BIOLOGY

Smooth Muscles in the Lungs of Some Urodeles

The effectiveness of the mouth floor pump in amphibians is greatly increased if the distance between the mandibular articulations is considerable. Owing to this fact there is a tendency among these animals to evolve low and broad skulls. The ratio of the height of the braincase to the distance separating the quadrate bones was about 6 in oldest palæozoic amphibians, it was 15 in *Eryops*, and in some recent anurans it reaches 25 (ref. 1). The lung ventilation in caudate amphibians is performed by the same mechanism as in anurans[2], but is probably less efficient, as owing to the shape of the body the distance between the quadrate bones is smaller and the lungs are more elongated.

During the stay in water both the amphibian larvæ and the urodeles take advantage of the pressure of the surrounding water in the respiratory mechanism. The air taken to the mouth cavity passes to the lungs, when the animal dives with head downwards. Nevertheless, in many urodeles the lungs are small, their inner surface is smooth and they play only a minor part in the gaseous exchange of the animal, as their capillaries constitute only about 20 per cent of all respiratory capillaries, for example, genus *Triturus*[3]. Therefore, an interesting problem concerns the air exchange in the lungs of aquatic urodeles having very long lungs, with highly developed inner surface, especially as the head of these animals is small and narrow.

In a course of work which will be reported in full elsewhere it was demonstrated that the surface of lung septa of *Amphiuma means* Garden is more than four times greater that the surface of lung sacs devoid of septa. In the largest specimen examined the lungs measured 380 mm. in length, but only 5 mm. in diameter. In *Siren intermedia* Le Conte the lung septa are not so well developed; their surface nevertheless exceeds the surface of lung sacs devoid of septa about three times. In the largest specimen the length of the lungs was 200 mm., the diameter 4 mm. The usual amphibian mechanism of lung ventilation would be unable to change efficiently the air in such lungs. The measurements show, however, that the lung capillaries constitute 68·20 per cent of all respiratory capillaries in *Amphiuma means* and 58·16 per cent in *Siren*. The capillary net in the lungs of these animals is comparatively very well developed (430–500 meshes per mm.^{2}) and is uniform on the whole length of these organs.

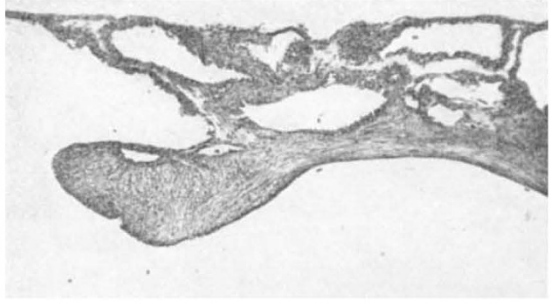

Fig. 1. Longitudinal section through a fragment of the lung of *Amphiuma means* Garden

It is suggested that the contractions of lungs play an important part in the lung respiration of these animals. It was found that the lung wall, and especially the septa, contain a very considerable quantity of smooth muscle cells. The thickness of the muscular layer of the lung wall varies between 50μ and 180μ. The muscle bands running in the septa are much stronger and in some places exceed 1,000μ in diameter. As is apparent in Fig. 1, the muscle bands are built of many small strands interwoven in a complicated pattern. The muscles of the lungs must play an important part in respiration; unfortunately only fixed material was at my disposal, and it was therefore impossible to make any direct observations on the way the lungs work in living specimens. The problem merits, however, the attention of zoologists having easy access to these interesting animals.

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Nature of Swarming in Nematodes

The phenomenon of swarming in *Tylenchorhynchus* species and other nematodes[1,2], under investigation for the past three years in Louisiana State University laboratories, has been related experimentally to physiological state, cuticle property and species specificity of plant parasitic and free-living forms.

Swarming has been observed in species of such diverse genera as *Tylenchorhynchus*, *Hemicycliophora*, *Rotylenchulus* and *Dorylaimus*. The fact that this phenomenon generally occurs only in greenhouse-bred populations of *Tylenchorhynchus martini* Fielding, 1956, is a fortuitous circumstance which makes possible work on induction. Although species specificity suggests that the capacity for entering a physiological state of swarming is under genic control, the following evidence indicates that its induction is determined by nutritional factors.

The state of swarming induced in *T. martini* by abundant and rapid host-plant growth persists in soil populations in greenhouse pots for several months after removal of host plants. However, subsequent populations produced on lower food-levels (established by controlling host-plant density and growth-rate) revert to the original state of non-swarming. The probable course of events under these conditions is that the ancestral population of swarmers undergoes normal senescence and death and is replaced gradually by a new, culturally adapted population of non-swarmers.

Apart from stickiness of the cuticle and durance of the swarming condition, altered physiological state in swarming specimens of *T. martini* is characterized by higher egg-laying rates than in non-swarming specimens. Swarming in *T. martini* is inhibited by enzymes such as papain, ficin and trypsin, which contain endopeptidases. This inhibition is removed by washing to eliminate the enzymes and constitutes evidence of the proteinaceous nature of the cuticle surface layer. Since work on the chemical composition of the nematode cuticle has been confined largely to *Ascaris lumbricoides* Linnæus 1758[3], the most fruitful use of swarming in a basic sense may involve its

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