

# NOTES FROM THE PLYMOUTH AQUARIUM

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(Plate I)

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During the daily maintenance work of a large aquarium many casual observations are made on the habits of the inmates. These are sometimes worthy of record, though too slight in themselves to justify separate papers each under its own distinctive title. It has, however, been thought fit to bring together in the form of a series of notes some of the more interesting of these observations. It is not intended to discuss each with full reference to the comparable literature; rather are they presented as raw material for the use of other investigators in their own specialized fields. Most of these observations have been made since the re-establishment of the Plymouth aquarium in 1946 (after its war damage), and up to the date of writing, November 1948.

## A DISEASE OF *ADAMSIA PALLIATA* (BOHADSCH)

In a shallow table tank strewn with shell-gravel there are regularly displayed a varying number of small hermit-crabs, *Eupagurus prideauxi* (Leach), with their cloak anemones, *Adamsia palliata* (Bohadsch). Normally the hermit-crabs die before the anemones, necessitating the removal from time to time of an accumulation of the latter from the bottom of the tank. It was therefore an unprecedented happening when on 17 March 1947 all the cloak anemones were found to be dead or almost dead, with most of the colour gone and the soft tissues shrunk away from their cuticular bases. Many had dropped off altogether to lie decaying on the gravel. The hermit-crabs themselves were alive and well but they looked peculiarly naked, their abdomens covered only with the thin brown cuticles of their late companions and the now absurdly small gastropod shells of their earlier youth.

Whatever it was that had killed the anemones had acted quickly. Two days before it had been noticed that the anemones were sickly, though previously there had been nothing unusual about their appearance, the tank having been looked over daily. About half the hermit-crabs and anemones present had come in straight from the sea less than a week before the catastrophe; others had been in the aquarium much longer, some perhaps for several weeks. The disease was probably introduced with the latest arrivals. There was no evidence of protozoan or other obvious parasites. (I am indebted to Mr Y. R. Tripathi for assisting me in the search for parasites.) The disease may therefore have been caused by some extremely small micro-organism.

On 20 March six hermit-crabs with cloak anemones newly brought in from the sea were put into the tank. Four days later the anemones were very ill and had begun to shrink away from their cuticular bases. On the next day their columns showed ugly lesions, and on the following day they were even worse, being almost detached from the basal cuticle. On this day (27 March) the tank was cleared of all hermit-crabs, anemones and visible traces of them and a new lot, procured by trawling, put in. In a few days these too had the disease and further batches also caught it soon after arrival. All this time there were a few hermit-crabs and anemones of the same species in another tank elsewhere in the building and these continued to be healthy, although the water running into their tank was supplied by the reservoir into which water from the diseased tank was draining.

On 2 May the entire contents of the diseased tank were removed and got rid of. The tank was emptied and swilled with antiseptic (Dettol) for 20 min. The antiseptic was washed away and the tank swabbed dry. It was then reflooded with sea water, new and well-washed shell gravel was strewn over the bottom, and a new lot of hermit-crabs with cloak anemones were put in. These had been caught a few days previously and acclimatized in another tank. There was no further trouble and there has been no recurrence of the disease.

#### LONGEVITY OF SABELLIDS

Many animals, once they have become accustomed to life in an aquarium, survive for many years. This is especially true of hardy fishes like grey mullet and bass for which a period of twelve or fifteen years in one tank is nothing unusual. Some invertebrates also reach and may exceed these figures (e.g. some sea-anemones) but only rarely are individual invertebrates kept sufficiently well isolated from others of their kind for definite records to be established.

In a tank containing grey mullet there had been for at least several months before the war one solitary *Sabella pavonina* Savigny var. *bicornata* Hornell (Ewer, 1946). This particular tank was one of the few to escape serious damage by enemy action, and throughout the war this sabellid maintained its position in the bottom gravel close to one side—and it is still there. The tank was emptied

and cleaned in 1946, but the worm was saved and replaced in its old position. It has therefore been alive for at least 10 years and during that period it has not been known to renew its crown, though this may have happened during periods when I have been away from the Laboratory.

