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Diving and asphyxia

A comparative study of animals and man

DIVING AND ASPHYXIA

A comparative study of animals and man

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PREFACE

We have assembled in this monograph our views regarding the physiological events that are collectively described as the *diving response*. The emphasis is mostly but not exclusively mammalian, as is appropriate to our experience. Adaptations to diving asphyxia were originally identified only in animals that live in aquatic habitats. It has since become evident that the natural divers display a well-developed variation of a more general defence against asphyxia. Much can be learned about asphyxia and related cardiovascular and metabolic responses from field and laboratory studies of diving animals, the natural specialists whose reactions yield conveniently to experimental manipulation. An even broader perspective suggests that the species so tolerant of diving asphyxia are part of a continuum of animals which respond to hostile environments and disturbances of homeostasis by strategic retreat into conditions of depressed metabolism. Knowledge derived from the study of diving animals contributes to biological understanding and also holds promise for practical applications to clinical medicine.

We are much in debt to colleagues and students for suggestions and discussions, but our failures in explanation and judgement are our own responsibility. We owe special and personal gratitude to those two pioneers in this field, Laurence Irving and P. F. Scholander, both recently deceased, who set high standards some forty years ago for deciphering the mysteries governing the adaptations of diving mammals and birds. Whatever good comes of this publication is dedicated to them. We are very grateful to Professor M. de Burgh Daly, colleague and friend, for stimulating discussions and support and for contributions to our thinking about control mechanisms and medical implications.

Two anonymous reviewers suggested important changes which substantially clarified and improved the text. Our wives, Elizabeth Elsner and Lesley Gooden, willingly read and re-read parts of the manuscript and made useful suggestions for its improvement. Mrs Helen Stockholm, Publications Supervisor, and typists Suzette Carlson, Martha Fisk, Roseanne Lamoreaux, Mauricette Nicpon, Nancy Ricci and Tricia Witmer, all at the Institute of Marine Science, University of Alaska, remained helpful and tolerant throughout the turmoil of producing the manuscript. Mrs Ana Lea Vincent drafted some of the figures.

Our experimental subjects, marine mammals, human breath-holders and others, cooperated by revealing some of their physiological secrets. The research was supported by the US Public Health Service National Heart, Lung and Blood Institute, the National Science Foundation, the US Antarctic Research Program, the Alaska Heart Association, the National Health and Medical Research Council (Australia), the National Heart Foundation of Australia, the Fulbright–Hays Programme, the Australian–American Educational Foundation, the Moody Foundation, Sea World, Seward Fisheries, the Universities of Adelaide, Texas, Nottingham, Alaska and California (Scripps Institution of Oceanography) and the Royal Society and Wellcome Trust (to Professor M. de Burgh Daly). Professors R. F. Whelan and A. D. M. Greenfield encouraged and supported our joint enterprise.

Our families contributed to the success of our research by helping with the care of experimenters and experimental animals: sea lions, seals, dolphins, a pilot whale, echidnas, dogs and new-born lambs. Dedicated technicians, especially Mr James Wright and Mrs Sally Dunker, kept their composure and resolve despite demands which were sometimes extraordinary and bizarre.

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