NATURAL HISTORY

JAN.-FEB.
1928

FISH
NUMBER

JOURNAL OF THE AMERICAN
MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

FIFTY CENTS

The Shepherd Fish and Its Strange Pasture Lands

THE REMARKABLE ASSOCIATION BETWEEN THE FISH, *NOMEUS*, AND THE PORTUGUESE MAN-OF-WAR, *PHYSALIA*

By G. H. PARKER
Director of the Zoological Laboratory, Harvard University

FOR a small fish the open sea is a habitat fraught with endless danger. Here he may become the prey of anything that can swallow him; he may be chased and eaten by the larger members of his own tribe; he may be snapped up and swallowed by such sea mammals as the porpoise or the dolphin; and he may be caught by diving birds and carried off as food for their nestlings. Almost nowhere is there safety. A floating bunch of seaweed, a box or a barrel, or even a piece of driftwood may afford a temporary refuge for him that at any moment may prove of vital importance. Around such an obstacle he may successfully dodge his huge pursuer, and in the interior of a mass of weed or of an empty box he may find a sanctuary as secure as a hollow tree for a land animal. Every collector of pelagic fishes knows the meaning of this habit, and, when he is on the open sea in search of small game, he steers for every floating object he sees, scoops it in with his collecting net, and is usually rewarded by a catch of small fry. When we think of the immense waste of oceanic waters with their relative freedom from floating material, we can appreciate to some degree the slim chance for self-preservation that a small fish has. No wonder that he uses every opportunity within reach as a protection against his voracious enemies.

But not everything that floats in the sea is a haven of refuge for the small fish. Whoever has been stung by a jellyfish knows that it is far from being a protection to any creature. Jellyfishes belong to a large group of animals that embraces a great variety of sea creatures including such forms as the corals, sea pens, sea anemones, Portuguese men-of-war, and the like. All these are provided with nettling organs which are best developed on their tentacles and similar parts. These nettling organs serve the double purpose of stinging invaders and thus driving them off, and of killing other creatures that may serve as food. In a number of these stinging animals, as for instance in our common sea anemones, the nettling organs, though present, are so weak that ordinarily they can make no impression on the human skin. Hence we look upon such forms as innocuous. But in others, as for example in the majority of the jellyfishes, the nettling organs are well developed and may inflict upon man not only a severe and painful injury but may poison him so seriously that it sometimes takes weeks for him to recover. Notorious among these more severely injurious kinds is the Portuguese man-of-war, *Physalia*. The tentacles of this jellyfish, if passed over the skin of a human being, may inflict such a vigorous urtication as to throw the person into spasms and leave him in a prostration that may last for many days. This particular species is commonly regarded as the one whose sting is the most vigorous of all marine animals. Both in immediate painfulness and in after effects it is quite comparable to the results of being stung many times by bees or wasps or by a scorpion.

The means whereby a jellyfish or other like animal can sting is of microscopic proportions. The nettling organs of these animals are to be found commonly upon the tentacles that surround the mouth or that hang from the edge of the bell. Such organs appear usually as small swellings on the surface of the tentacle. When these swellings are examined under the microscope, one sees that they contain multitudes of microscopic capsules within each one of which is a spirally twisted filament. If the skin of a fish

The Portuguese man-of-war, *Physalia*, sheltering several shepherd fish, *Nomeus*, amid its tentacles, which bear myriads of nettling organs. Photograph of a model in the American Museum

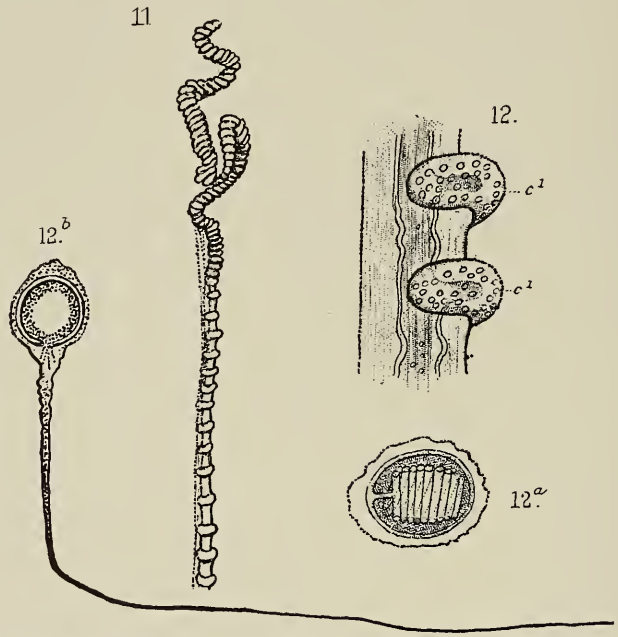
or of a human being comes in contact with a nettling organ, thousands of these minute filaments are shot out and in a very remarkable way penetrate the skin of the creature concerned. Each filament is a hollow tube of extremely fine caliber whose cavity leads into that of the capsule from which the filament has emerged. Through this microscopic tube the minute amount of poison contained in the capsule may be injected into the wound inflicted by the filament itself. Each filament, with its attached capsule, is in fact a microscopic hypodermic syringe which, after insertion under the skin, may continue to inject poison into the creature whose misery or death it may thus bring about. A person stung by a jellyfish is punctured by myriads of such microscopic syringes, each one of which is forcing its irritating contents into the wound produced by its needle. In most jellyfishes these organs of torment are of such a size as to be visible only under the high power of the microscope, but on the tentacles of the Portuguese man-of-war the nettling organs are so large that, when their filaments are discharged, these organs seem to be covered with a fine woolly growth easily visible to the naked eye. The nettling filaments of this jellyfish are in all probability the largest of their kind, and the pain and wounds that they inflict are dreaded by all those who have occasion to touch them.

The Portuguese man-of-war or *Physalia*, as it is technically called, is a native of the warmer waters of the Atlantic and the Pacific oceans. Each *Physalia* consists of a gas-filled sac which floats on the top of the water. From the underside of the sac long purplish tentacles trail a dozen feet or more into the sea. In addition to these tentacles the underside of the sac carries innumerable trumpet-shaped mouths that hang down an inch or so into the sea-water below. The long tentacles are the parts on which the very vigorous nettling organs are situated. The sac or float to which all these parts are attached maintains its position like an inflated bladder on the surface of the water. This float is glassy-clear in its transparency and is tinted in varying shades of blue, purple, and pink. One end of it is pointed, the other is blunt, not unlike the hull of a vessel. The upper part of the float rises into a high, fluted crest, giving the whole the appearance of an ancient galleon under full sail. Nothing is more beautiful than to meet a flotilla of these miniature, brightly colored barks making their way under a gentle breeze across the surface of a tropical sea. They rise and fall with the waves and stand to the wind with such regularity and precision that they recall in a most realistic way a miniature reproduction of the ancient fleets of Spain or of Portugal.

In the blue waters below their diminutive hulls, the long, delicate tentacles with their deadly nettling organs stream out many feet like anchor lines. Almost transparent and of the tint of the blue sea water itself, one of these tentacles may be struck by an unwary fish. Instantly batteries of nettle capsules are discharged with the double result that the fish is made to adhere to the tentacle at the same time that it is seriously poisoned. Its struggles excite the tentacle to shorten and thus the victim is drawn up nearer to the clusters of sucking mouths. Its movements, moreover, bring it into contact with other tentacles, in this way making its capture doubly certain. Sooner or later the fish, if not

too large, is entirely overcome by the poisonous injections and is drawn up to within range of the numerous mouths which spread their trumpet-shaped lips so generously over the benumbed prey as to cover it entirely. Digestion proceeds in this semi-external position and the resulting juices and fragments of the partly digested fish are sucked up by the mouths and elaborated as food for the man-of-war as a whole. It is not unusual to find Portuguese men-of-war with the remains of several partly digested fishes still held to the underside of the float. Sooner or later these are cast off, for the jellyfish certainly catches many more fishes than are necessary for its food.

Could a Portuguese man-of-war be improved upon as a device to catch small creatures in the open sea? As a floating object it naturally attracts fishes in consequence of the protection it appears to promise. But long before they reach it they may collide with one of its numerous tentacles which, as already explained, are arranged to kill, hold, and transport to the mouths any fish of reasonable size. Even the struggles of the fish increase the certainty with which it will be brought to its end. Thus in all respects the Portuguese man-of-war is an admirable death trap for small fishes.



Details of tentacle and nettling organ from the Portuguese man-of-war. No. 11—a slightly magnified portion of a tentacle showing the transverse swellings. No. 12—two of these swellings enlarged to show the embedded poison capsules (c′). No. 12a—one of the undischarged capsules (c′) with its coiled thread, greatly enlarged. No. 12b—one of the discharged capsules with its extended filament. Redrawn from Huxley (*Oceanic Hydrozoa*, 1859, pl. X).

Notwithstanding the deadly nature of the *Physalia*, there is to be found under its float and in among its poisonous tentacles a small fish, the *Nomeus*, which lives in this situation with apparent impunity. This fish is found

commonly only in association with the man-of-war. There is no obvious reason against its independent occurrence in oceanic situations but, as a matter of fact, when it is not taken in immediate association with a man-of-war it is not far separated from the jellyfish, and in regions where its occurrence is periodic it comes and goes with this particular form. The species of *Nomeus* that is thus associated with the *Physalia* has been reported from the Indian Ocean as well as from the warmer parts of the Atlantic Ocean. Its maximum length is about four inches. In consequence of the large black patches on its body and of its pair of broad, fan-shaped ventral fins it is by no means inconspicuous. The most ready way of obtaining it is to dip up with a large net any Portuguese men-of war within reach; under many of these one or more *Nomeus* may be taken. They often show considerable range in size and as many as ten have been reported from a single *Physalia*. The most remarkable peculiarity in the whole situation is that though other small fishes in the same locality as *Nomeus* would quickly meet with death, this fish finds its environment among the tentacles of *Physalia* so favorable that, as already explained, it is seldom found elsewhere.

This little fish was first described by Gmelin in 1788 under the name of *Gobius gronovii* in honor of Gronovius, a senator of Holland and one of the ablest students of fishes in his day. The name was changed in 1817 by the great French naturalist Cuvier to *Nomeus gronovii*. In Homeric Greek *nomeus* is the shepherd or pastor and the latter name is often applied as the common English designation for the fish. Why Cuvier should have chosen the name *Nomeus* for the fish is difficult to conjecture. As a matter of fact these little fishes are more like a herd of sheep than is any one of them like a shepherd. It is probable that Cuvier's employment of the name is a loose use of language. But however this may be, the pasture land of *Nomeus* is certainly a remarkable one, for it is the region circumscribed by the tentacles of *Physalia*. In this relatively limited space much of the life of *Nomeus* is passed, a space in which apparently no other kind of fish can easily live.

What are the mutual relations of *Physalia* and *Nomeus* that this association of the two forms should be maintained? The answer to this question can be at best only conjectured. The presence of *Nomeus* among the *Physalia* tentacles probably induces other small fishes to enter the deadly territory and thus helps in providing *Physalia* with an abundant food supply. More or less of this supply in a partly digested condition falls to the share of *Nomeus*. But the chief advantage of the combination that accrues to the fish is the possession in the open sea of a territory peculiarly its own. No other inhabitant of the ocean can trespass on this strange pasture land without danger to its life. How *Nomeus* accomplishes the invasion so successfully is unknown. Is the fish immune to the deadly poison of the *Physalia* or does its skin contain a substance that prevents the discharge of the nettle capsules of the jellyfish? These and other like questions can be answered only by a further study of *Physalia* and *Nomeus*.