minute cells, its margin begins to extend as a thin layer over yolk (Fig. 5). Margin of blastoderm reaches equator of yolk at 21 hours (Fig. 6). Blastoderm covers 3/4 yolk mass at 24 hours (Fig. 7) completely enclosing it at 30 hours ; embryo appears as a ridge along the middle of blastoderm (Fig. 8). Rudiments of optic vesicles appear at 53 hours, half an hour later first myotomal division initiated. Auditory vesicles appear 10 hours after optic vesicles.

At 72 hours (Fig. 9) optic and auditory vesicles well formed, 5-6 somites present, Kupffer's vesicle present below posterior end of embryo. Head slightly tucked into yolk mass ; blood corpuscles appear at 84 hours, heart starts pulsating very feebly 2 hours later, slow streaming movement of yolk granules into blood stream discernible. At 20 hours (Fig. 10) embryo well advanced with 16 myotomes, black chromatophores appear on yolk mass ; 5½ hours later tail becomes free from yolk, 21 myotomes present, embryo exhibits feeble movements.

In 4-day-old embryo myotomes increase to 22, upper part of eye develops black pigmentation ; 6 hours later 2 myotomes added, upper half of eye deeply pigmented, embryo exhibits frequent movements ; 15 hours later myotomes increase to 28, embryo moves frequently, often changing the position of its tail, eyes black, heart beats regularly, embryonic and extra-embryonic circulation established. The general pattern of development of circulatory system is similar in both species.

At 5 days (Fig. 12) tail grows further and curves over head ; with reduction in yolk mass the chromatophores on it aggregate below embryo, eyes dark, glisten by reflected light. Pigmentation on the ventral side of 6-day-old embryo increases (Fig. 13), eyes appear quite black.

In 7-day-old embryo (Fig. 14) yolk further reduced, gradually becomes paler with progress of development. Eyes richly pigmented with orange chromatophores, start moving about this time. A heart-shaped orange chromatophoral cluster

with branched melanophores in the middle develops between eyes, melanophores hitherto present on yolk migrate onto alimentary canal. Blastophore present as a circular opening at the end of alimentary canal. In 8-day-old embryo (Fig. 15) yolk appears very pale, rudiments of pectoral fins appear, melanophores appear on mid-ventral line of tail, oil globule reduced.

At 9 days (Fig. 16) eyes black with orange pigment along margin, walls of alimentary canal with large melanophores, black and orange chromatophores between eyes expand further, melanophores on tail increase in size, expansion and contraction of chromatophores a constant feature. Mouth clearly differentiated.

Hatching :

Hatching is similar in both species, the actual process lasting from 7½ to 25 minutes. The head of the embryo presses against the tough egg membrane which offers considerable resistance and is consequently stretched out as a conical protuberance till it is ripped open. The larva immediately rushes out of the membrane as if shot out and swims actively.

Thomson and Bennet (1953) observed in *Omobranchus anolius* (Val.) that each larva as it is hatched is taken into the mouth of the parent and expelled from the nest with a sharp spitting movement, apparently to free the larva from an irregular layer of structureless material, presumably derived from the yolk. Such a behaviour was not observed in the species under study, but the way in which the larva rushes out ripping open the egg membrane may serve the same purpose.

Larva soon after hatching (Fig. 17) :

Yolk sac present below pectoral fins, oil globule disappears, jaws well formed, anus situated at less than 1/3 distance from tip of snout. Pectoral fin a membraneous flap, its base with orange chromatophores and a few scattered melanophores, orange lines radiate from base into flap, 29 melanophores in mid-ventral line of tail, orange band from tip of snout to anterior margin of orbit, orange margin round eye, ventral and dorsal walls of alimentary canal black. Vertical fin fold well developed, continuous. Larva swims actively.

24-*hour-old larva* (Fig. 18) :

Yolk much reduced, orange band on snout extends to posterior end of maxilla (Figs. 18-20), melanophores and a few brown chromatophores develop among orange bands on pectoral fins.

48-*hour-old larva* (Fig. 19) :

Ten pre-anal, 34 post-anal myotomes, pigmentation on pectoral fin increases, 32 melanophores on tail. Few leaf-like papillate structures appear on opercles (Fig. 21). Larva slightly opaque.

4 *days and* 8-*hour-old larva* (Fig. 20) :

Yolk completely absorbed. Brown and yellow chromatophores appear in the orange bands on snout, which now appears yellowish, melanophores on alimentary canal appear circular, yellow chromatophores appear on pectoral base which appears yellow with scattered melanophores.

