

**MANUAL OF
EXPERIMENTAL
BOTANY**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649097432

Manual of experimental botany by Frank Owen Payne

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

FRANK OWEN PAYNE

**MANUAL OF
EXPERIMENTAL
BOTANY**

100
P.P.

MANUAL
OF
EXPERIMENTAL BOTANY

BY
FRANK OWEN PAYNE, M.Sc.
ASSISTANT IN BIOLOGY, HIGH SCHOOL OF COMMERCE
NEW YORK



396831
6.10.91

NEW YORK ··· CINCINNATI ··· CHICAGO
AMERICAN BOOK COMPANY



COPYRIGHT, 1912, BY
FRANK OWEN PAYNE.

ENTERED AT STATIONERS' HALL, LONDON.

—
PAYNE'S BOTANY.

W. P. I

PREFACE

THERE is something in an experiment which appeals to the mind of the young. The innate desire to find out what is in a toy, how it works, and why various things happen, is largely responsible for this.

Chemistry and physics owe their great popularity to the fact that they have been taught by experiment. Zoölogy and botany have always been less popular because they have often been taught without experimentation.

In the days when morphology was the *summum bonum* of botanical study, there could be small room for experiment. But in these later years, when the science has been taught more along physiological lines, the use of experiment has come into more general vogue.

It is the purpose of this little book to teach botany by experiment. Plants yield themselves very readily to experiment. Being alive, they respond to all external influences most admirably, and there is no reason why such work with plants should not prove as interesting and as useful as similar exercises with levers, leuses, vibrating pendulums, and cords.

It is hoped that something may be found in this book which will remedy the inadequacy which exists in the laboratory instruction of many schools.

The work is not entirely physiological in character, but it has been thought wise to present the morphological part also in the form of experiments.

In a number of places, several experiments have been introduced to demonstrate the same truth. It is not intended, however, that all such exercises be undertaken by the same class in any one term. They are offered so that the courses from term to term can be varied, using alternative experiments.

This gives variety to the work and will make the use of old laboratory notebooks less likely.

It is also expedient often to assign for home experiment such exercises as are omitted in school. Field work should be undertaken wherever possible; but as real field work is out of the question in large cities, much reference work can be done, and a certain amount of it ought to be required.

Reference work will include the looking up of topics in libraries, and visits to museums and parks.

Written reports on assigned topics should be expected. A certain number of common plants should be known by name. This can be accomplished by requiring pupils to bring in specimens. These collections may be arranged for exhibition where all may see them and learn to recognize them.

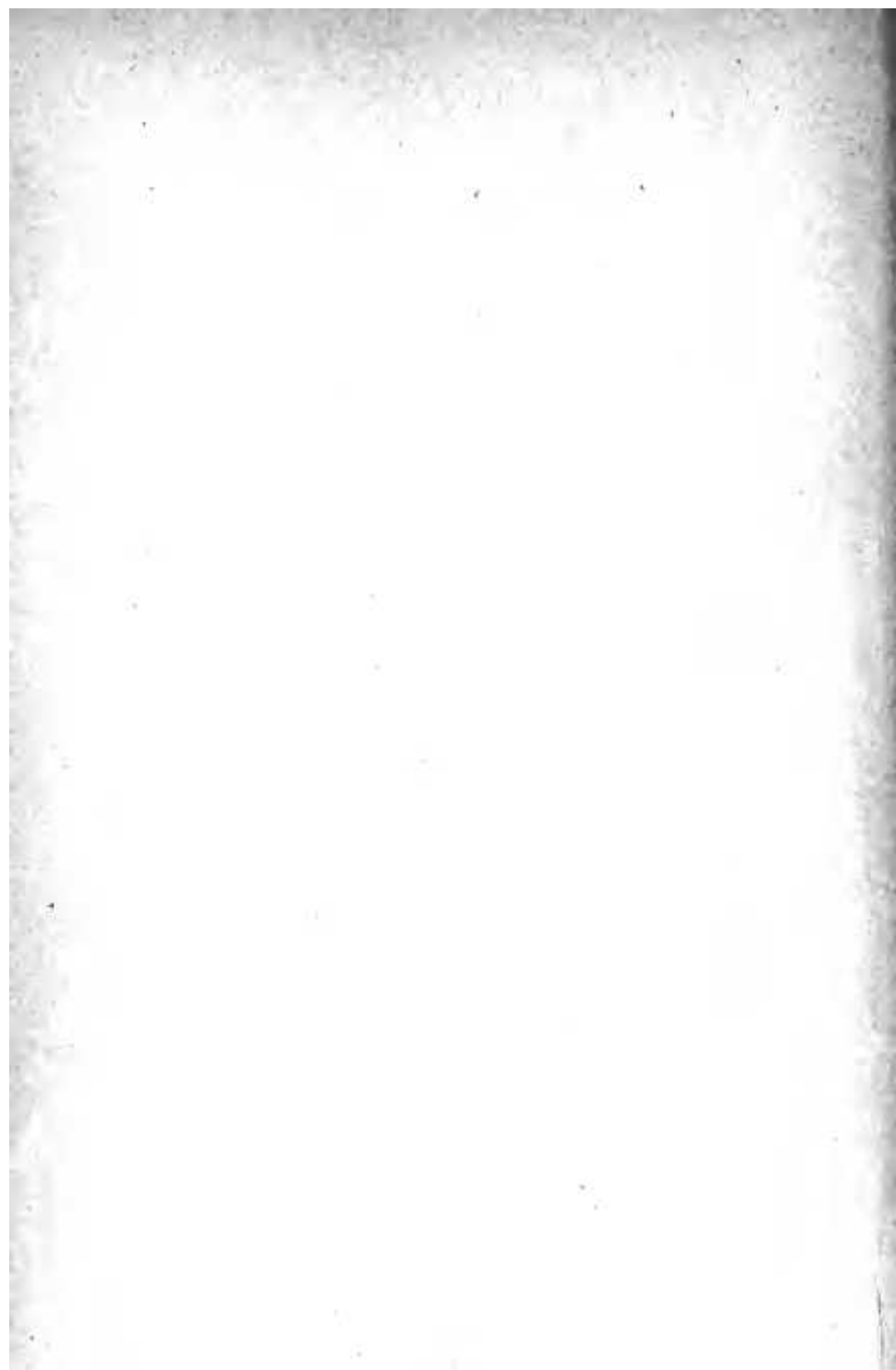
Walks about streets and parks to identify trees and shrubs should be made from time to time, and their leaves should be collected as a means of recognizing them. The same method is recommended for ferns and garden flowers.