In the same tank, close to the *Sabella*, is a piece of limestone dredged from the Sound; it also has been in the tank since before the war. It was selected for exhibition because of the large number of the boring sabellid *Potamilla torelli* Malmgren which it contained. To-day there are fewer of these worms to be seen than there were originally, but the stone is still a beautiful sight when all have expanded their crowns. It is not known whether the worms still living were present in the stone when it was dredged ten years or so ago, or whether they are newcomers. Some may be newcomers, for it is known that sabellids can breed in the aquarium system. Lately several *Branchiomma vesiculosum* (Montagu) have appeared in several tanks, particularly those with sandy bottoms, which had never had any of these worms put into them. The species is kept in other tanks in the same circulatory system, and the free-swimming larvae must have been carried round through the pump.

#### AN APPARENT EXAMPLE OF LEARNING IN *PALINURUS VULGARIS* LATREILLE

In 1947 there were together in a large tank four or five *Palinurus vulgaris* Latreille and twenty or more large hermit-crabs, *Eupagurus bernhardus* (L.), in whelk shells on which were usually one or more parasitic anemones, *Calliactis parasitica* (Couch). The only other inhabitants of the tank were a few flounders. For some months these lived together peacefully and then, at a time when food was scarce, the *Palinurus* attacked the hermit-crabs, pulled them out of their shells and ate the soft abdomens. They continued this habit even when well fed. Any new hermit-crabs put into this tank were soon found and eaten and it was no longer possible to keep hermit-crabs with these particular rock lobsters. The latter were therefore removed and replaced by a similar number from another tank. The new *Palinurus* did not attack the hermit-crabs though kept with them for several months, and though they too sometimes went short of food during periods of scarcity.

#### REGENERATION OF ARMS IN *MARTHASTERIAS GLACIALIS* (L.)

In May 1947 a specimen of *Marthasterias glacialis* (L.) regenerating four arms was brought in from the sea. The four regenerating arms were relatively short, about 2 cm. long, the fifth and unregenerated arm being about 15 cm. in length. This starfish was photographed shortly after arrival and was then kept in a small tank apart from any others of the same species. From time to time it was fed on mussels or on pieces of squid, but feeding was irregular and there were often long periods without food. The four regenerating arms slowly increased in size but they were still only a fraction of the length of the fifth arm when in

July 1948 the latter broke off at the disk and died. It may be that irregular and insufficient feeding had brought about some wastage of tissues, perhaps to supply materials to the regenerating arms. However that may be, there was soon to be seen on the side of the disk at the place where the old arm had been severed the rudiment of a new one. Now, in November 1948, the starfish consists of a disk about 2 cm. in diameter, four arms 6-7 cm. long and one arm 1.5 cm. long. There is some difference in appearance between the tissues of various ages, especially as regards colour, the disk being darkest and the newest arm lightest in tone. Thus had the specimen come in from the sea in its present condition, careful examination would have revealed the history of these events. Presumably in time the colour differences between the tissues of three distinct ages will become less and when the arms reach sizes commensurate with the disk there will be produced a starfish showing little or no trace of its history. The age of such a starfish is the age of its disk. In the sea such accidents to the arms may well delay growth of the disk and result—when the new arms have grown to match the disk—in a starfish, apparently normal and complete, but considerably smaller than others of the same species and age living under identical feeding conditions.

REGENERATION OF FINS IN *TRIGLA HIRUNDO* BLOCH  
AND *MUGIL CHELO* CUVIER

There are comparatively few references in the literature to the regeneration of fins in fishes. Aquarium keepers know that in due course torn fins usually heal to show no signs of injury, but actual records are not numerous.

In the autumn of 1946, not long after the reconstruction and reopening of the aquarium, a sapphirine gurnard, *Trigla hirundo* Bloch, about a foot long, was brought in from the sea and put into a tank with some others. It had been damaged in the trawl and for several days was very ill. Almost the whole of the upper lobe of the caudal fin showed extensive bruising and before long the tissues died and rotted away. The 'fingers' of both pectoral fins were likewise bruised, and similarly rotted away for about half their lengths. The condition of the fish was such that it was expected to die and there was some intention of removing it from the tank before it did so. However, some signs of recovery were noticed and it was allowed to remain, although for several weeks supuration of the fingers was marked and the lesion of the caudal fin was inflamed. Slowly the wounds healed and eventually it was seen that the upper lobe of the caudal fin was being regenerated. For several months this regenerating lobe was darker in colour than the lower and it was, of course, much smaller. By the end of the first year it had by no means reached the dimensions of the lower lobe and even now, two years after the event, the upper lobe is still a little smaller than the lower. The fingers were also regenerated, some of them abnormally, the new growths being directed ventrally at various angles to the

old proximal parts. On the third finger of the left pectoral the angle is so acute that this particular finger is bent right back on itself. Some of the less acutely bent fingers are now straightening out.