Larva did not survive beyond this stage. Attempts to feed them on copepods, nauplii, fish eggs and various other planktonic organisms were not successful and they probably died of starvation.

PLATE I

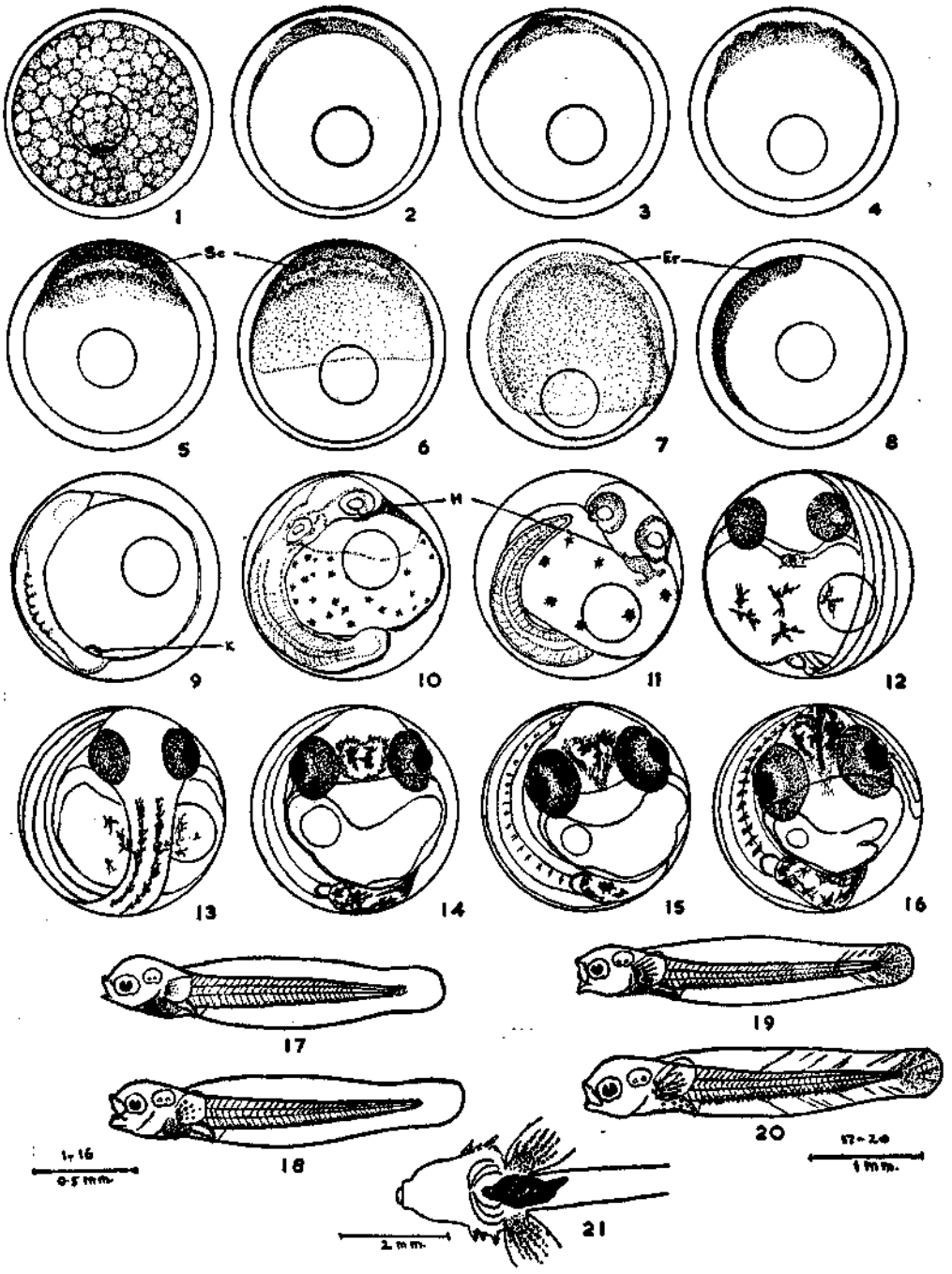

Plate I, figs. 1-21. Stages in the early development of *O. japonicus*.

