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PREFACE

Although William Harvey in 1628 used a truly comparative approach in his study on 'The Movement of the Heart and Blood', mentioning crustaceans, fishes, amphibians, reptiles and birds as well as mammals, physiologists now tend to be classified as either mammalian or comparative. One objective of the discussion meeting and this associated review volume was to bring together experienced scientists from either side of this arbitrary division who between them covered a large proportion of the animal kingdom. The major objective, however, was to view the separate central and peripheral mechanisms controlling the respiratory and circulatory systems, and then to see how these systems are controlled and co-ordinated during various types of behaviour and activities in order that an adequate supply of oxygen to the metabolizing tissues may be maintained, presumably with the least expenditure of energy.

Such 'goal-directed' control and co-ordination may seem an obvious necessity during exercise, particularly for those air-breathing animals that spend much of their time underwater or for those that live at high altitude. However, a similar objective may be achieved during that most energy-conserving of all activities, sleep. The rhythmic ventilation of most mammals, which is generated by medullary neurones and which modulates output to the cardiovascular system, becomes irregular during desynchronized sleep. This irregular pattern may be controlled by a different central generator from that functioning in the awake animal, but its irregular nature is similar to that seen in a number of resting poikilothermic animals and in the marine mammals. In these animals wide fluctuations in blood gases are experienced, so the concept of internal respiratory homeostasis is not appropriate. Interestingly, the reflex control of circulation during sleep is mainly by way of the peripheral chemoreceptors, which is similar to the condition in the foetus where the baroreceptors do not function. However, the presence of a baroreflex in aquatic vertebrates indicates that it has not evolved solely in response to the influence of gravity on the circulatory system. The general level of arterial blood pressure may, in fact, be set centrally, with the peripheral receptors merely 'fine-tuning' the system.

Respiratory and cardiovascular adjustments associated with some patterns of behaviour can be studied in traditional ways with anaesthetized or restrained animals. The defence-arousal response and a pattern of sympathetic activity similar to that seen during desynchronized sleep can be obtained by stimulating specific regions of the brain. Other types of activity cannot be so usefully studied under such conditions. It is now clear that the physiological responses to submersion (diving) are different when the animal dives spontaneously compared with forced submersion.

At this meeting we heard from scientists studying topics as widely different as the connexions and interactions of central neurones, peripheral sense organs and whole animal activities in crustaceans, fishes, reptiles, birds and mammals (including man). At first sight this may appear an impossibly broad area to cover at a three-day meeting and in a relatively slim volume. In the event it was clear that important mechanisms for compensation are widespread throughout the animal kingdom (e.g. both the cray-

fish, *Austropotamobius*, in hypoxic water and man at high altitude benefit from the leftward shift of the blood oxygen equilibrium curve that results from a respiratory alkalosis). It is hoped that the truly comparative approach to physiology will be fostered by this volume. As Harvey found, by studying a wide range of animals we are better able to understand the mechanisms which determine our own responses to the environment and, maybe, our aspirations within it.

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