

A Freshwater Eel on Zanzibar Island

Playfair and Gunther's "Fishes of Zanzibar", 1866, bears a somewhat misleading title, for some of the species included come from places other than Zanzibar, some quite distant.

"Zanzibar" to-day means Zanzibar Island itself, whereas in earlier times the dominion and name extended over a wide area, including the coastal regions of East Africa. In consequence, creatures unknown from the Island itself have been recorded as occurring in "Zanzibar". One such is the freshwater eel, *Muræna mossambica* Peters, 1844.

Owing partly to the porous nature of the Island, there are few and restricted bodies of fresh water on Zanzibar, and there is only one run of water which merits naming as a river, and that disappears before it reaches the sea. The wide fluctuations in ocean-level during the Pleistocene would, in periods, have reduced the present Zanzibar Island to at most a group of islets, with almost certain extinction of most of the purely freshwater fauna of the more extensive lower drowned levels. During the recessions of the glacial periods some of this may have been restored; but there is no evidence that the larger rivers of the adjacent mainland flowed near Zanzibar. It is therefore not surprising that there is only a severely restricted freshwater ichthyofauna on the Island, only three or four species having been found there. In passing, it may be indicated that some of the recent wide fluctuations in ocean-level may well provide a clue to the explanation of at least some of the puzzling features in the land fauna of Mafia, Zanzibar and Pemba.

In current ichthyological literature, the freshwater eel is listed as occurring in Zanzibar. No less than three species, namely, *mossambica* Peters, 1844, *bengalensis* Gray, 1830, and *australis* Richards, 1841, are stated to be present in Zanzibar by Boulenger ("Freshwater Fishes of Africa", 3; 1915). These are apparently based on specimens recorded in Playfair and Gunther's "Fishes of Zanzibar" of 1866. A record of *mauritanica* Bennett, 1831, from Zanzibar by Weber and de Beaufort ("Fishes of the Indo-Australian Archipelago", 3, 247; 1916) is presumably based on the record of *A. johannæ* in Playfair and Gunther's "Fishes of Zanzibar".

Investigation reveals that none of the records is from Zanzibar Island itself, and so far as may be ascertained there is no authentic record of any species of freshwater eel having been found there. If the marine origin of the eels of this region be accepted, as they are found in the Ruvu and Pangani Rivers of the adjacent mainland, but for the accident that only comparative trickles of fresh water reach the sea from Zanzibar Island, it is surprising that no eels have ever been found there.

During a recent visit to investigate the fish life of the Zanzibar area, I inquired into the matter of the freshwater fishes, which have been investigated by several people during the past hundred years; but no further discoveries have been made in that period. Towards the close of my stay I learned that a large 'water snake' had been seen in a disused reservoir in which the lower "Chem-Chem" spring is completely enclosed; this structure is an unfortunate experiment by an engineer of earlier times, it is said, for he had failed to determine in advance the hydrostatic level of the source of the water. At my request the authorities kindly agreed to assist, and by means of a portable pump the water in this enclosed and roofed

structure was reduced to a level where it kept pace with the restored flow through the porous coral rock. No life was visible in the considerable body of water remaining; but by means of an irritant chemical and nets, we soon captured the 'water snake', which proved to be a 30-in. well-nourished specimen of *Muræna mossambica* Peters, 1844, apparently the first to be known from Zanzibar Island.

This spring lies less than half a mile from the sea; but how the fish got into it is a mystery, as no water has ever flowed out of it, and the manholes in the roof of the enclosing structure have iron covers, supposed to have been kept closed for many years. It is just possible that a minute elver might have come through the eye of the spring, but not very likely in view of the absence of flow. The aliments in this specimen have not yet been examined, but its food can have consisted of little else than insects, and most likely of the smallest only.

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Encapsulation in Rumen Bacterial Fractions

METHODS of fractionating the rumen contents of sheep previously described in the literature (see, for example, footnote 1) involve centrifugation of uncooled, strained, rumen liquids at varying speeds on centrifuges running at room temperature. These procedures were found by us to be unsatisfactory for two reasons. First, during the time between collection and centrifugation of the liquids, the composition of the sample might alter as a result of bacterial fermentation and autolysis; and secondly, during the centrifugation, especially at high speeds, the liquids warm up to as much as 40° C., thus setting up convection currents in the centrifugate and causing fermentation with the liberation of gases which break up the sediments. We have found that these difficulties are overcome by the following procedure, which allows of fractionation on a small scale.

Rumen contents were collected through a permanent rumen fistula² by means of a wide-bore glass tube fitted with a rubber suction bulb, and immediately pipetted into a conical flask cooled in a freezing mixture of ice and salt, which reduced the temperature of the rumen contents to c. + 1° C. in 10-15 min. Further operations were then carried out in a cold room at + 1° C. The rumen contents were strained through a 60-gauge copper gauze to remove plant particles. (It is well to note that, if the fractions are required for cultural studies, the copper gauze should be replaced by bolting silk, as small traces of copper have a bactericidal effect.) The resulting liquid was centrifuged for 20 min. at 22,500 g in a 'Superspeed' head on a refrigerated centrifuge (M. S. E., London), conditions being adjusted so that the rumen liquid remained at + 1° to + 3° during centrifugation. If the temperature was further lowered, ice began to separate from the liquid.

Two sheep were used in the experiments. One was fed mixed concentrates (250 gm.) and potato starch (100 gm.), twice daily, with one feed of hay (250 gm.) in between, and the other was fed on hay (*ad lib.*). The rumen contents were sampled three hours after the morning feed. The samples from the starch-fed sheep were thick and formed four distinct