extracts the substrate, which is redissolved in water after the alcohol is evaporated off. Table 1 gives the oxygen uptake in c.mm. of the various combinations of enzyme, substrate and vanadium after half an hour at pH 6.7 and 37°C. 0.5 cc enzyme suspension and about 10 per cent. of the amount of substrate present in one guinea pig liver was used in a total volume of 2.0 cc in the Warburg vessels.

**Table 1**

<table>
<thead>
<tr>
<th></th>
<th>O₂ uptake c.mm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enzyme</td>
<td>0</td>
</tr>
<tr>
<td>Enzyme + vanadate</td>
<td>0</td>
</tr>
<tr>
<td>Vanadate + substrate</td>
<td>0</td>
</tr>
<tr>
<td>Enzyme + substrate</td>
<td>12</td>
</tr>
<tr>
<td>Enzyme + vanadate + substrate</td>
<td>119</td>
</tr>
</tbody>
</table>

Work on the chemical identification of the substrate is now proceeding. Experiments have shown that it is probably not an amino acid, amine, simple alcohol or aldehyde, purine, low fatty acid, choline, succinate, cholic acid, citrate, lactate, pyruvate, glucose or ascorbic acid. It is probably a phospholipid.

As vanadium is found in small traces in all tissues these results raise the question whether it has a normal catalytic function in the body and whether it is an essential element.

FREDERICK BERNHEIM
MARY L. C. BERNHEIM
DUKE UNIVERSITY MEDICAL SCHOOL

**A COMPARATIVE STUDY OF THE SUBTERRANEAN MEMBERS OF THREE FIELD GRASSES**

A comparative study was made of the roots and root hairs in upper soil levels for oats, winter-rye and Kentucky bluegrass. Soil samples 3 inches in diameter and 6 inches deep (42 cubic inches) were taken from the fields by means of a cutting tube, and measurements made of the included subterranean plant parts. Total lengths of both roots and root hairs were used in computing the extent and surface exposed by the underground members. In Tables 1 and 2 the values given are the average of the three soil samples surveyed for each species.

**Table 1**

<table>
<thead>
<tr>
<th>Roots*</th>
<th>Total number of roots</th>
<th>Total length of roots (ft.)</th>
<th>Total root surface (sq. in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats</td>
<td>4,700</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>Rye</td>
<td>6,400</td>
<td>210</td>
<td>78</td>
</tr>
<tr>
<td>Bluegrass</td>
<td>84,500</td>
<td>1,260</td>
<td>330</td>
</tr>
</tbody>
</table>

* Per soil sample (42 cubic inches).

In a comparison of the cultivated rye plants grown in competition with a non-competing greenhouse rye plant, previously surveyed,¹ it was found that the field


**Table 2**

<table>
<thead>
<tr>
<th>Root Hairs*</th>
<th>Total number of root hairs (in millions)</th>
<th>Total length of root hairs (miles)</th>
<th>Total root hair surface (sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oats</td>
<td>6.3</td>
<td>4.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Rye</td>
<td>12.5</td>
<td>10.0</td>
<td>8.2</td>
</tr>
<tr>
<td>Bluegrass</td>
<td>51.6</td>
<td>32.0</td>
<td>16.9</td>
</tr>
</tbody>
</table>

* Per soil sample (42 cubic inches).

rye had approximately 5 times the number of root hairs per unit of root length as the non-competing greenhouse plant. However, the indoor plant had far more and longer roots, and consequently a greater total number of root hairs.

Assuming that roots and root hairs were evenly distributed throughout the samples, one cubic inch of soil from this oats field would have approximately 110 roots and 150,000 root hairs, with a combined length of about 630 feet and a surface area of 15 square inches. A similar cube of soil from a field of winter rye would have approximately 150 roots and 300,000 root hairs with a combined length of 1,300 feet and a surface of about 30 square inches. Kentucky bluegrass would have, per cubic inch of soil, approximately 2,000 roots and 1,000,000 root hairs, with a combined length of over 4,000 feet and a surface area of about 65 square inches. When it is considered that these grasses have from 150,000 to 1,000,000 root hairs per cubic inch of soil their importance in the physics of the soil is obvious. From the standpoint of their usefulness as soil binders oats would be least efficient, rye intermediate and bluegrass far superior to either of the others in retarding erosion.

