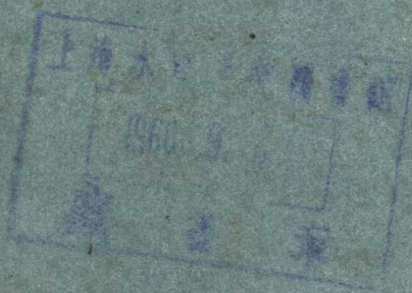




Physiology of Muscular Activity

Karpovich.



Physiology of Muscular Activity

Originally by Edward C. Schneider, M.P.E., Ph.D., D.Sc.

Peter V. Karpovich, M.D., M.P.E.

*Research Professor of Physiology,
Springfield College, Springfield, Massachusetts*

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Preface to Fifth Edition

DR. SCHNEIDER, the originator of this book passed away on October 4, 1954. Although no full appraisal of his influence on physical education has been made, it is safe to say that it was of a tremendous and lasting importance.

The present edition is a humble token of my personal esteem to Dr. Schneider.

This edition differs from the preceding one in several aspects. One of the old chapters has been divided, and therefore there is a new chapter: *Muscle Training*.

Among the materials added, one will find discussion on the following topics: Effect of Warming-up on Athletic Performance; Prediction of Weight Lifting Records; Comparison of Isotonic and Isometric Methods of Muscle Training; the Heart and Training; Relation between Physical Fitness and Intelligence; and Experimental Account of the Effect of Benzedrine upon Athletic Performance.

Moreover, at the end of each chapter there is a list of questions which might serve as a guide for studying and for quizzing. Attention is called to Question 17, Chapter 11. This type of question helps to tie together bits of information gathered in different chapters for a better understanding of physiology of muscular activity.

I want to thank my wife, Josephine (*Teach-Yourself-to-Relax*) Rathbone, for her indispensable and unruffled assistance in the revision of this book. I also want to thank Miss Clare Condron for her cheerful secretarial help with the manuscript.

PETER V. KARPOVICH

Springfield, Mass.

Preface to Second Edition

THIS BOOK was written for readers who have had a brief introductory course in human anatomy and physiology and it assumes some knowledge of physics and chemistry. An effort has been made to embody the general trends of present-day investigations of the physiology of physical activity. In as intensive a field of research as this has become, conclusions are not final. Hence, it frequently has been necessary to present both sides of debatable topics and to avoid dogmatic statements. General trends have been presented by making selections from the large number of original articles.

It is of vital importance for advancement that the student of physical education should have a good foundation on which to build the structure of his experience.

That this book will contribute something of value to both teacher and student is the earnest hope of the author.

EDWARD C. SCHNEIDER

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Chapter 1

Introduction

WHEN SIGNORA GALVANI saw the dancing frog legs that her husband had hung on the balcony of their villa, the physiology of muscular activity was born.

Because of an element of the spectacular, and because of the relative ease with which phenomena of muscular activity can be investigated, this branch of physiology has served as an introduction to other branches. Even at the present time, many teachers prefer to begin student laboratory work with experiments in muscle physiology. As to the spectacular qualities, they are probably better now than ever before.

On one occasion, the author, to his great surprise, received an invitation from a Society of Magicians to speak about science. He decided, instead, to give a demonstration in Scientific Magic, which was really nothing more than a series of laboratory experiments in the physiology of muscular activity. Frog legs danced, saluted a flag, and lifted tremendous weights. The success of the show was beyond expectation; especially when a "hypnotized" rooster remained motionless in spite of lusty applause.

Even a casual observer may notice the powerful effect of muscular activity on the processes of his body. His respiration increases, his heart beats faster, he feels warmer, and perspiration becomes noticeable. These changes indicate that

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certain adjustments have been made in order to mobilize the organism for a greater output of energy. These simultaneous reactions also demonstrate the close interrelation between various physiological functions. In reality, it is impossible to discuss changes due to muscular activity in one physiological system without referring to the other ones as well.

The most essential aspect in the mobilization of the human organism during muscular activity is the coordination of three functions: communication, energy production and transportation. This means that nerves must stimulate muscles to contract; fuel must be made available for the muscles and other organs; oxygen must be provided; and waste products eliminated.

The simplicity of this statement is more apparent than real. Upon careful analysis it becomes evident that the basic adaptation of the organism embraces such a multitude of adjustments that a description of all the changes would fill a good-sized book.

One may ask: What is the use of this particular branch of physiology, the Physiology of Exercise? Physiology of exercise constitutes the scientific basis of the evolving physical education. At the present time, physical education is mostly art and a little science. For this reason, even uneducated men may and do contribute a great deal in this field. As far as skills are concerned, one need not have an academic degree in order to teach other people. An instructor in golf, in tennis, or in dancing is not required to know the intricacies of blood circulation or the functions of the liver. As far as boxing is concerned, it is probably better if the boxer knows nothing about physiology, because otherwise he would realize how irrational it is to indulge in the gentle art of brain concussion.

When, however, we consider physical education from the standpoint of its effect upon the development and growth of children, or from the standpoint of the health of adults, the picture radically changes. One of the aims of physical education is to assist in the normal growth and development of the human organism and the maintenance of a needed degree of physical fitness. For this, knowledge of physiology is essential.

In a study of the functions of any organism, it becomes

apparent that some sort of unifying or integrating force subordinates the separate organs, tissues and cells of the body to the unity or individuality of the organism as a whole; that the unifying factor or factors, acting throughout life, regulate the growth and activity of the parts, accelerating or retarding them as the needs may be, and compelling them to conform to the needs of the organism as a whole.

The welfare of the organism requires that it be protected from too great, too rapid, and too irregular fluctuations in its internal environment. Hence many of the organs of the body participate in the endeavor to keep certain physical and chemical conditions within a small range of fluctation. The physiology of exercise must explain or interpret these mechanisms.

As we take up the discussion of the physiology of physical exercise, we shall keep in mind that the activity of every organ is more or less integrative; that is, it contributes to the good of the whole. Yet in order to obtain a clear understanding of their contribution to the whole, we shall first consider each organ more or less in isolation. Having done this and having discovered that the number of bodily variables during physical exertion is large, we shall endeavor to find how these variables are correlated and how they maintain the efficiency and stability of the bodily machine as a whole.

One should not forget that the physiology of exercise at the present time is still in its infancy, and therefore one should not expect too much from it. Likewise, one should not be too disappointed that the present book does not answer all his questions. As a matter of fact, the book may contain more questions than answers.

It is hoped that some unanswered questions will stimulate the curiosity of a reader and lead him to search for a proper answer or explanation. It is also hoped that schools of physical education will give more attention to laboratory work in physiology, and will encourage original research in physiology applied to Physical Education.