Results. Results of a typical experiment are presented in the Figure. Thyroxine (T_4) added to the ACSF infused did not influence significantly T_{re} at rest. Both in the control and T_4-experiments, T_{re} declined by approx. 0.3 °C. At the beginning of exercise, T_{re} of the control dogs was 38.1 ± 0.2 °C (SE), and in the dogs infused with ACSF + T_4 38.05 ± 0.2 °C. At the end of the control exercise, T_{re} was 39.2 ± 0.1 °C while in the T_4 treated dogs it reached 39.7 ± 0.1 °C.

From the 6th min of exercise, T_{re} increases (ΔT_{re}) were significantly higher ($p < 0.05$ or $p < 0.01$) in the dogs treated with T_4 than in the same dogs infused with ACSF alone.

At the end of exercise, the mean difference in ΔT_{re} between the control and T_4 treated dogs amounted to 0.47 ± 0.07 °C ($p < 0.002$). During the run, Hct changed only slightly ($p > 0.05$) both in the control and T_4 treated dogs, and plasma FFA concentration increased by 142.7 ± 22.4 µEq/l and 144.7 ± 23.3 µEq/l respectively ($p > 0.05$).

Discussion. Contrary to the results obtained in cats[3], the data presented here indicate that in dogs infusion of 1 µg thyroxine into the lateral ventricle of the brain does not affect body temperature at rest. It does, however, cause significantly higher exercise-induced increases in rectal temperature in comparison with control runs performed by the same dogs following infusion of ACSF alone. This finding supports the previously made hypothesis that the exercise-hyperthermia described in the dogs injected s.c. with a single large dose of thyroxine or triiodothyronine (T_3)[1] may be partly due to the central action of thyroid hormones on the structures involved in thermoregulation. It has been shown recently[6] that T_3 and T_4 given by i.v. infusion to dogs penetrate both brain and CSF.

The mechanism of the hyperthermic action of intraventricularly administered T_4 during exercise is difficult to explain. In this case, peripheral calorigenic effects of thyroxine, being mostly due to potentiation of metabolic action of catecholamines[2], can be excluded, since no difference in blood FFA level at the end of exercise was found between the control and T_4 treated dogs.

It may be supposed that T_4, applied in a small dose into the brain ventricles, either acts directly on the activity of central neurons involved in thermoregulation, or it exerts its action by changing sensitivity to neurotransmitters[7] during physical exercise.

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How Gill Surface of *Saccobranchus fossilis* Facilitates Active Gas Exchange?

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Summary. The surface morphology of fish gill has been studied by scanning electron microscopy. The surface of gill epithelium shows a pseudoconcentric arrangement of arborizing ridges and channels. Further, at places on gill filaments the surface shows several infoldings labelled as micropits. The role of these morphological adaptations has been correlated with the gas exchange physiology.

There is no means other than diffusion by which the respiratory gases are carried across the surfaces separating water from the blood. In fish gills, the secondary lamellae of the gill filaments are the main centres of gas exchange. The fine structure of secondary lamellae shows that these are mainly composed of a pair of two-layered epithelial sheets (each about 3 µm thick) joined together by pillar cells[2] (Figure 1). The flanges of these pillar cells line most of the channels through which blood flows in the secondary lamellae; and due to this pillar cells come in a very close contact with the whole blood during circulation. The pillar cells thus form an important part of respiratory

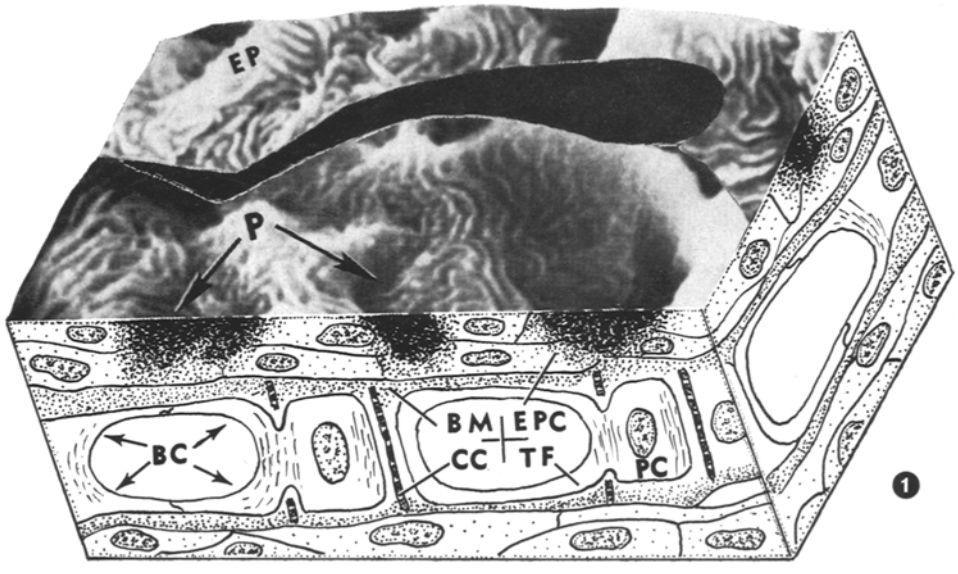
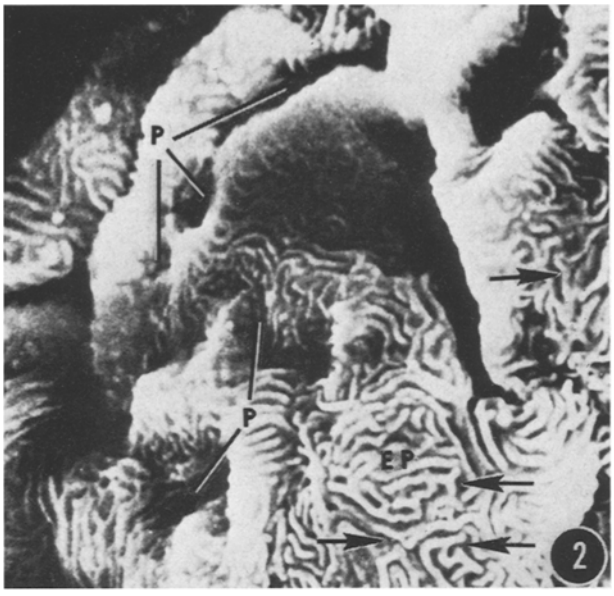


