THE RESPIRATORY FUNCTION
OF THE BLOOD

PART I

LESSONS FROM HIGH ALTITUDES
THE RESPIRATORY FUNCTION OF THE BLOOD

PART I
LESSONS FROM HIGH ALTITUDES

by

JOSEPH BARCROFT
Fellow of King's College, Cambridge

CAMBRIDGE
AT THE UNIVERSITY PRESS
1925
TO THE MEMBERS OF MY PARTY IN SOUTH AMERICA

C. A. BINGER
A. V. BOCK
J. H. DOGGART
H. S. FORBES
G. A. HARROP
J. C. MEAKINS
A. C. REDFIELD
PREFACE

TO THE FIRST EDITION OF

THE RESPIRATORY FUNCTION OF THE BLOOD

At one time, which seems too long ago, most of my leisure was spent in boats. In them I learned what little I know of research, not of technique or of physiology, but of the qualities essential to those who would venture beyond the visible horizon.

The story of my physiological “ventures” will be found in the following pages. Sometimes I have sailed single handed, sometimes I have been one of a crew, sometimes I have sent the ship’s boat on some expedition without me. Any merit which attaches to my narrative lies in the fact that it is in some sense at first hand. I have refrained from discussing subjects which I have not actually touched, but which might fittingly have been included in a modern account of the blood as a vehicle for oxygen. Such are the relation of narcosis to oxygen-want and the properties of intracellular oxidative enzymes. The omission of these and other important subjects has made the choice of a title somewhat difficult. I should like to have called the book, what it frankly is—a log; did not such a title involve an air of flippancy quite out of place in the description of the serious work of a man’s life. I have therefore chosen a less exact, though more comprehensive title.

After all, the pleasantest memories of a cruise are those of the men with whom one has sailed. The debt which I owe to my colleagues, whether older or younger than myself, will be evident enough to any reader of the book. It leaves me well-nigh bankrupt—a condition well known to most sailors. But I owe another large debt of gratitude to those who, as teachers, showed me the fascination of physiology, to Dr Kimmins*, and especially to

* Formerly science master at the Leys School, now Chief Inspector of the Educational Department of the London County Council.
viii 

PREFACE

Dr Anderson*. At a later stage I learned much from Dr Gaskell, Professor Langley and Dr Haldane.

There are occasions on which every sailor of the deep sea has to ship a pilot. Mr A. V. Hill has brought me into those harbours which are best approached through the, to me, unknown channels of mathematics.

* Formerly supervisor in physiology to King’s College, now Master of Gonville and Caius College.

J. B.

Cambridge, 
December, 1913.
PREFACE
TO
LESSONS FROM HIGH ALTITUDES

The rapid advance of knowledge rendered impossible the task of revising The Respiratory Function of the Blood for a second edition. The book was in three parts with an Appendix on technique: there is now more than enough known about the subject-matter of each part to justify a book on that alone. I have therefore determined to break up the volume into a series of manageable units, originally intended to correspond more or less to the "Parts" of the original work. The first volume of this series is now presented.

I have to thank the Royal Society for permission to reproduce Figs. 10, 11, 12, 13, 14, 15, 17, 18, 25, 26, 29, 30, 37, 41, 42, 44, 45, 46, 48 and 50; Physiological Review, Figs. 31, 32, 33, 34; Journal of Physiology, Figs. 23, 24; R.A.M.C. Journal, Figs. 22, 39, 40; Quarterly Journal of Medicine, Figs. 20 and 38; the Medical Research Council, Figs. 35 and 36; the Peruvian Corporation, Fig. 3; Nature, Fig. 16, and my friends Dr Douglas for the plates of Figs. 1, 7, 8 and 9, Professor Durig for that of Fig. 5, and Professor Aggazzotti for those of Figs. 4 and 6.

J. B.

Cambridge,
September, 1925.
CONTENTS

Preface to Lessons from High Altitudes ..... ix

CHAP.
I. Mountain Sickness and its Cause ..... 1
II. Some Places where Mountain Sickness is Studied ..... 21
III. The Dwellers at High Altitudes ..... 37
IV. The Colour of the Face and its Significance ..... 50
V. The Diffusion of Oxygen through the Pulmonary Epithelium ..... 63
VI. Muscular Exercise ..... 75
VII. The Hydrogen-Ion Concentration of the Blood ..... 88
VIII. The Pulse ..... 103
IX. The Circulation Rate ..... 116
X. The Strain on the Heart ..... 131
XI. The Number and Nature of the Red Corpuscles ..... 138
XII. The Mind ..... 155
XIII. Acclimatisation ..... 168

Appendix I. Physiological Difficulties in the Ascent of Mount Everest ..... 170
Appendix II ..... 182
Appendix III ..... 196
Appendix IV ..... 199
Index ..... 201