1. Fertilized egg; 2. two-cell stage; 3. Four-cell stage; 4. 16-cell stage; 5. Egg at 19 hours—segmentation cavity appears and blastoderm starts to extend over yolk mass; 6. Egg at 21 hours—blastoderm extends to equator; 7. Egg at 24 hours—blastoderm covers ¾ of yolk mass; 8. Egg at 30 hours showing embryonic ridge; 9. Egg at 72 hours—future heart develops in the vacant space in front of head; 10. Egg at 90 hours—heart pulsates, embyonic and extra-embryonic circulation initiated; 11. Egg at 111 hours with tubular heart; 12. 5-day old egg; 13. 6-day old egg; 14. 7-day old egg—heart-shaped chromatophoral cluster develops between eyes; 15. 8-day old egg—melanophores appear on tail; 16. 9-day old egg—chromatophores between eyes expand; 17. Larva soon after hatching; 18. one-day old larva; 19. 2-day old larva; 20. 4-days and 8-hour old larva; 21. Ventral view of head showing leaf-like papillate structures. Er=Embryonic ridge; H=Heart; K=Kupffer's vesicle; Sc=Segmentation cavity.

Development of *C. smithi*

(Plate II, Figs. 1-13)

Eggs were in different stages of development at the time of collection (Fig. 1, Table I). The egg with earliest stage of embryo hatched 8 days later, this stage was more or less similar to the 3-day-old embryo of *O. japonicus*.

Egg 8 days before hatching (Fig. 3) :

Myotomes 7. Rudiments of eyes and auditory vesicles present, head and tail still attached to yolk mass, future heart appears as a small vacant space in front of head. About 24 star-shaped melanophores on yolk, arranged in a diffused group.

Egg 7 days before hatching (Fig. 4) :

Myotomes 16. Melanophores on yolk increase in size, scattered, few arranged on mid-ventral part of embryo. Head and tail extend further over yolk mass, head slightly dipping into it and tail gradually getting free. Red blood corpuscles appear in the vacant space in front of head followed 40 minutes later by a slight movement of yolk granules, heart starts pulsating 2 hours after the appearance of blood corpuscles, 4 hours later primitive embryonic and vitelline circulations established.

Egg 6 days before hatching (Fig. 5) :

Myotomes 28. Eyes and auditory vesicles distinct. Scattered melanophores appear on eye, most of the melanophores on yolk concentrate below embryo. Embryo exhibits frequent movements.

Egg 5 days before hatching (Fig. 6) :

Melanophores on yolk migrate on to the dorsal and ventral surfaces of embryo. Embryo constantly moves changing the position of tail very often.

Egg 4 days before hatching :

Yolk a little reduced. Eyes black and shining, melanophores appear on mid-ventral line of tail. Numerous streams of vitelline vessels into heart discernible.

Egg 3 days before hatching (Fig. 7) :

Melanophores on the embryo come to lie just behind auditory vesicles in a single patch, two large melanophores develop between auditory vesicles, melanophores on tail enlarged and branched, black bands appear on pectoral rudiments.

Egg 1 day before hatching (Fig. 8) :

Yolk pale, much reduced. Five black bands radiate from pectoral base into membraneous flap, pigmentation on eye localised to optic cup, cornea silvery with few scattered black and orange chromatophores. Embryo exhibits wriggling movements.

Larva soon after hatching (Fig. 9) :

Five pre-anal, 28 post-anal myotomes. Larva transparent, yolk sac small, eyes and auditory vesicles well developed, mouth well formed, anus at 1/3 distance from tip of snout. A black band from tip of snout to anterior margin of eye, a broad black band along upper and a narrow band along lower margins of rectum, 26 melanophores on the mid-ventral line of tail, 2 star-shaped melanophores bet-