If the boy or girl who studies this book comes to realize that plants are *alive* as *we are alive*, — that they eat, digest, grow, and reproduce their kind as truly as we perform these functions; that they respond to outside influences as *we* do; that they are in a way our brothers; that they are necessary to us and we to them, — my object will be fulfilled.

To Dr. Walter Hollis Eddy, of the High School of Commerce, New York, for his many helpful suggestions of material and method of presentation; to Mr. Frederick L. Holtz of the Training School for Teachers, Brooklyn, who has read the

manuscript and has given it most careful criticism; and to my colleagues in the High School of Commerce, Messrs. Matthewson, Barbour, A. H. Lewis, Sprague, and Hahn, who have rendered substantial assistance in the preparation of this book, — I desire to express my sincerest thanks.

The following texts have been freely consulted: Bailey, *Principles of Agriculture, Plant Breeding, and Botany*; The Cornell University Bulletin; Osterhaut, *Experiments with Plants*; Percival, *Agricultural Botany*; United States Department of Agriculture Bulletins, and the botanical textbooks of Andrews, Atkinson, Bergen, Coulter, Barnes, and Cowles, Dana, Goff and Mayne, Goodale, Gray, Hunter, Leavitt, and Sharpe.



CONTENTS

- I. PRELIMINARY EXPERIMENTS. — 1. Oxygen. 2. Carbon. 3. Carbon dioxide. 4. Hydrogen. 5. Nitrogen. 6. Acids, bases, and salts . . . 9-18
- II. FOOD MATERIALS AND HOW TO DETECT THEM. — 7. Protein. 8, 9. Starch. 10. Sugars. 11. Grape sugar. 12. Oils and fats. 13. Water. 14. Amount of water. 15. Mineral salts 19-29
- III. DIFFUSION AND OSMOSIS. — 16-18. Diffusion. 19-22. Osmosis 30-35
- IV. SOIL AND SOIL PREPARATION. — 23-26. Contents of soils. 27-30. Character of soils. 31, 32. Effect of tilling 31-44
- V. FIELD WORK OR REFERENCE WORK. — I. Fertilizing. II. Tilling. III. Planting. IV. Cultivating. V. Harvesting. VI. Marketing. VII. Flower gardening 45-48
- VI. SEEDS. — 33. Parts of a seed. 34, 35. Effect of soaking. 36-37. Seeds exert pressure. 38. The embryo. 39. Comparative structure. 40. Seeds with food inside the embryo. 41. Seeds with one seed leaf 49-57
- VII. GERMINATION OF SEEDS. — 42, 43. The water factor. 44. The heat factor. 45-47. The air factor. 48. Relation of depth to germination. 49. Respiration. 50. Heat from germination. 51. Effect of light. 52-54. The fate of cotyledons. 55, 56. Effect of mutilation 58-71
- VIII. GROWTH OF SEEDLINGS. — 57-60. Growth (germination). 61, 62. Growth (force exerted). 63, 64. Growth (effect of light). 65. Growth (effect of obstacles). 66. Growth (rapidity) 72-78
- IX. SEED TESTING. — 67. Purity. 68. Weight. 69. Color and odor. 70. Form. 71. Germination capacity. 72. Percentage of germination. 73. Germination speed 79-84
- X. ROOTS. — 74-85. Roots (structure and growth). 86-88. Roots (artificial propagation). 89-97. Roots (functions). 98. Commercial fertilizers. 99, 100. Roots (light and heat effects). 101. Roots (plant foods) 85-108
- XI. STEMS. — 102. Location of growth. 103. Upward growth. 104-106. Stems (effect of light on growth of stems). 107. Stems (parts of a typical stem). 108, 109. Structure. 110-112. Twigs. 113-115. Sap circulation. 116. Sap