

VI. THE ADAPTATIONAL FEATURES IN THE GILLS OF THE
AIR-BREATHING TELEOSTS

The study of the organisms living in transitional habitats shows that they possess certain characters which have a survival value for that habitat but nevertheless they serve as preadaptations with reference to certain habits which the organism might acquire during the course of future evolution. Insensitivity of the blood to carbon dioxide of certain fresh-water fishes investigated by Willmer (1934) and Black (1940) seems to be one such character with reference to air-breathing. As Carter (1951) has pointed out that the blood of those fishes which are insensitive to carbon dioxide has a preadaptive value in air-breathing because of the considerable concentration of carbon dioxide which is likely to remain in the air-breathing organs. The immediate aquatic progenitors of the terrestrial vertebrates probably developed some characters having a preadaptive value especially those relating to the prevention of desiccation of delicate parts such as the gills which were immediately exposed to the atmospheric conditions.

The process of respiration as is well known, involves a gaseous exchange between the respiratory organs and the environment. Among the vertebrates during this process, the respiratory gases pass through a thin film of water which

covers the respiratory epithelium. In water-breathing organs this thin film is in the form of a stationary aqueous layer, which is a few molecules thick while in terrestrial animals it is in the form of a mucous layer on the lung (Carter-1931 & Baldwin-1949). The presence of this mucus is essential to prevent the evaporation of water and the consequent drying up of the respiratory epithelium.

The air-breathing fishes are known to survive for a longer period, when they are removed out of water. Living specimens of Ophiocephalids and Heteropneusteus are often transported without water for a considerable period without any ill-effects. Same is the case with certain marine fishes such as Macrones and Boleopthalmus. Some purely water-breathing fishes also are known to survive longer periods outside water. Most of the water-breathing fishes, however, are known to get asphyxiated much quicker. Transverse sections of the gills of some fishes in 95 % alcohol were taken and studied to find out if any adaptational features exist in the gills of air-breathing fishes in contrast to those of the water-breathers.

The water-breathing fishes examined included the following :-

1. Labeo rohita (Ham.)
2. Cirrhina mrigala (Ham.)
3. Glyphidodon caelestus (Cuv. & Val.)
4. Wallago attu (Bloch)

The air-breathing fishes included the following :-

5. Notopterus notopterus (Pallas)
6. Macrones gulio (Ham.)
7. Ophiocephalus punctatus (Bloch)
8. Osphronemus gourami (Lacep)
9. Ophichthys (Pisoodonophis) boro (Ham.)
10. Boleophthalmus dussumieri (Cuv. & Val.)

Results

The gills of the water-breathing Wallago attu which is known to survive for a long time after it is removed from water, and air-breathing fishes were found to be lined by a thin mucous lining, not found in most of the water-breathers.

Discussion

Schöötle (1931) states that the gobiid fishes capable of living out of water have their gill-lamellae so arranged that they do not collapse when the fish is on land. Gray's findings (1954) also indicate that fishes with larger gill-lamellae spaced apart often live longer out of water than those with closely packed fine lamellae. A toad fish (Opsaunus tau) according to this author lives for hours on the laboratory floor while a butter-fish (Poronotus triacanthus) dies in a matter of minutes. The delicate

closely spaced lamellae obviously adhere together when removed from an aquatic medium resulting in the reduction of the functional respiratory surface and bring about the asphyxiation of the fish.

While the arrangement of the lamellae no doubt influences the period of life of a fish out of water there can be no doubt that the rate of desiccation is also an equally important factor which determines the life of the fish when out of water. Mucus obviously helps in preventing desiccation.

Conclusion

The finding of this piece of investigation is that the respiratory epithelium of air-breathers and a few water-breathers such as Wallago attu, which do not get asphyxiated outside water for a fairly long period, is lined by a mucous aqueous layer. Such a layer is absent in most of the water-breathing fishes.