Gills of a Living Coelacanth, *Latimeria chalumnae*

During the recent French/British/American expedition it was possible to examine the gills of several specimens of *Latimeria*. The gross structure, morphometry and ultrastructure have been investigated. The gills on each of the four branchial arches are more or less equally developed and gill filaments on the hyomandibula form a hyoidean hemibranch. Investigations of the blood supply to this gill by ANTHONY and ROBINEAU[1] indicated a probable function in respiration and they also drew attention to the absence of a pseudobranch. The basic organisation of the gill filaments on the arches is primitive in having well-developed interbranchial septa[2] similar to those found in *Neoceratodus*, the lungfish most dependent upon water for its oxygen supply. Individual septa continue to support filaments of both of the constituent hemibranchs after they separate, and almost to their tips (Figure 1). The two hemibranchs are not equally developed along the length of each arch. Dorsally the filaments of the anterior hemibranch are shorter and expose the septum which binds together filaments of the posterior hemibranch. Ventrally, the filaments of the posterior hemibranch are the shorter (Figure 1). Each arch presents a fairly narrow profile to the water but they are relatively broad, have numerous dispersed spines, but gill rakers are not well developed. Relative to the breadth of the arches, the filaments appear short and each is supported by a gill ray. Measurements of two of the specimens examined confirm that the total filament length is small relative to other fish of comparable size (Figure 2), although they are similar to that of other fishes captured at corresponding depths and measured during the expedition. Only gills of the second fish obtained by the expedition, at Iconi, were in good enough condition to allow detailed measurements of gill area etc. Frequency of secondary lamellae was, however, measured on the specimen captured at Anjouan in January 1972.

The results summarized in the Table show that the gills of *Latimeria* are poorly developed with respect to all the parameters that were measured. The very low O_2 diffusing capacity would add to the hypoxic stress of fish brought to the surface and contribute to their poor survival.

Electron micrographs showed that the secondary lamellae have the same basic structure as that known for

Measurements on gills of *Latimeria chalumnae* (10 kg)

Total filament length (L)	4403.14	cm
Sec. lamellae/mm on one side of filament (1/d′)	12.62	mm
Bilateral area of average secondary lamella (bl)	0.17	mm²
Total area of sec. lamellae	1889.30	mm²
Area/g body wt.	18.9	mm²/g
Diffusing capacity of water/blood barrier (D_t)[8]	0.0057 ml O_2/min/kg/mmHg	

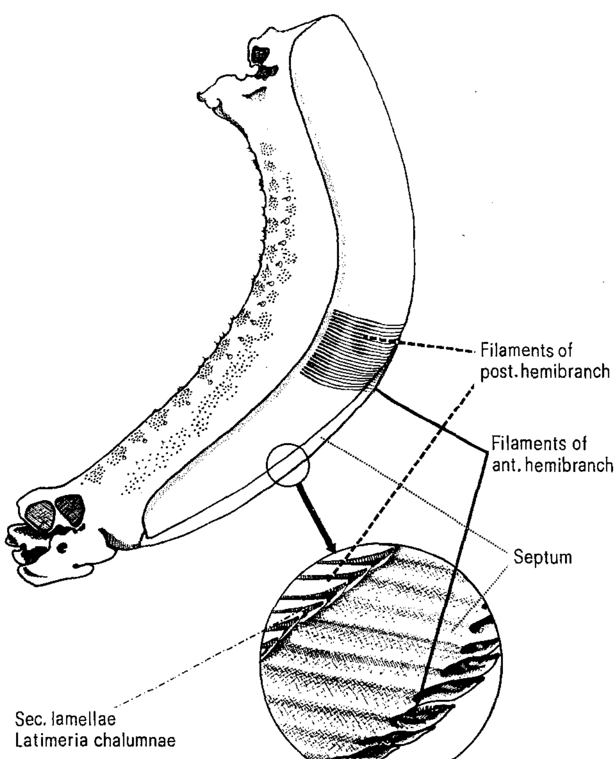

Fig. 1. The second branchial arch of the right side of *L. chalumnae*. The insert shows the difference in relative lengths of the gill filaments of the two hemibranchs and the continuation of the inter-branchial septum along the back of the anterior hemibranch.

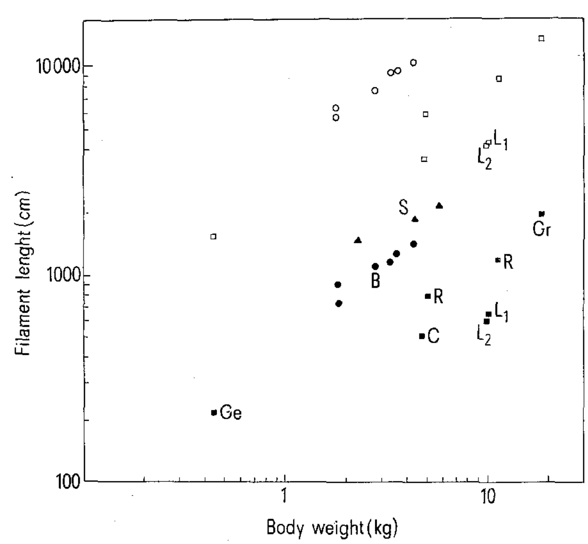

Fig. 2. Filament length for Comorean fish of different body weight plotted on log/log co-ordinates. Open symbols are for total filament length and filled-in symbols for filament length of the second arch alone. Squares are for deep-water fish.
B, Barracuda; C, deep-sea Conger; Ge, Gemphylid; Gr, Grouper; L, *Latimeria*; R, *Ruvettus*; S, Skipjack tuna.