PLATE II

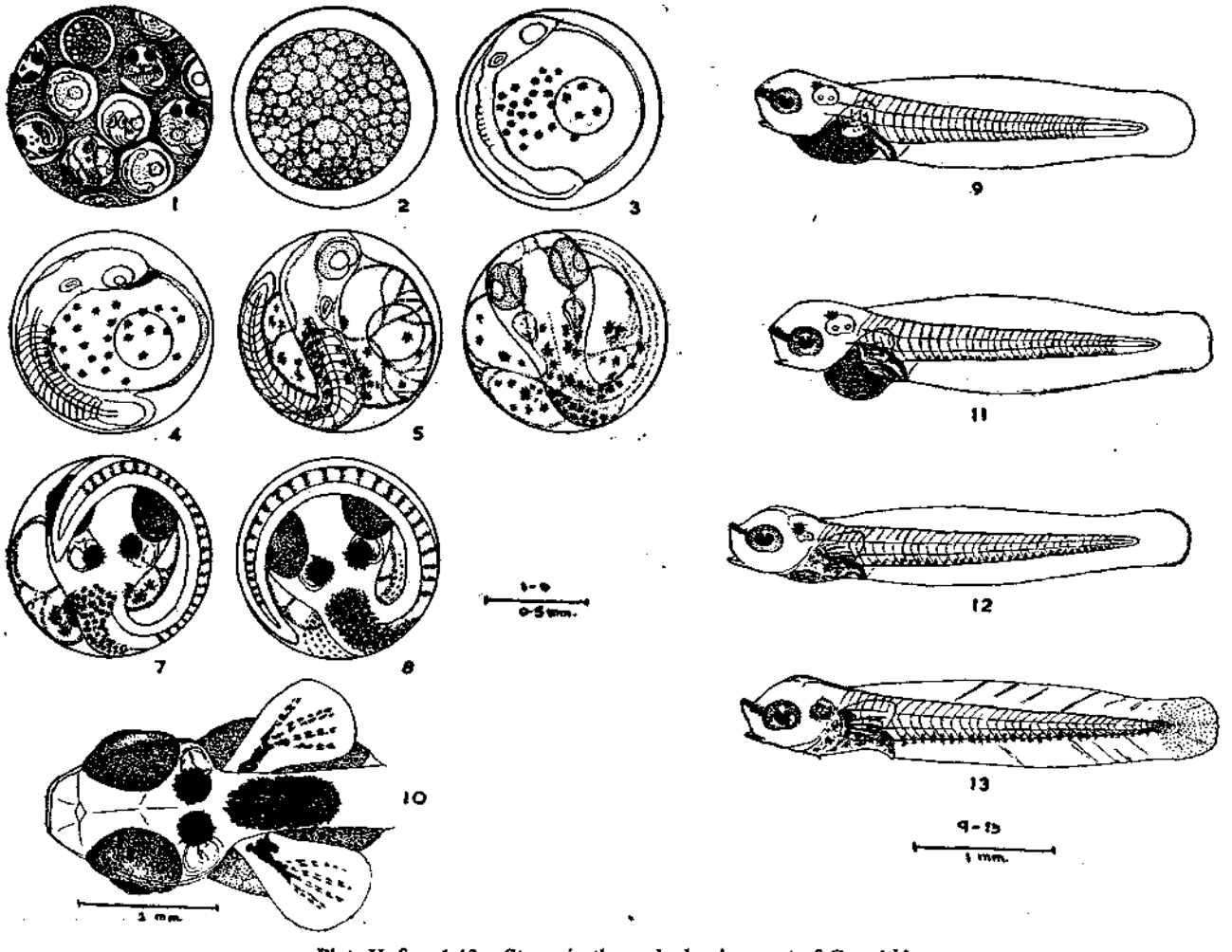

Plate II, figs. 1-13. Stages in the early development of *C. smithi*.

1. A portion of the patch of eggs enlarged to show eggs in different stages of development; 2. Fertilized egg; 3. Egg 8 days before hatching—vacant space in front of head for the development of future heart; 4. Egg 7 days before hatching—melanophores scattered all over the yolk mass; 5. Egg 6 days before hatching—embryonic and vitelline circulation fully established; 6. Egg 5 days before hatching—melanophores concentrate below the embryo; 7. Egg 2 days before hatching—2 large melanophores appear between auditory vesicles; 8. Egg 1 day before hatching—melanophores on the yolk mass concentrate on the dorsal wall of stomach; 9. Larva soon after hatching; 10. Enlarged view of head and anterior part of body showing characteristic pigmentation; 11. 24-hour old larva; 12. 2-day old larva; 13. 4-day old larva.

ween auditory vesicles, a large oval patch of radiating melanophores between pectoral fins (Fig. 10). Pectoral fin well developed with a prominent black patch on its base from which radiate 4 broken double bands into the fin. Larva swims actively taking rest at the bottom of the trough at regular intervals.

24-*hour-old larva* (Fig. 11) :

Eight pre-anal, 28 post-anal myotomes. Four discontinuous black bands on pectoral become continuous

48-*hour-old larva* (Fig. 12) :

Post-anal myotomes 30, yolk sac reduced. Melanophores on tail more branched, the 4 longer bands on pectoral confined to lower half, very short bands develop in upper half.

72-*hour-old larva* :

Post-anal myotomes 31. Larva very active, swims along the rim of the trough. A black blotch on opercle above auditory vesicle, longer bands in lower half of pectoral fin forked at tips, smaller bands in upper half increase in length, 29 melanophores on mid-ventral line of tail.

4-*day-old larva* (Fig. 13) :

Yolk completely absorbed, jaws well formed, ventral fins appear as two projections below opercles. Pigmentation on pectoral fin, head and mid-ventral line increase. Leaflike papillae develop on opercles. The larvae did not survive beyond four days.

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