SOME OBSERVATIONS ON THE PHYSIOLOGY OF LYSOMANES VIRIDIS WHICH SHOULD APPLY TO THE ARANEAE IN GENERAL. D. E. Hill

Recently I examined the structure of the cryofractured book lung of Phidippus audax with a scanning electron microscope. Each book lung is essentially a stack of flattened air-sacs, or lamellae, which project anteriorly into the lateral hemolymph space of the anterior opisthosoma. Each lamella is roughly triangular in shape. Hemolymph flows across each lamella from the medial to the lateral side (Fig. 1). Air enters the lamellae from the third, posterior side, after passing through a network of irregular cuticular struts (air filter) which lines the atrium of the book lung. The thin walls of each lamella are joined by rigid struts near the medial side, and the intra-lamellar air space cannot be expanded or compressed in this region. Toward the posterior and lateral sides, however, the two walls of each lamella are not joined. Here the inner surface of the ventral (or ventro-lateral) wall is covered with buttressed studs, while the opposing dorsal (dorso-medial) wall is completely smooth. Thus a large portion of each lamella is capable of considerable expansion, and the residual (minimal) air volume is dictated by the height of these studs (about 3 μm). S. J. Moore (1976) describes a similar structure for some other spiders (Araneus, Argiope, Argyroneta and Tegenaria). This distinctive structure demands a functional explanation.

In this regard, I have been able to observe regular movement of the book lung lamellae directly, through the transparent lateral wall of the opisthosoma of Lysomanes viridis (Fig. 2). An unrestrained adult female, resting on a near-vertical surface after feeding, was observed under a binocular microscope at a magnification of 144 X. The spider was carefully tilted until I was able to look directly across the surface of the lamellae (This near-lateral view is about 15 degrees above the lateral view, and both lighting and the fortuitous placement of leg IV by the spider are critical). In this position, the rapid movement, up and down, of the series of lamellae in unison is evident. Each upward movement of the lamellae coincides with the pulsatile flow of hemolymph through the readily visible pulmonary vein, as the heart contracts at a rate varying from 150 to 210 cycles/minute. After completing this observation, I discovered that V. Willem (1918) had observed the same synchrony of heartbeat and lamellar movement in Pholcus phalangioides. I have subsequently repeated this observation with a local pholcid. In Lysomanes, the visible movement is greatest for the dorsal lamellae, nearest to the pulmonary vein. The ability of the

Fig. 1. The hemolymph bellows hypothesis for book lung ventilation: Schematic transverse sections of the left book lung, as seen from the rear. Hemolymph of the medial sinus (MS) flows between the lamellae (flattened air-sacs) of the book lung to the lateral sinus (LS), then ascends dorso-medially to the heart via the pulmonary vein. Left: The lamellae are inflated with air as hemolymph is pulled out of the inter-lamellar spaces by the contracting heart. Right: With relaxation of the heart, hemolymph enters the book lung from the medial sinus to compress the lamellae.
Perhaps one of the most impressive observations which one can draw from looking at transparent spiders, including *Lyssomanes*, is the extreme translucidity of internal structures. This includes both nerves and muscle, as well as the individual cells of the digestive diverticula containing darker droplets. One is greatly impressed by the important distinction between the fixed artifacts of a histological preparation and the dynamics of a living, fluid structure.

REFERENCES:
