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Physalia, the Fish-eater

The Portuguese Man-of-War Sails the Tropic Seas and Discharges Its Stinging Batteries When Small Fishes Touch Its Tentacles

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A LITTLE FISH swimming or floating near the surface of the sea is forever at the mercy of enemies in the air above and in the water beneath. It needs shelter, and it needs it desperately. A box, a board, a piece of driftwood, a bit of floating sea-weed, is a place of refuge and a godsend. Presently a shadowy form floats by; from it trails a tangled cluster of "vines." It might be – to a fish's eye it looks like – a bit of Sargasso weed. Into the "vines" the little fish darts, and that is the end of the fish. For the "vines" are the stinging, paralyzing tentacles of Physalia.

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Physalia is no doubt known under its picturesque common name of the Portuguese Man-of-War to many persons who have never seen the creature. Unfortunately, it must remain a name only to almost everyone except those who cruise in tropic seas or live along tropic and subtropic shores, for Physalia is so extremely sensitive to mechanical shocks and to even faint traces of unusual chemicals in the water that it is virtually impossible to keep it alive in aquariums. But if technical ingenuity can devise a method of exhibiting this hollow-bodied marine animal, it is to be hoped that the technicians will attempt the job when a new aquarium is built in New York City, for Physalia would certainly repay the effort that would make its close study possible.

I well remember the first Physalias I ever saw – at Sand Key, some miles off Key West, many years ago. From the low bow of a launch, the only part of the animals that could be seen were the pneumatophores, or gas-bubbles, that floated on the surface and were driven hither and yon by every stray breeze. Steering in close, I lifted one of the shimmering bubbles to examine the great cluster of tentacles and zooids on its lower surface. These were its organs for catching and eating food and for reproduction.

This was my only contact with Physalia during four seasons in the Florida Keys and at the laboratory of the Carnegie Institution of Washington at Tortugas, and during ten summers at the laboratory of the U. S. Bureau of Fisheries at Beaufort, N. C., I never saw Physalia even once. They occur only seasonally, and even then spasmodically, so it may be judged how difficult it is to study the habits of these fragile and sensitive creatures.

Only a few students of marine life have seen Physalia catch and eat fishes, and their accounts are widely scattered in scientific books and journals. In recent years I have spent some time searching out the few accounts quoted in this article; no other attempt has ever been made to bring the data together.

