

there is of light at abyssal depths ; but this is not probable. Murray observes that the eyes of the Fishes are in general unusually large at depths of 480 to 1200 feet ; but beyond this depth, small-eyed species as well as large-eyed are common, and many also are blind.

The Littoral zone. — By means of light, rather than temperature, the limits of the *Littoral zone* are determined. Reef-forming Corals, and therefore coral-made reefs, have their limit in depth at 120 or 150 feet in the equatorial regions, and at 90 to 96 feet near the border of the coral-reef seas ; and since the temperature of 68° F. in the tropics is usually 600 feet below the surface, light is made, by Fuchs, to be the chief cause. A vast variety of species are congregated under like limitation, the coral-reef seas being "the gathering grounds of an extremely rich fauna," says Fuchs, and one so peculiar that the terms coral-fishes, coral-mollusks, and the like, would not be inappropriate ; a fauna that embraces "the whole splendor of the animal life" of the Indian and Pacific oceans. Within this *Littoral zone* belong, moreover, the areas of large Bivalves, such as Oysters, Pearl Oysters, Scallops, which have their maximum development in from 48 to 60 feet, and are not found below 120 feet.¹

The seaweed areas reach to a depth of 30 fathoms, or about 200 feet. Plants are dependent on light for assimilation, and hence comes this narrow limit for the aquatic part of the vegetable kingdom.

The Fucoids and strap-like Laminarians, or the brown and olive Seaweeds — related, it is supposed, to the Seaweeds of early time, when no seas were colder than those of the modern temperate zone — live now on most shores from the tropics to the poles, and attain their greatest size in the colder latitudes.

The only deep-water plants thus far observed are Corallines at 900 feet, and small Algæ, found to bore into corals that came up, according to Duncan, from a depth of 6000 feet.

The depths. — Below 420 to 480 feet are the regions of darkness. They are divided locally into two sections, a *warm* and a *frigid*, by the Gulf Stream and other tropical currents. The depth to which the warm waters of this stream extend along the borders of the Atlantic basin, and thence across the ocean to Great Britain, are mentioned on page 5. Where these waters wash the sides of the Atlantic basin from Florida north-eastward, there is a profusion of life of all marine kinds ; and the same is true for the area within the British sea.

The cold belt passes close by the western side of the warm belt off New Jersey and Nantucket. The commingling of the two in a storm is stated by Professor Verrill (1882) to have probably caused the extermination — only temporary, it has proved — of a large food-fish, the Tile-fish, of the genus *Lopholatilus*, which was caught abundantly by a Fish Commission expedition in 1881 off Nantucket with a trawl at a depth of 420 to 900 feet. During the following winter great numbers of the dead Tile-fish were seen by passing vessels, floating at the surface ; and in the dredging of 1882 over the same area not one was obtained ; and many other species dredged in 1881 were missing in 1882. In 1890 the Tile-fish was again found.

The bottom of the ocean through all its depths is constantly receiving contributions of the hard parts of its living species, from the bones of Whales and Sharks to the siliceous shells of Diatoms, and the calcareous of Rhizopods. It is often difficult to determine for the smaller species whether they are denizens of the dark depths or of more superficial waters. Most of the pelagic species that are found abundantly at the surface of the ocean during the dark hours of the night, and may then be easily taken with a hand-net, go to greater depths during the day, showing that they are really part of the fauna of the darkness. Pelagic species, according to Agassiz, are mostly confined to within 1200 feet of the surface.

¹ J. Fuchs, *Geol. Verhandl. Reichanstalt*, No. 4, 1882 ; *Ann. Mag. N. Hist.*, January, 1883.