In mid-June 1947 thirty or forty medium-sized grey mullet (*Mugil chelo* Cuvier) were caught in a seine-net in the estuary of the River Yealm and transported to a large reserve tank outside the main aquarium building. Within two or three days all the fish showed extensive bruises and each one had a mark around the head, or forepart of the body, where a mesh of the net had encircled it. Almost all the fins were torn and lacerated, particularly the caudal and paired fins which were extensively frayed with bared fin rays; in some instances only the stumps of the pectorals were left. Some of the fish died but more than half survived, their lesions becoming covered with thick brown scabs, often extensive, on head and body. In this condition they remained for several weeks, eventually feeding well. Towards the end of July and during August the scabs were reduced and disappeared entirely. At the same time the fins were regenerated and by September the fish were clean and fit for exhibition. Two or three of them were put with the grey mullet we have had for many years but most of them were sent by rail to the London Zoo aquarium where they are still living. The few kept in Plymouth still show marks, apparently scabless, where the deeper bruises had been.

#### PARTIAL BURYING OF *TRIGLA HIRUNDO* BLOCH

Before the war *Trigla hirundo* Bloch were kept in a tank strewn with small pebbles; they are now kept on a sandy bottom and this has led to the observation that they can bury themselves, at least partially (Pl. I). The burying habit was most noticeable during the winter of 1947-48, especially did it take place late in the evening after the aquarium had been in darkness for a few hours. Burying has also been noticed during the daytime, particularly in the autumn of 1948 when the temperature of the water was falling rapidly. The observations are insufficient to associate the habit with low or falling temperatures, or with low light intensity, but they do at least indicate that it is usual for these fishes partially to bury themselves in the sea-bottom from time to time. The closely allied sea robins (*Prionotus*) are stated to bury themselves up to the eyes when disturbed (Romer, 1941).

The sand in the tank is not very deep and it seems likely that the fish would have covered themselves more completely had they been able to do so. The closed caudal fin was sometimes completely buried and the sand was heaped up on each side of the body towards the lateral line. Except for the fingers the pectoral fins were out of sight under the sand; the fingers emerged from it and were visible. The head was never covered in any way and the gill-slits were free from sand, respiration taking place in the usual manner and being unimpeded.