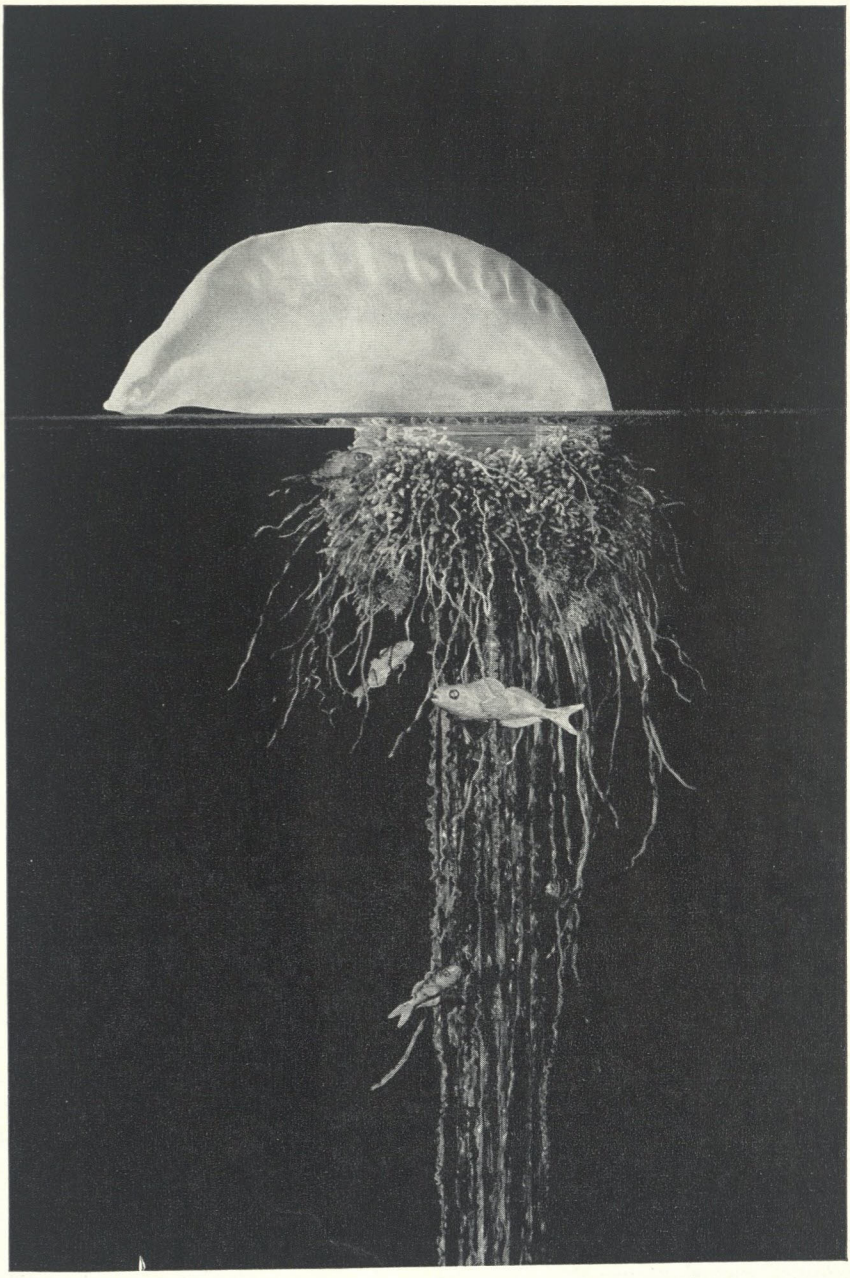
* * *

Some fifteen years ago Prof. G. H. Parker[1] reported some of his studies on the physiology of Physalia which he made at Key West.

"In the blue waters below their diminutive hulls, the long delicate tentacles with their deadly nettling cells stream out many feet like

This is the third of a series of articles recounting the fishing proclivities of the lowly, hollow-bodied marine animals known as Coelenterates. Article No. 2, "Jellyfishes as Fish-eaters," appeared in the *Bulletin* for March-April, 1934.

[1] Parker, George H. 1928. The Shepherd Fish and its Strange Pasture Lands. The Remarkable Association between the Fish, Nomeus, and the Portuguese Man-of-War, Physalia. Nat. Hist., **28**, 53-57, 2 figs.



To a fish, the long, flowing tentacles of Physalia might very well resemble a clump of dangling sea weed. But, as this model shows, a fish that made one such mistake would very likely never make another. On the surface of the water is the floating air bladder; the zooids dangle from it in the water. This is a photograph of a model in the American Museum of Natural History.

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 within range of the numerous mouths which spread their trumpet-shaped lips generously over the benumbed prey so 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 undersides of the float. Sooner or later these are cast off, for the jellyfish certainly catches many more fishes than are necessary for its food. . . . Thus in all respects the Portuguese man-of-war is an admirable death trap for small fishes."

Of all the jellyfishes in southern Florida, Physalia is most dreaded by bathers. If the stinging tentacles strike the body of a swimmer, thousands of the nettle cells penetrate the skin and pour out their poison. Intense stinging, poisoning and swelling follow, and from a heavy enough dose a swimmer may be almost paralyzed for some time. Many an incautious swimmer can testify to the power of Physalia's tentacles and thus their effects on small fishes could be surmised even if there were fewer eye-witness accounts than there are.

The earliest first-hand statement of the fish-killing activities of Physalia goes back 118 years to 1824. In 1817, the French Government sent the corvettes "Uranie" and "Physicienne" on an exploring voyage around the world. The results of this three-year voyage were published in seven quarto volumes. That volume dealing with the zoology of the voyage was written by two scientific men, Quoy and Gaimard, who made the collections. In speaking of Physalia, they say: "We know that physalias feed on fishes for we have several times seen them suck up and digest the little fishes which had received shocks from their fiery tentacles."[2]

Lesson, in his great work on the Acaleph Zoophytes,[3] says that Physalia nourishes itself on fishes, "tel que scombres, maquereaux et avocets." He personally observed that fishes which improvidently ran into its tentacles were quickly killed. He saw fishes as strong as a herring killed and eaten, but flying fishes were the special prey of the Physalia.