[1] J. ANTHONY and D. ROBINEAU, C. r. Acad. Sci, Paris *266*, 375 (1968).
[2] E. S. GOODRICH, *Vertebrate Craniata* (A. and C. Black, London 1909), vol. 1.

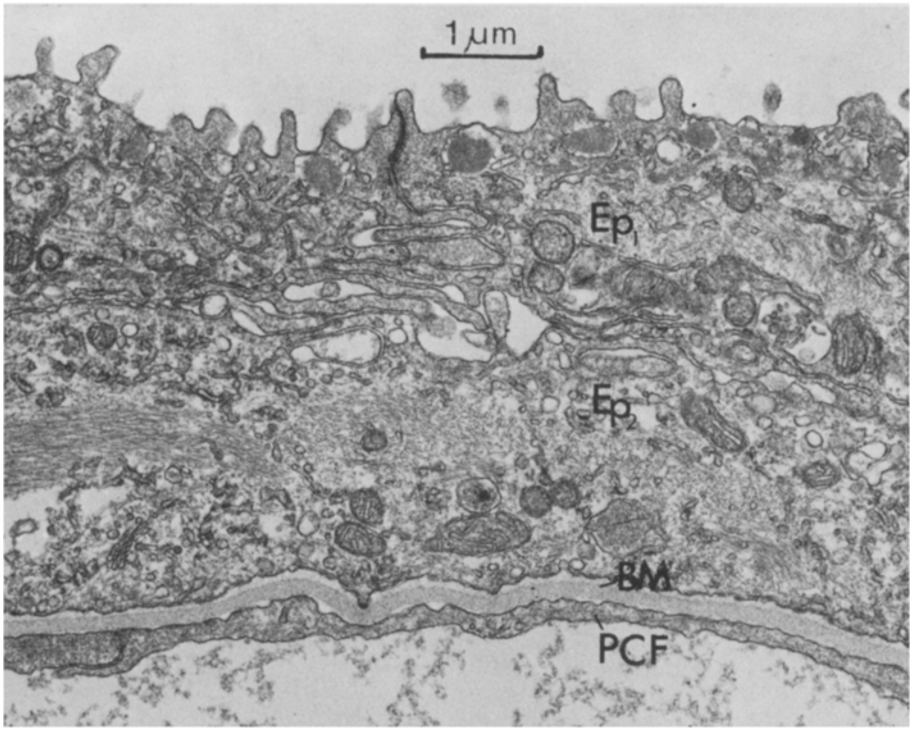

Fig. 3. *Latimeria*. Electronmicrograph of the water/blood barrier of a secondary lamella. (Facilities kindly provided by Professor Weibel, Bern). Ep_1, Ep_2, outer and inner epithelial layers; BM, basement membrane; PCF, pillar cell flange.

other groups of fishes[3–7] (Figure 3). The water/blood barrier consists of two epithelial layers, a relatively thin basement membrane, and a pillar cell flange layer. The pillar cells have fairly stout collagenous columns numbering from 4–6. Thick columns have also been found for tuna pillar cells[6] so that this cannot be associated with the benthic habits of *Latimeria*. The outer surface of the outer epithelial layer has many microvilli beneath which are found vesicles similar to those found in elasmobranchs[5] and *Neoceratodus*[9].

It is concluded that the gills of *Latimeria* retain a primitive organisation and their poor development, together with a low O_2 carrying capacity of the blood[10], suggest a fairly sluggish mode of life. The presence of 4 fully developed gills and a hyoidean hemibranch contrasts with the 3 holobranchs of sluggish benthic teleosts such as toadfish[7] (*Opsanus tau*) and angler fish (*Lophius piscatorius*), and further confirms the primitive construction of the arches in *Latimeria*.

Zusammenfassung. Nachweis, dass die Kiemen von *Latimeria* einen Primitivzustand mit gut entwickelten Interbranchial-Septen aufweisen. Die Gesamtlänge der Filamente ist relativ kurz, doch ähnlich derjenigen von Tiefseefischen. Die Gesamtfläche der Kiemen ist auffallend klein im Verhältnis zum Körpergewicht. Die Sekundärlamellen weisen in ihrer Ultrastruktur gewisse Ähnlichkeiten zu Elasmobranchien auf.

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Erythrocyte Cation Concentrations and Changes in Dietary Electrolyte Intake

As part of the effort to understand the biology of affective disorders (depression and mania), attention has been focused on possible alterations in electrolyte metabolism[1,2]. This interest is a result of the involvement of electrolytes in the conduction of electrical impulses as well as their role in the reuptake and storage of putative central nervous system transmitter substances.

We have been measuring intra-erythrocyte (RBC) electrolyte values in patients as an index of tissue electrolyte concentrations[3]. It was thought necessary to determine whether variations in dietary electrolyte intake would produce significant changes in RBC electrolyte concentrations, as our patients show marked alterations in their daily dietary intake.