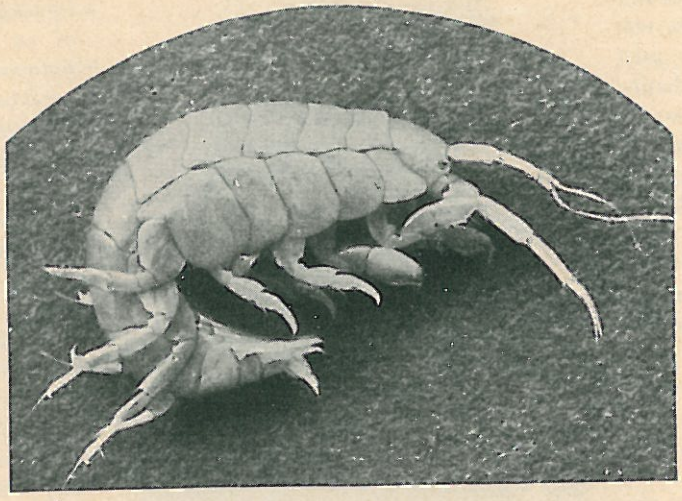
THIS IS *AMPHITHOË RUBRICATA*, WHO DWELLS IN A TUBE OF SILK

HIS SPINNING POWERS ALONE SAVE HIM FROM HIS MYRIADS OF ENEMIES



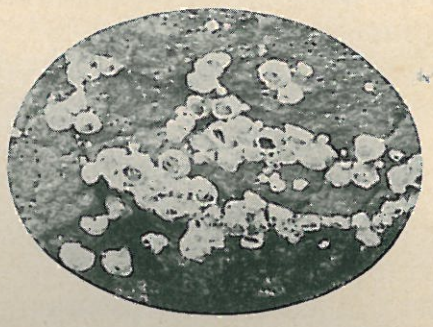
THE SPINNING CRUSTACEAN

In Tidal Pools He Builds His Silken Home

by Alexander F. Skutch

THE ARMY of spinners in the animal world is a motley one. There is the queen of spinners, the spider, whom the silkworm excels in quantity. There are the tent-caterpillars, who build in families, and the young ant larvæ, who secrete the silk they can make at the commands of their elders. But among the host there is one who is little known, who spins beneath the surface of waters shifting with the tide. This is the spinning crustacean, the dweller in a tube of silk.

He is an amphipod, known as *Amphithoë rubricata*. Most of his relative amphipods inhabit the sea, although some, such as the sand-flea, leave the water and swarm along the sandy shore. Some inhabit fresh-water streams and even wells; they have been found in a moist ravine near the top of a tropical mountain a mile and a half high. But *Amphithoë rubricata*, who, alas, owns no common name, always lives at the borderland of rock and water, on the edge of the North Atlantic and its arms, and would fall over on its side and be utterly helpless away from its element. And his only defense is the product of his body—his silk. He looks like the shrimp, in diminutive form; he has two pairs of antennæ, two pairs of "pincers", five of legs, and several of swimmerets. He is brown, and there is an attractive white spot near the posterior margin of each of the segments making up the hind part of his body. And the tidal pools which are twice flooded and twice uncovered by sea waters from the Bay of Fundy to Long Island Sound, from Norway to the Azores, form his only home.



BARNACLES

A neighbor of the weaver and likewise well armed for a hard life

Those who have spent a summer near the rock-bound shore of northern New England will remember the numerous pools which nestle among the inter-tidal rocks. They range in size from little water-filled pockets so small that they could be covered with a handkerchief, to ponds broad and deep enough to swim in. As we see them during a stroll along the rocks when the tide is near the ebb, each is a microcosm with a flora and a fauna all its own, but as the tide rises the waves pour into it, and it is again merged into the general life of the great ocean. Now it is a minute portion of the great ocean system of the globe, now a little, independent entity. Each pool is twice a day lost in the vastness of the sea, twice a day called back to individuality. From the ocean it receives an abundance of those elements which all living things require, while during the period of isolation it is exposed to the sunlight which is essential to all self-

supporting plants. Accordingly it is the seat of an abundant plant and animal life. At ebb tide one may look into the quiet waters of the pools and distinguish a rich variety of seaweeds of all forms and colors—green, brown, red, pink, purple, and even some almost black. Closer examination will reveal an equal variety of animal life. Amphipods and isopods dart among the plants, worms creep through the submersed branches, mussels and sea-urchins are attached to the rocks or the plants.

How do all of these organisms manage to persist in these pools when the enormous breakers are pounding into them while the tide is high? Along the exposed shores there is seldom a day even in summer when the breaking waves do not decorate the cliffs with a margin of white foam. Free-swimming animals cannot exist here. The plants are all firmly anchored to the rock-bottom of the pool by root-like "hold-fasts". The animals must be attached directly to the rocks, as the mussel by its strong byssi, or are dependent upon the plants for shelter.

The spinning crustacean is of the latter group, and has solved the problem of finding protection in an unique way. It builds a tubular dwelling for itself among the living seaweed, the walls bound together and lined with a silky thread which it secretes. The character of the nest varies considerably according to the kind of seaweed in which it is built. There is *Spongomorpha*, a green seaweed which covers large areas of the more shallow, sunny pools with a close-set sward. The thick, compact bundle of slender, branching filaments of which the plant is composed is penetrated by a tubular passage two inches or more in length, and about a quarter of an inch in diameter. The filaments surrounding the tube are bound together by the delicate strands of amphipod silk, which form a lubricous lining for the nest, and give firmness to the structure. The tube is open at both ends, and a keen observer, standing by the brink of the pool, may often discern the upper entrance of a tube in the middle of a green tuft. The amphipod builds differently in different plants.

HOME GROUNDS

It is in this tufted green seaweed, Spongomorpha hystrix, *that the spinner builds*

The amphipods are of a solitary disposition. Usually a single animal is found in each tube, occasionally a male and a female occupy a tube together, but almost never two of the same sex, and never more than two. Male and female alike build and occupy the tubes. The thread which binds together and lines the nest is as fine as the finest cobweb. The transparent strands measure only the twelve-thousandth of an inch in diameter.

How does the animal construct its nest? Fortunately *Amphithoë* works well in captivity, as the rock-pool is not a favorable place to observe such small details. As soon as the amphipods are liberated they swim up to any nearby seaweed and burrow in among its branches. Most of them work their way in so far that we can not observe their subsequent behavior, but occasionally one will begin to spin while it is near the outside of the tuft, covered by only a few filaments. The silk-secreting glands are situated in the first two pairs of legs, and open by pores at their tips. The animal plies these legs back and forth between the filaments with a steady, sustained motion resembling the playing of a piano. Before long, if we touch the filaments with a needle, we observe that they are bound together by unseen bonds. After working in one position for a time, the animal turns a somersault, or pivots sideways, so as to spin at another portion of the incipient tube. After twelve hours the tube has assumed a definite form. The layer of threads becomes so thick that the movements of the amphipod within the tube can not be seen clearly, but the

THE BORDERLAND

Where the tides ceaselessly range over rock and seaweed the spinning crustacean lives his short life

animal probably spins for several days before the lining of silk is completed.

When the nest is built in the *Spongomorpha* no other material is used in its construction. But the case is quite different when the amphipod supports its dwelling in the seaweed known as Irish moss. This plant forms flat, thick sheets of tissue, instead of the slender branches of the former. The animal supports its tube against the smooth, somewhat concave face of a branch. Where the tube is not in contact with the Irish moss, its wall is built up of a varied assemblage of material,—fragments of shell and bits of seaweed, bound together with a liberal supply of silk, which also lines the entire nest. The Irish moss plant bristles with the foreign material. The builder in this plant impresses one as a much more ingenious and skillful artisan than his brother in the *Spongomorpha*, who has only to burrow and to spin. However, if we take some animals from the green seaweed and place them in the red Irish moss, then sprinkle broken-up shells and shreds of sea-lettuce over the plants, we find, after a few days, that these amphipods have built nests resembling in every way those found in the Irish moss in the rock-pools. *Amphithoë* is a versatile builder.

BUSILY AT WORK
For several days he spins, now and then turning somersaults to build new defenses

Beneath the female are eight roundish flaps of skin, four on each side. These are bordered by long bristles, by the entanglement of which they are joined together to form a pouch. Here the female deposits her eggs, and from fifty to seventy-five amphipods hatch out and pass through the early stages of their lives. But when they are scarcely an eighth of an inch long, and still white and unpigmented, the young amphipods are cast upon their own resources. They settle down immediately to build tiny nests of their own, often clustered around the mouth of the maternal dwelling, like fumaroles around the crater of a volcano.

The principal food of *Amphithoë* is seaweed of various kinds, although when this is not abundant it partakes of animal food, and is not abstemious of its own kind. These amphipods are practically never seen swimming about in the rock-pools, and it seems probable that they do not leave their nests to forage, but eat such fragments of seaweeds as the waves waft within reach of the nest. This lacking, they partake of the seaweed in which the tube is built, or even the tube itself. The twisted strands of silk often found in their stomachs are evidence of this. In captivity, when sufficient food is not supplied, all of the seaweed surrounding the tube is eventually consumed. A bit of seaweed placed in the dish three inches from the mouth of the tube will be neglected for days, but if it is held in a forceps in front of the amphipod, the animal will dart forward and grasp it in his pincers, and hold on so tenaciously that the whole nest may be pulled around on the bottom of the bowl by the food. The animal never lets go of the nest in its forward lunge. Bits of wood and other inedible objects are grasped in the same way, but afterwards ejected from the tube. In the rock-pools, it is necessary first to shake the nest gently, as though it were rocked by the waves. Then the amphipod will often move up to the entrance and grasp the profferd morsel.

Amphipods which are destitute of the protection afforded by the nest live in the same rock-pools with *Amphithoë*. Compared with *Amphithoë*, which is relatively helpless outside of its nest, these amphipods are powerful swimmers. During high water they take refuge among the seaweed, to which they probably cling. The method followed by the *Amphithoë* is, then, only one of those by which it is possible for amphipods to maintain themselves in the teeth of the constantly pounding surf.

THE TIDAL POOLS
Here dwell myriad forms, not least of which is the little silk maker, secure and comfy in his retreat