HOWARD J. DITTME

DEPARTMENT OF BOTANY,
STATE UNIVERSITY OF IOWA

**BOOKS RECEIVED**


SEIFRIZ, WILLIAM. The Physiology of Plants. Pp. vi + 315. 95 figures. Wiley. $3.50.


KODACHROME FILM IN CUT SHEET FORM

TYPE B for artificial illumination;

and DAYLIGHT TYPE

Kodachrome Professional Film is supplied in standard sizes, for cameras that use cut-sheet film. Transparencies of the appropriate size may be bound between cover glasses to make full-color lantern slides. The Type B film is in every way suitable for full-color photomicrography.

EASTMAN KODAK COMPANY, ROCHESTER, N. Y.

Sixth Edition—Now Ready

American Men of Science

A BIOGRAPHICAL DIRECTORY

EDITED BY J. McKEEN CATTELL AND JAQUES CATTELL

The first edition of this Biographical Directory of American Men of Science was published in 1906, the second edition in 1910, the third edition in 1921, the fourth edition in 1927 and the fifth in 1933. The present edition contains the records of about 28,000 living men of science, as compared with about 4,000 in the first edition. No single book of reference can cover the whole of North America and all lines of activity; it therefore becomes necessary to prepare special works. This volume, devoted to the men of science, sets standards in its treatment of a group on which the material prosperity and intellectual leadership of the country depend.

The book contains viii + 1608 pages. It has been edited with great care and is believed to be as complete and accurate as any work of the character. It is well printed by The Science Press Printing Company; the high standards of the typography and binding of the book are representative of its contents.

Price: Twelve Dollars, net, postage paid

THE SCIENCE PRESS
LANCASTER, PA.—GRAND CENTRAL TERMINAL, NEW YORK, N. Y.
Successful MOSBY Texts

TEXTBOOK of ZOOLOGY

At last there is available a textbook on Zoology that is different—a book written from a new and refreshing viewpoint by a new group of authors. Printed on a new type of paper called "Eye-Tone," a tinted stock, this text is said to be easier to read and less tiring on the eyes. It is also profusely illustrated. It should be the purpose of a textbook in general zoology to present the animal kingdom in a logical and natural way and at the same time carry the interpretation of the facts in terms of the principles involved. This text meets this requirement, striking a working combination of the two schools of teaching and yet covering the fundamental knowledge of the subject. Many animals from west of the Mississippi River are featured in this book, making it more adaptable to all parts of the country.

By GEORGE EDWIN POTTER, Ph.D., Professor of Zoology, Baylor University, Waco, Texas. 915 Pages, 440 Illustrations, 15 Color Plates. Price, $3.00.

TEXTBOOK OF PHYSIOLOGY

An ideal text for teaching and reference. In compact form it deals with every phase of this wide field including the interrelation of each organ and part with all the others. The new Sixth Edition, recently off the press, has been changed to meet the needs of the modern and up-to-date requirements. It is a truly scientific work, yet admirably adapted to everyday human needs. The style is clear, exact, and explanatory without being verbose. The text is profusely illustrated. By W. D. ZOETHOUT, Ph.D., Professor of Physiology in the Chicago College of Dental Surgery (Loyola University). New 6th Ed. 714 pages, 291 illustrations. Price, $4.00.

ELEMENTS OF PSYCHOLOGY

This text introduces the student to adult human psychology. The book is drafted not only to teach the facts and theories of general psychology, but to require the student's energy and concentration to learn successfully and thoroughly the fundamentals of the subject. By KNIGHT DUNLAP, Professor of Psychology, University of California, Los Angeles. 449 pages, 65 illustrations. Price, $3.00.

IMMUNOLOGY

The student is led to correlate some of the teachings of physiology, pharmacology, organic, biological and physical chemistry as well as anatomy, pathology and general biology. By N. P. SHERWOOD. 550 pages, 26 illustrations. Price, $6.00.

TEXTBOOK OF GENERAL BIOLOGY

This text is divided into three sections: Part I—the Unity of Life. Part II—Problems of Biology. Part III—Plant and Animal Kingdom. Parts I and II constitute one semester's work. Part III can be used for two semesters—one for Botany and one for Zoology, or selections can be made for a single semester. By E. GRACE WHITE, Professor of Biology, Wilson College, Chambersburg, Pa. 2nd Ed. 667 pages, 336 illustrations. Price, $3.50.

TEXTBOOK OF BACTERIOLOGY

This text applies the fundamentals of bacteriology to the medical side of the subject. Tested before publication in the classroom for weaknesses this book stands today a well-balanced and effective bacteriology for the student. By R. W. FAIRBROTHER, Lecturer in Bacteriology, University of Manchester, London. 457 pages. Price, $4.50.