SHOALING OF *Gobius flavescens* FABRICIUS

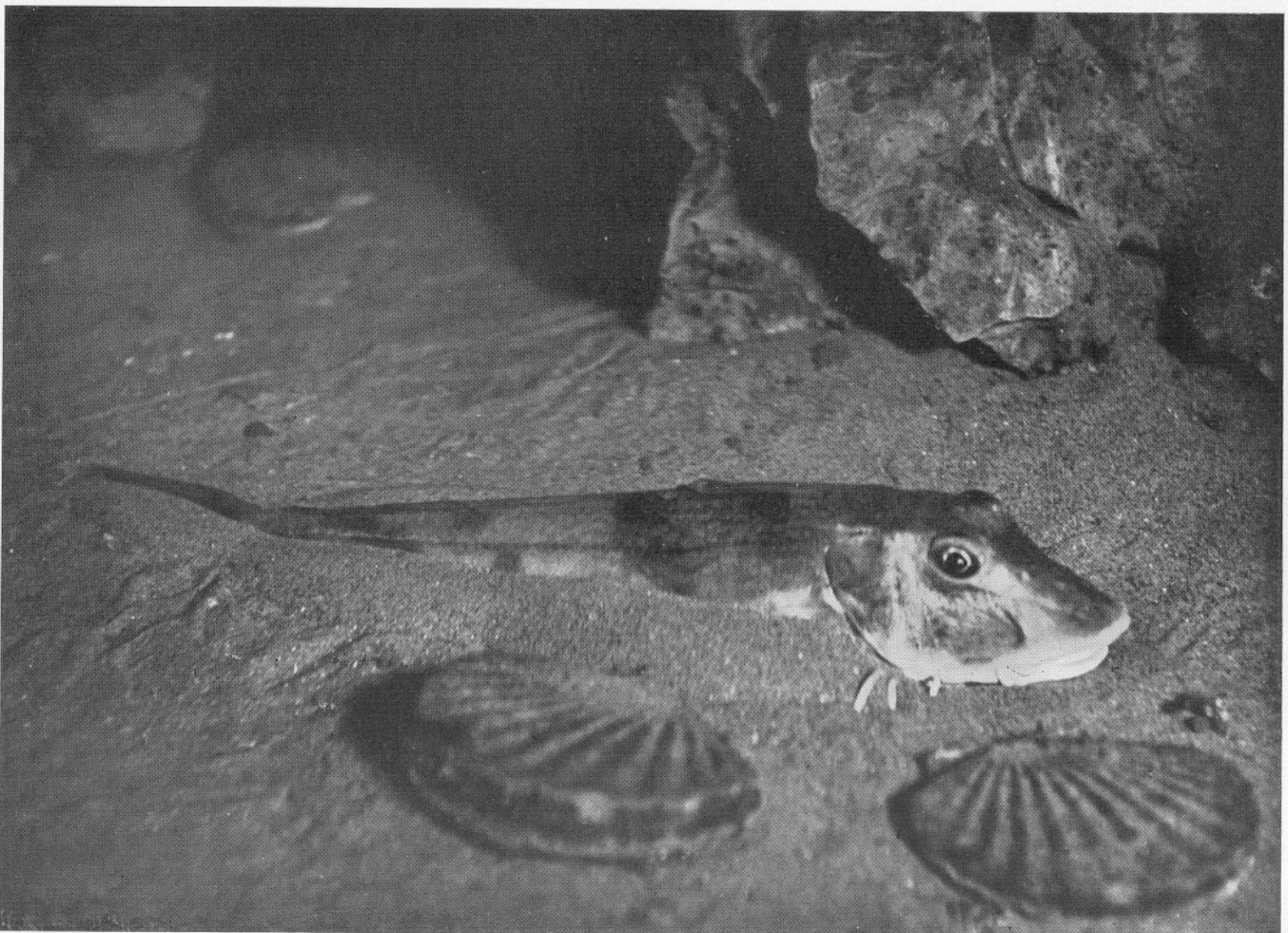
It has been the practice for some years to keep *Gobius flavescens* Fabricius in the largest tank in the aquarium, together with conger eels, dogfishes, nurse-hounds and large turbot. They swim about in the tank and are but little inclined to rest on the bottom or on the rocks, their habit being pelagic rather than demersal. The larger fishes take no notice of them, presumably because they are too small to tempt their appetites. The gobies normally swim about individually with no tendency to shoal. They progress with jerky forward motions produced by the beating of the pectoral fins, their chief organs of locomotion.

In the summer of 1948 two or three hundred young fishes of this species, each an inch or less long, were netted in shore pools and placed in the tank. Instead of dispersing immediately they kept together in compact rather globular shoals, each consisting of fifty or a hundred fishes. For one or two days these shoals moved slowly through the tank keeping more or less in mid-water. The jerky forward motions of the fishes were out of step and gave a curious scintillating appearance to the shoals. Gradually the shoals became less compact and in a few days each little fish was swimming about its business without reference to its neighbours. The gobies scattered throughout the tank, mainly in the lower levels but a few swam well up near the surface. Since then there has been no tendency to shoal, although occasionally the fishes gather into straggling groups. Perhaps the shoaling was a fear reaction induced by capture and by strange surroundings; perhaps it takes place in the sea when the gobies are very young, or when alarmed.

*BLENNIUS GATTORUGINE* BLOCH GUARDING EGGS

Early in April 1946 a *Blennius gattorugine* Bloch spawned in a corner at the back of a medium-sized tank in the research laboratories. There was some sandy gravel on the bottom of the tank but no rockwork, and the eggs were attached in a single layer to the vertical slate. They were assiduously guarded by what was presumably the male parent, and his devotion continued for many weeks although the eggs soon died and therefore did not hatch. It was the end of June before he ceased to guard them. It would be of some interest to know whether the hatching of the eggs would have been a signal for the guarding fish to cease his duties and whether this long and fruitless devotion was due to the signal not having been given.

There were several other specimens of the same species in the tank, but at the time there seemed no doubt at all that it was the same fish on guard the whole time. Any other fish approaching the vicinity of the eggs was vigorously chased away.



## REFERENCES

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## EXPLANATION OF PLATE I

*Trigla hirundo* Bloch, partially buried in sand, about 8.30 p.m. in December 1947. The tracks in the sand were produced by the lower lobe of the caudal fin dragging along the bottom as the fish walked on its 'fingers'. Photograph by flashlight.