George Bennett, in his delightful "Gatherings of a Naturalist in Australasia,"[4] figured in color and described a Physalia from Australian waters. Of its feeding habits he writes that

". . . having one day captured a specimen in my towing net, I observed entangled by the tentacles some little fishes (among them a small *Centronotus niger*). . . . On placing them all together in a tub of sea-water, the Physalia, being apparently very hungry, immediately seized the fishes entangled in its grasp, and the process of feeding by absorption was distinctly observed. The tubes to which the suckers were attached were soon seen to be filled with portions of the fish, readily to be distinguished through their diaphanous coats by the silvery hue imparted to them."

Thirty-nine years later (1899) another Australian scientific man, E. R. Waite,[5] confirmed Bennett's observation. Waite was acquainted with the sanguinary habits of Physalia and in addition he reports that his friend, T. Whitelegge, had often seen small fishes entangled in the tentacles of Physalia or found in its stomach or siphon organs.

The scientist, who had had the best opportunity to study under laboratory conditions the fish-eating habits of Physalia, was R. P. Bigelow. In August 1889, considerable numbers of this coelenterate came into Vineyard Sound, on the southern coast of Massachusetts. Bigelow brought numbers to the aquaria of the Fish Commission Laboratory at Woods Hole and studied their habits. None, however, could be kept alive longer than ten days, even when fed regularly.

[2] Quoy, J. R., & Gaimard, P. 1924. Zoologie (in Freycinet, L. de. Voyage autour du Monde sur les Corvettes. . . . "l'Uranie et la Physicienne" pendant. . . . 1817-20). Paris (Physalia catching fishes. p. 561).

[3] Lesson, Rene P. 1843. Histoire Naturelle des Zoophytes Acalèphes. Paris. (Physalia feeding on fishes, pp. 547-553).

[4] Bennett, George. 1860. Gatherings of a Naturalist in Australasia, etc. London. (Physalia and its fish-eating habits, pp. 5-12, col. pl.)

[5] Waite, E. R. 1899. Scientific Results of the Trawling Expedition of H.M.C.S. "Thetis"—Introduction. Australian Memoirs 4 (Physalia feeding on fishes. p. 15).

Several specimens when brought in had partly digested fishes in their siphons. Other fishes were held fast by the mouths of many siphons. Minnows put in jars with a Physalia would soon come in touch with a tentacle and would succumb. The tentacles tended to encircle the fishes. When a fish was secured, the siphons sucked themselves fast to its side and the process of digestion began.

Here follows Bigelow's careful summary of his observations. In this he makes us see the details of what takes place out in the open sea when Physalia catches its prey. The picture is a vivid one.

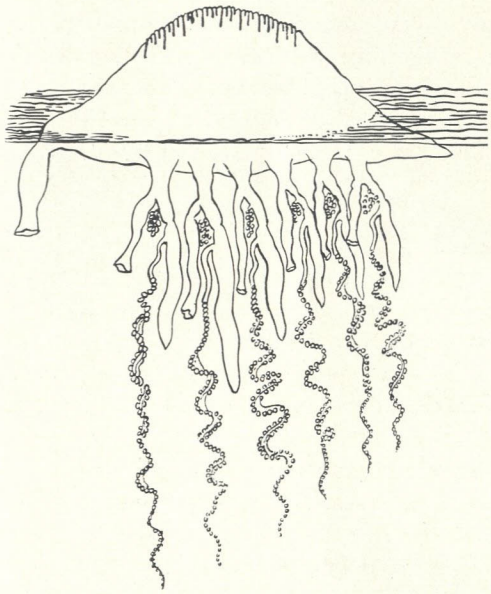
"For food this animal catches small fishes. It floats there on the sea, quietly waiting for some heedless individual to bump its head against one of its tentacles. The fish, on striking, is stung by the nettle cells and fastened, probably by them, to the tentacles. Trying to run away, the fish pulls on the tentacles. The tension on its peduncle, thus produced, is a stimulus on some center there, which sends an impulse along the tentacle that causes it to contract. The fish in this way is drawn up so that it touches the sticky mouths of some of the squirming siphons, or feeding polypoids. As soon as the mouths, covered as they are by a gluey substance and provided with nettle cells, touch the fish they stick fast, a few at first and gradually more. The mouths open and their lips are spread out over the fish until they touch, so that by the time it is dead the fish is enclosed in a tight bag composed of the lips of a dozen or so of siphon mouths. Here the fish is digested. As it begins to disintegrate, partially digested fragments are taken into the stomachs of the attached siphons. When they become gorged they detach themselves from the remains of the fish, the process of digestion is completed in the stomachs, and the nutrient fluid is distributed through the hollow pedicles and peduncles to the other parts of the animal."[6]