TEXTBOOK OF HISTOLOGY

The minute structure of tissues and organs is described, omitting details primarily of academic interest, and referring to human organism unless the contrary is stated. Emphasis is laid on the "physiological" appearances and their relation to function. The reactions of tissues to various conditions are briefly described. By EVELYN E. HEWER, Reader in Histology in the University of London. 365 pages, 340 illustrations. Price, $4.50.
Successful MOSBY Texts

**FUNDAMENTALS OF ANATOMY**

In writing this book Dr. Francis has kept in mind the essentially practical significance of a knowledge of anatomy in both its professional and lay aspects. His long experience as a teacher and his intimate knowledge of the subject in his role of physician to the Developmental Health Inquiry of the Associated Foundations establish the authoritativeness of his text and illustrations. This text differs mainly in its approach—the author opening the door through LIVING anatomy. This approach has these advantages: 1st. Living anatomy emphasizes the normal body. 2nd. It serves to act as basic knowledge in understanding hygiene and health. 3rd. It goes hand-in-hand with normal physiology. 4th. Normal, living anatomy should be had for the proper understanding of physical changes in disease.

By CARL C. FRANCIS, Senior Instructor in Anatomy, Laboratory of Anatomy, Western Reserve University. 320 Pages, 176 illustrations, including 26 color plates. PRICE, $2.75.

**PERSONAL HYGIENE**

This book presents the essential, present-day knowledge of personal health within available time and space limitations and with enough anatomy, physiology, and other underlying sciences to clarify and support the health teaching. By C. E. TURNER, Professor of Biology and Public Health in the Massachusetts Institute of Technology. 335 pages, 84 illustrations, 3 color plates. Price, $2.25.

**MICROBIOLOGY AND PUBLIC HEALTH**

In many institutions courses on preventive medicine and public health are being given in connection with bacteriology. Doctor Sharp is the pioneer to offer a text for this field, closely interrelating microbiology with public health and preventive medical problems. Teachers giving courses from this viewpoint will welcome this new and interesting text. By WILLIAM B. SHARP, Professor of Bacteriology and Preventive Medicine in the Medical Department of the University of Texas. 580 pages, 125 illustrations. Price, $4.50.

**FUNDAMENTALS OF HUMAN PHYSIOLOGY**

This is a beginner’s physiology, unfolding the elements of the subject so that the picture of physiology can be seen and understood easily. The latest theories and facts, including those on the Endocrines and Vitamins, make this an ideal text. By J. J. R. MACLEOD, Late Regius Professor of Physiology in the University of Aberdeen; and R. J. SEYMOUR, Professor of Physiology, Ohio State University, Columbus, Ohio. 4th Ed. 424 pages, 108 illustrations, 4 color plates. Price, $2.50.

**PERSONAL AND COMMUNITY HEALTH**

All phases of hygiene are covered in Turner’s book. Not only are the usual points of hygiene of nutrition, digestion, excretion, etc., taken up in Part I, but all the newer trends in personal hygiene are also explained. Among these are body mechanics, bodily activity, foot hygiene, narcotics and stimulants, and heredity and health. Physiology has been used as the basis in teaching hygienic principles. Part II embraces the community aspect of hygiene. By CLAIR E. TURNER. 4th Ed. 680 pages. Price, $3.00.

**A LABORATORY MANUAL OF GENERAL BIOLOGY**

The exercises in Part I of this manual cover the sections on “The Unity of Life” and “Problems of Biology” of the large text, and are performed in one semester with four hours of laboratory work each week. The exercises in Part II and Part III cover the series of plant and animal types based on the plant of progressive organization presented in the section of “The Plant and Animal Kingdoms” of the large text. By E. GRACE WHITE. 236 pages. Price, $1.50.
PULFRICH PHOTOMETER

(Arranged as Colorimeter)

This instrument is designed for colorimetry without comparison solution. It measures the absorption occurring in different wave-length regions with a degree of precision formerly obtainable only with a spectro-photometer. The results are rapidly determined by one measurement without variation of the depth of liquid.

Additional accessories equip this instrument as a Nephelometer, Glossimeter, and Comparison Microscope. Literature will be gladly sent on request.

CARL ZEISS, INC.

485 FIFTH AVENUE    728 SO. HILL STREET
NEW YORK             LOS ANGELES