

## Some Studies on the Heart Beat of Scorpion, *Heterometrus fulvipes*

KANUNGO<sup>1</sup> reported that acetylcholine inhibits the heart beat of scorpion, *Palamnaeus bengalensis* C. Koch, and attributed this to the myogenic nature of the heart. However, the studies of POLICE<sup>2</sup>, ZWICKY and HODGSON<sup>3</sup>, and RANDALL<sup>4</sup> have revealed the existence of cardiac ganglion in different species of scorpions. ZWICKY and HODGSON<sup>3</sup> have recorded spontaneous volleys from the

beat, and the severing of connections of the anterior pair of nerves resulted in the acceleration of the heart beat.

The hearts were perfused with acetylcholine (ACh) of different concentrations and the inhibitory effect of ACh was shown to be dependent on the concentration of the drug. Simultaneous recordings from the cardiac ganglion and the heart muscle were made using the liquid potentiometer connected to a dual beam oscilloscope. Figure 2 shows the spontaneous volleys of the cardiac ganglion on the upper beam and the corresponding contractions of the heart muscle on the lower beam. Each volley corresponds to a burst of nerve activity that triggers the heart contraction.

The cholinesterase (ChE) activity of the heart muscle was determined<sup>7</sup>. The level of enzyme activity was shown to follow a regular circadian rhythm like that of the heart beat, with the maximum enzyme activity at about 20.00 h and the minimum enzyme activity at about 08.00 h (Figure 1). The determination of cholinesterase in the heart muscle suggests the possibility of acetylcholine acting as a predominant transmitter in the conduction of impulses. The presence of a cardiac ganglion on the dorsal aspect of the heart, a pair of nerves innervating the heart from the posterior part of the brain, and the available pharmacological evidence suggest that the heart of the scorpion is an innervated myogenic one. Further details and discussions on this aspect will be published elsewhere<sup>8</sup>.

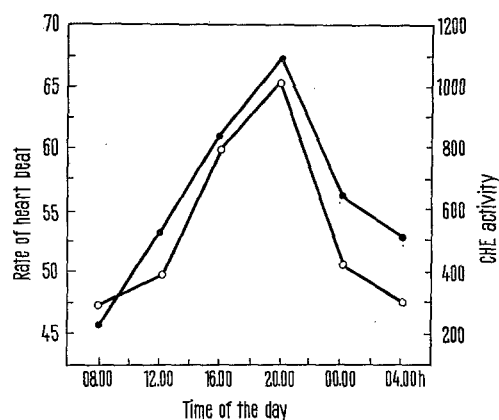


Fig. 1. Graph showing the circadian rhythm in relation to the heart beat and cholinesterase activity in the heart of scorpion, *Heterometrus fulvipes*. ●—●, rate of heart beat; ○—○, ChE activity.

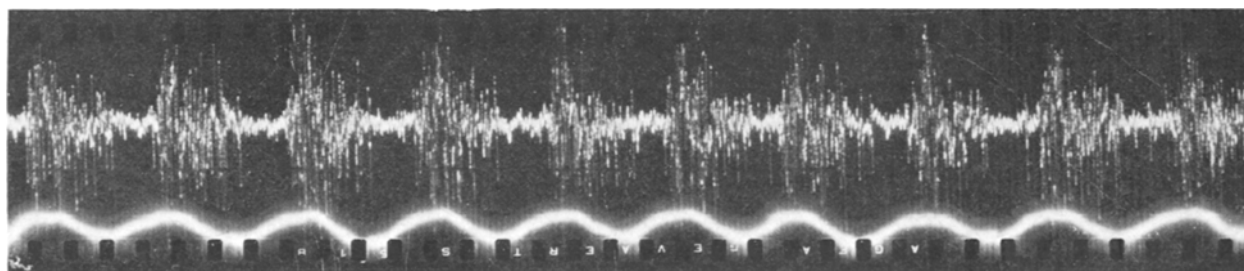


Fig. 2. Simultaneous recordings of the electrical activity from the cardiac ganglion (upper beam) and the mechanical activity of the heart (lower beam); 1:1 correspondence of the 2 showing the nervous dependence of the heart beat.

detached cardiac ganglion of scorpion, *Urodacus*, and suggested the neurogenic nature of the heart. But in all these studies, no attempt has been made to analyze the exact nature and the mechanism of the heart of the scorpion. The present investigation is an attempt to understand the nature and the mechanism of the heart beat of the scorpion by comparing anatomical, pharmacological, electrophysiological and biochemical evidences.

A commonly available South Indian Scorpion, *Heterometrus fulvipes*, was used in the present investigation. The normal heart beat was determined by exposing the heart to the perfusion medium<sup>5</sup>. The rate of beat of intact hearts was 65–70/min and those of isolated hearts was 75–80/min. The heart rate showed a regular circadian rhythm with the maximum heart beat at about 20.00 h and the minimum heart beat at about 08.00 h (Figure 1).

The innervation of the heart was studied by fixing the heart in Bouins fluid, sectioned and stained with Ehrlich Hematoxiline and Eosin<sup>6</sup>. It consists of a long chain of nerve cells placed along the middorsal line of the heart – the cardiac ganglion, and a pair of nerves innervating the heart from the posterior border of the brain. Removal of the cardiac ganglion resulted in the inhibition of the heart

*Zusammenfassung.* Anatomische, pharmakologische, elektrophysiologische und biochemische Studie über die Innervation des Skorpionherzens von *Heterometrus fulvipes*.

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<sup>8</sup> Acknowledgment. I wish to thank Dr. B. PADMANABHANAIKU for his guidance and Dr. K. S. SWAMY, Head of the Department of Zoology, for providing me with the necessary facilities during the tenure of this work. Grateful thanks are also due to the Ministry of Education, Government of India, for awarding a National Merit Loan Scholarship during the course of this investigation.