called the twilight zone, we find many silvery fishes and invertebrate animals with very large eyes and an abundance of luminescent organs, such as *Argyropelecus* and the little myctophids.

Below this twilight zone the darkness is absolute except where broken by the light produced by the animals themselves. Rooted in mud on the bottom are luminous sessile organisms forming oases of light in the blackness that surrounds them, and swimming free, far above the bottom, are the erratic moving lights of various kinds of animals. Some of the fishes, squids and shrimps have very complicated light organs and others glow by means of a coating of luminous mucus.

There are, of course, non-luminous creatures as well, and some of these are blind. *Phoberus*, a large, pink, lobster-like crustacean inhabiting the sea floor about 2,500 feet beneath the surface, has only vestigial eyes. The fish *Ipnops* is apparently blind, too, but for some obscure reason has developed large luminescent plates where its eyes should be.

Many deep-sea fishes, particularly those that are blind or with small eyes, have acquired various sensory organs to compensate for the darkness or for their poor vision. Thus *Chauliodus* has the first ray of its back fin elongated and directed forward over its head. Long fin-rays of this sort are rather common and are considered to be tactile in function.

Chin barbels are another form of sensory organ, although we can only guess at their purpose. *Lamprotoxus* wears a slender barbel much longer than its body. *Linophryne arborifer*, one of the anglers, has a relatively shorter one, stout and extensively branched, with some of the branches loaded with little sensory swellings.

### FISHES WITH FISHING-RODS

*Linophryne* is only one of a queer lot of angler fishes. Derived from surface forms like the goose-fish of our Atlantic coast or the little frog-fishes that live among sea weeds, these deep-sea anglers have changed the lure of the surface forms into a luminous bait to attract the little fishes of the depths whose curiosity, or whatever, leads them to investigate a light in the water.

The various species of anglers exhibit an infinite variety of lures that include simple rod-like structures as well as large head lights with assorted branches and tentacles. *Lasiognathus* has even gone so far as to develop three horny hooks at the end of its long rod. The rod is joined to the head in such a way that it can be cast forward and then withdrawn, when, presumably, the fishing-fish clamps its capacious jaws over the prey.

The stomachs of many deep-sea fishes are appallingly distensible. Among others, *Chiasmodon niger* is often found to contain a recent meal consisting of a fish larger than itself. The act of swallowing such a disproportionate morsel is made possible by possession of a large mouth conveniently equipped with backwardly depressible teeth that facilitate the entry of prey but at the same time render escape difficult. Indeed, the fish is probably unable to release a victim that has once entered its mouth and is forced to swallow whatever is seized, whether he will or no.

### PROTOZOANS TO WHALES

Almost every large group of the animal kingdom is represented in deep water, from one-celled protozoans to vertebrates. There are coelenterates and worms, echinoderms and mollusks. Deep-sea crustaceans are most common of all, except for the fishes, and squids have also evolved into a wide variety of forms ranging from less than an inch in length to a giant species known mostly from fragments found in the stomachs of whales.

The most abundant and highly specialized forms of fishes are found among primitive groups whose greater age has given them more time to develop special adaptations to insure a successful tenancy of the depths. Most of these are strange, unfamiliar, and entirely lacking the popular names with which their more available cousins have been endowed. Whole families and even orders of fishes are entirely confined to deep water, and some of them are so unique that relationships to other fishes are obscure.

One of these nonconformists, *Stylophthalmus*, was assigned a family to itself until proved to be the young of fishes belonging to entirely different families. The most obvious character of stylophthalmine fishes is that the eyes are carried at the ends of stalks, which are gradually absorbed as the infant matures and acquires its other adult characters. Differences in shape and proportions render these baby fishes so alien in appearance to their parents that it is impossible to determine their true relationships until a complete series of growth stages has been secured.

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## A BOTANICAL EXPEDITION TO UPPER ORINOCO

By LLEWELYN WILLIAMS
CURATOR OF ECONOMIC BOTANY

History relates that the first white man to explore the Orinoco was Ordaz, who in 1531–32 ascended as far as the estuary of the River Meta. In 1800, Humboldt and Bonpland undertook their memorable voyage. About 50 years later the English botanist, Richard Spruce, entered from Brazil. They were followed by Richard Schomburgk, Chaffanjon, and other scientists.

Despite their efforts, the southwestern section of Venezuela remained until recent years one of the least known though richest regions of the western hemisphere, from the standpoint of plant life and forest resources.

In collaboration with the Venezuelan Ministry of Agriculture, and in continuation of previous botanical explorations made in 1939 and 1940, Chicago Natural History Museum sponsored a third expedition to the Orinoco basin through most of 1942. From Caracas the writer traveled by truck for several days through the *Llanos* or plains to Cuidad Bolívar, thence on a steamer up the Orinoco.

With field equipment and food supplies, and accompanied by native guides, we left Sanariapo in two open dugout canoes, powered by outboard motors, arriving two days later at San Fernando de Atabapo, a center 30 or 40 years ago for the rubber tapping industry.

Except for the small rapids of Chamuchina and Guarinuma, traveling along the Atabapo River presented no serious hazard. Two days after leaving San Fernando we reached Yavita, and entered the ancient trail leading about 11 miles through lofty forest, which furnished the shortest and most traveled route between the river systems of the Orinoco and the Amazon.

On the return trip northward from San Carlos we retraced the route over Pimichin-Yavita trail, down the Atabapo and Orinoco to Puerto Ayacucho. We then turned southward to San Fernando de Atabapo and continued up the Orinoco. In these forests one frequently encounters stands of cacao trees, remnants of those planted several hundred years ago by Spanish colonists. We continued upstream to Esmeralda, located in a plain dominated by the lofty mountain Duida, with an elevation of 8,000 feet.

Between Duida range and the mountains of Guapo and Padamo extend wide grassy plains. A semi-circular ridge of fantastically piled granite blocks, in whose crevices grow small trees and scattered shrubs, cuts off a small savanna on which stands Esmeralda. Along the Orinoco and on the margins of the plain rise hills of granite and schist, some nearly naked, others forest-clad. The rock is chiefly micaceous schist, leading the Spanish explorers to believe that they had discovered emeralds. As Spruce wrote in 1854, "If you can fancy all this by a setting sun—the deep ravines that furrow Duida on the east buried in nocturnal gloom, while the salient edges glitter like silver—you will realize in some degree a scene which has few equals." But though the site may be a paradise from the viewpoint of panorama, in reality it is an inferno scarcely habitable by man.

The vast region is one of the most interesting floristically of Venezuela. Seven-eighths of its area is covered by rain forests, containing a wide variety of palms, narcotic plants or stimulants and many latex-yielding trees, chief of which is *Hevea* rubber. As a result of seven months' effort, a large and valuable collection of plant materials, wood specimens, fibers and other products was obtained for the Museum.