* * *

At the beginning of this article I described the tragic fate of a small fish seeking the fatal shelter of Physalia's dangling tentacles. Now I close with a somewhat similar picture, but with a different ending.

If one lifts a Physalia out of the water, a number of beautiful little fishes are likely to dart wildly about with panic-stricken, erratic movements. Cross-barred with the same purplish color that one sees on the tentacles of Physalia, they seem to harmonize in color with the much larger jellyfish, but their association is much more than aesthetic. These fishes, *Nomeus gronovii* by name, live under the floating pneumatophore and swim unharmed among the deadly tentacles. They never voluntarily go any distance from their host and home. They have no other home.

Nomeus has long been thought to possess some charmed immunity to the poisonous nettle cells and, in return for this protection, to lure other fishes to destruction. Other fishes, chasing Nomeus, strike against the tentacles, are paralyzed, and are drawn up to the nutritive zooids and eaten. Any "leftovers" are thought to be eaten by the Nomei.



The mechanism of Physalia can be seen more clearly in this diagrammatic drawing than in the photograph. The compound organisms below the float become more numerous as the colony grows older. Each cluster is composed of a finger-like tactile organ, a reproductive organ looking like a cluster of grapes, a long stinging tentacle, and a feeding polyp with an open mouth. The drawing is from Miner, after Delage-Heroud and Haeckel.

The matter of this curious association is of sufficient interest to warrant going into it further, and on looking up the literature I have found some very curious things. First, as early as 1896, Samuel Garman[7] declared that this immunity is at least sometimes wanting. He states that, "On several occasions Physaliae have been taken with partly digested Nomei in their

[6] Bigelow, Robert P. 1891. Notes on the Physiology of *Caravella maxima* (*Physalia caravella*). Johns Hopkins Univ. Circulars, 10 (no. 88), 90-93, fig.

[7] Garman, S. 1896. Report on Fishes collected by the Bahama Expedition of the State University of Iowa. Bull. Labs. Nat. Hist. State Univ. Iowa, 4, (*Nomeus gronovii* eaten by Physalia, p. 81.)

grasp, which would indicate that the little fishes were sometimes preyed upon by the 'men-of-war.'" These observations were made at the Dry Tortugas, Florida. I spent four seasons there but, alas, I did not see a single Physalia and had no opportunity to study this curious association.

That there is another side to this behavior of Nomeus and Physalia is attested by the observations of a Japanese scientist, Kojiro Kato.[8] In 1933, at the Mitsui Institute of Marine Biology near Shimoda, Japan, he had opportunity to study a very unexpected and unusual phase in the relationship of Nomeus and Physalia. As a result of his investigations, he asks the question —"Is Nomeus a harmless Inquilinus of Physalia?"

[8] Kato, Kojiro. 1933. Is Nomeus a harmless Inquilinus of Physalia? Proc. Imp. Acad. [of Japan], **9**, 537-538.

Now, the designation "inquiline" (as the dictionary tells us), is from an Italian word meaning a lodger. As to this relationship, Kato answers his query, as follows: "While watching carefully these animals [in the sea and in an aquarium], I soon found that, contrary to what had been written by previous writers, the fishes were vigorously attacking the Physalia from below, eating indiscriminately various zooids, together with the tentacles." Then, to check up on the matter, Kato sectioned the stomach of one of these fish and identified in it the unmistakable tissues of Physalia. Perhaps these little fish were ravenously hungry. At any rate, in this game of tit for tat, they retaliated on Physalia for dining on their brethren.