Fig. 1. Semi-diagrammatic representation of the structure of secondary gill lamella from a gill filament showing surface and sectional views. Note the engravings on the surface of the epithelium (EP); micropits (P) show their depth in sectional view (dark areas); BC, blood channel; BM, basement membrane; CC, collagen column; EP, epithelium; EPC, epithelial cell; PC, pillar cell; TF, thin flange of pillar cell. (modified after BETTEX-GALLAND and HUGHES[2]).

and circulatory system. The recent EM studies also suggest that changes in the length of pillar cells clearly have a considerable influence on the whole of the cardiovascular dynamics[2].

Much of the recent literature on the gills of various fishes is confined to electron microscopical[2–6], developmental[7,8] and physiological[9,10] studies. The present work appears to be the first report on the surface architecture of gill filaments of an Asian catfish, *Saccobranchus fossilis*. The thorough examination of the surface of gill filaments with the help of a scanning electron microscope (after careful fixation, dehydration, drying and gold evaporation) reveals many interesting features. The hexagonal epithelial cells (EP, Figures 2 and 3) displaying the surface of gill filaments show a unique pattern. The pattern gives a clear indication of a pseudoconcentric arrangement of arborizing ridges and channels (see arrows, Figures 2 and 3). Thus each epithelial cell provides a more expansive lumenal surface area. In other words it can also be said that the whole of the gill surface is highly engraved. Further, at certain places on the gill filaments the surface gives clear impressions of several natural infoldings which are labelled as micropits (P, Figures 1–3). Comparatively the number of such micropits observed is higher in the regions of secondary lamellae than in the remaining part of the gill filament (compare P in Figures 2 and 3). By observing such an interesting architecture on the surface of gill filaments, the conclusions drawn in view of the functional interpretation are: a) The surface engravings of the gill epithelium facilitates mechanically the adhesion of water molecules, that ultimately helps in the active diffusion of the respiratory gases from water to the blood and vice-versa, through epithelium, basement membrane and flanges of pillar cells. b) The frequent presence of micropits on the surface of secondary gill lamellae acquires special significance since the pitted area becomes the most active site for gas exchange. At places where these micropits form, due to infolding of the epithelial surface (P, Figure 1), the epithelial sheets become thinner with the result that there is an increase in surface area and decrease in diffusion distance. This ultimately reduces the resistance and initiates an easier diffusion of respiratory gases. In this way, the surface engravings, together with micropits, increase adsorptive and absorptive surfaces of the gill, providing an easy ion/water transport across the gill surfaces.

The present finding is an interesting correlation between morphological and functional asymmetry, since the function of gill epithelium has been ascertained purely on the basis of morphological studies by scanning electron microscopy, and the observations on the surface pattern are indicative of areas responsible for active gas exchange, which may be subject to increased mechanical stress by environmental forces. A full account of the work, comprizing other cytological characteristics, will be published elsewhere.



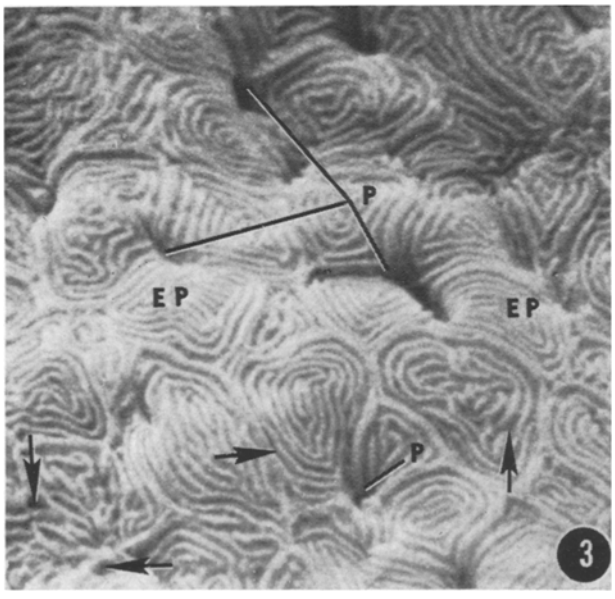


Fig. 2. Scanning electron micrograph of surface of secondary gill lamella showing micropits (P) and engravings on the epithelial surface (arrows). The black area of the extreme upper right corner represents the region between the two secondary lamellae. EP, epithelium. × 6000.

Fig. 3. Scanning electron micrograph of surface of gill filament other than the region of secondary gill lamella. Note the number of micropits (P); EP, epithelium; arrows, surface engravings. × 3000.

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