Benchmark Papers
in Human Physiology V. 15

# HIGH ALTITUDE PHYSIOLOGY

Edited by
**John B. West**

Hutchinson Ross Publishing Company

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University of California,
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# SERIES EDITOR'S FOREWORD

The reactions of man and other animals to high altitude have fascinated investigators for centuries. Much is now known, due to the pioneering efforts of those quoted in this volume, but many problems remain to be solved. Among them may be listed the endocrine alterations evoked by high altitude, pulmonary edema, acute mountain sickness, and retinal hemorrhage. These problems have attracted physiologists to the low pressure chamber and the more adventurous to the high and foreboding mountains.

John West is a pioneer in the true sense of that word. He is a superb physiologist and a seasoned mountaineer. No one is better qualified to edit this fascinating volume. John West was born in Adelaide, Australia. There he developed his sturdy physique and his brilliant mind. After receiving a medical degree in 1952 he moved on to the University of London to study applied physiology and received the Ph. D. from that university in 1960. He then became a member of the Himalayan Science and Mountaineering Expedition and climbed those imposing mountains to carry out important respiratory experiments. He apparently was irreversibly smitten.

In 1969, Dr. West came to the United States to become Professor of Medicine at the University of California at San Diego. And, in the very near future, he will return to the Himalayas to continue his studies.

High-altitude physiology is dear to my heart. In 1940 I began to investigate the influence of high altitude on the adrenal cortex, an investigation that became the basis for my thesis. Thus it is a joy revisited to reread the articles by Torricelli and Boyle, Paul Bert and Barcroft, Haldane and Henderson, Bohr and Krogh, and to read some of the others for the first time.

The articles reproduced in this volume represent research at its most exciting: the totality under John West's knowledgeable editorship is certainly nothing less.

L. L. LANGLEY

# PREFACE

Of the various motives for agreeing to edit a book, sheer pleasure is unfortunately rare. But the prospect of gathering in one volume some of the key papers on high-altitude physiology was so appealing that I seized the opportunity when it was offered to me by Dr. Lee Langley and James Ross. The subject has so many fascinating aspects—stories of early ballooning, expeditions to high mountains, the controversy on oxygen secretion—that it must be one of the most enjoyable areas of physiology or medicine. Only when I came to select the articles did I have some misgivings. The space of less than 350 pages offered by the publishers is so small in comparison with the range of topics within the area of high-altitude physiology that the process of selection could be very frustrating. As a result, I have had to severely restrict the field, and the reader will find nothing on the effects of cold, dehydration, exposure, or solar and ionizing radiation on man. In addition, there is very little on animals other than man, and whole areas such as the effect of high altitude on the endocrine system have been virtually omitted.

Even so, many articles are represented by only a few pages, and obviously reproducing such fragments does not do justice to the authors. However, I hope that these portions will introduce the reader to some of the key articles that can then be obtained in their entirety from libraries. Some of the papers have been chosen because they are normally difficult to come by and some because I felt they would not generally be associated with advances in high-altitude physiology. Most of the work in this area has been done since 1870; as a consequence the articles are generally available in good biomedical libraries. There seemed to be no point in simply reproducing easily accessible papers cited in any good comprehensive review of high-altitude physiology. The resulting selection may raise some eyebrows and is naturally very subjective, but it certainly does not closely resemble any other volume in print. Inevitably there is some bias toward articles written in English since these are the most familiar in the English-speaking countries.

I am indebted to Drs. Ralph Kellogg and Sukhamay Lahiri for reviewing the selection and to the staff of the Biomedical Library at the University of California, San Diego for finding difficult papers. It is a pleasure to acknowledge the help of the general editor, Dr. Lee Langley, and James Ross of Hutchinson Ross Publishing Company.

JOHN B. WEST

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> On reaching the top, I sit down and let my legs dangle into space. . . . In my state of spiritual abstraction, I no longer belong to myself and to my eyesight. I am nothing more than a single, narrow, gasping lung, floating over the mists and summits.

So wrote Reinhold Messner, the first climber (with Peter Habeler) to reach the summit of the world's highest mountain, Mount Everest, without using supplemental oxygen (see Paper 7). Not only is mountain exploration one of the most romantic areas of high altitude physiology but the deleterious effects of high altitude were first documented by travelers and explorers.

There is some controversy about when the first reference to mountain sickness appeared. Robert Boyle in the first edition of