

**GRAY'S LESSONS IN
BOTANY. THE ELEMENTS OF
BOTANY FOR BEGINNERS
AND FOR SCHOOLS**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649571031

Gray's Lessons in Botany. The Elements of Botany for Beginners and for Schools by Asa Gray

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

ASA GRAY

**GRAY'S LESSONS IN
BOTANY. THE ELEMENTS OF
BOTANY FOR BEGINNERS
AND FOR SCHOOLS**

GRAY'S LESSONS IN BOTANY

REVISED EDITION

THE

ELEMENTS OF BOTANY

FOR BEGINNERS AND FOR SCHOOLS

BY ASA GRAY

DEPARTMENT OF EDUCATION
LELAND STANFORD JUNIOR UNIVERSITY

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

626080

GRAY'S BOTANICAL SERIES

- Gray's How Plants Grow
Gray's How Plants Behave
Gray's Lessons in Botany
Gray's Field, Forest, and Garden Botany
(Flora only)
Gray's School and Field Book of Botany
(Lessons and Flora)
Gray's Manual of Botany. (Flora only)
Gray's Lessons and Manual of Botany
Gray's Botanical Text-Book
I. Gray's Structural Botany
II. Goodale's Physiological Botany
Coulter's Manual of Botany of the Rocky
Mountains
Gray and Coulter's Text-Book of
Western Botany

Copyright, 1887, by ASA GRAY

REV. LESSONS

W. P. 5

PREFACE.

THIS volume takes the place of the author's *LESSONS IN BOTANY AND VEGETABLE PHYSIOLOGY*, published over a quarter of a century ago. It is constructed on the same lines, and is a kind of new and much revised edition of that successful work. While in some respects more extended, it is also more concise and terse than its predecessor. This should the better fit it for its purpose now that competent teachers are common. They may in many cases develop paragraphs into lectures, and fully illustrate points which are barely, but it is hoped clearly, stated. Indeed, even for those without a teacher, it may be that a condensed is better than a diffuse exposition.

The book is adapted to the higher schools, "How Plants Grow and Behave" being the "Botany for Young People and Common Schools." It is intended to ground beginners in Structural Botany and the principles of vegetable life, mainly as concerns Flowering or Phanerogamous plants, with which botanical instruction should always begin; also to be a companion and interpreter to the *Manuals and Floras* by which the student threads his flowery way to a clear knowledge of the surrounding vegetable creation. Such a book, like a grammar, must needs abound in technical words, which thus arrayed may seem formidable; nevertheless, if rightly apprehended, this treatise should teach that the study of botany is not the learning of names and terms, but the acquisition of knowledge and ideas. No effort should be made to commit technical terms to memory. Any term used in describing a plant or explaining its structure can be looked up when it is wanted, and that should suffice. On the other hand, plans of

structure, types, adaptations, and modifications, once understood, are not readily forgotten; and they give meaning and interest to the technical terms used in explaining them.

In these "Elements" naturally no mention has been made of certain terms and names which recent cryptogamically-minded botanists, with lack of proportion and just perspective, are endeavoring to introduce into phanerogamous botany, and which are not needed nor appropriate, even in more advanced works, for the adequate recognition of the ascertained analogies and homologies.

As this volume will be the grammar and dictionary to more than one or two Manuals, Floras, etc., the particular directions for procedure which were given in the "First Lessons" are now relegated to those works themselves, which in their new editions will provide the requisite explanations. On the other hand, in view of such extended use, the Glossary at the end of this book has been considerably enlarged. It will be found to include not merely the common terms of botanical description but also many which are unusual or obsolete; yet any of them may now and then be encountered. Moreover, no small number of the Latin and Greek words which form the whole or part of the commoner specific names are added to this Glossary, some in an Anglicized, others in their Latin form. This may be helpful to students with small Latin and less Greek, in catching the meaning of a botanical name or term.

The illustrations in this volume are largely increased in number. They are mostly from the hand of Isaac Sprague.

It happens that the title chosen for this book is that of the author's earliest publication, in the year 1836, of which copies are rarely seen; so that no inconvenience is likely to arise from the present use of the name.

ASA GRAY.

CAMBRIDGE, MASSACHUSETTS,
March, 1887.

CONTENTS.

	Page
SECTION I. INTRODUCTORY	9
SECTION II. FLAX AS A PATTERN PLANT	11
Growth from the Seed, Organs of Vegetation	11
Blossoming, Flower, &c.	14
SECTION III. MORPHOLOGY OF SEEDLINGS	15
Germinating Maples	15
Cotyledons thickened, hypogæous in germination	18
Store of Food external to the Embryo	20
Cotyledons as to number	22
Dicotyledonous and Polycotyledonous	22
Monocotyledonous	24
Simple-stemmed Plants	26
SECTION IV. GROWTH FROM BUDS; BRANCHING	27
Buds, situation and kinds	27
Vigorous vegetation from strong Buds	28
Arrangement of Branches	29
Non-developed, Latent, and Accessory Buds	30
Enumeration of kinds of Buds	31
Definite and Indefinite growth; Deliquescent and Excurrent	31
SECTION V. ROOTS	33
Primary and Secondary. Contrast between Stem and Root	34
Fibrous and Fleshy Roots; names of kinds	34
Anomalous Roots. Epiphytic and Parasitic Plants	36
Duration: Annuals, Biennials, Perennials	37
SECTION VI. STEMS	38
Those above Ground: kinds and modifications	39
Subterranean Stems and Branches	42
Rootstock, 42. Tuber, 44. Corm, 45. Bulb and Bulblets	46
Consolidated Vegetation	47
SECTION VII. LEAVES	49
§ 1. LEAVES AS FOLIAGE	49
Parts and Venation	50
Forms as to general outline	52
As to apex and particular outline	58

As to lobing or division	56
Compound, Perfoliate, and Equitant Leaves	57
With no distinction of Petiole and Blade, Phyllodia, &c	61
§ 2. LEAVES OF SPECIAL CONFORMATION AND USE	62
Leaves for storage	62
Leaves as bud-scales, 63, Spines, 64, and for Climbing	64
Pitchers, 64, and Fly-traps	66
§ 3. STIPULES	66
§ 4. THE ARRANGEMENT OF LEAVES	67
Phyllotaxy, 67, of Alternate Leaves	69
Of Opposite and Whorled Leaves	71
Venation or Pinnation	71
SECTION VIII. FLOWERS	72
§ 1. POSITION AND ARRANGEMENT, INFLORESCENCE	73
Raceme, 73, Corymb, Umbel, Spike, Head	74
Spadix, Catkin, or Ament	75
Panicle: Determinate Inflorescence	76
Cyme, Fascicle, Glomerule, Scorpioid or Helicoid Cymes	77
Mixed Inflorescence	78
§ 2. PARTS OR ORGANS OF THE FLOWER	79
Floral Envelopes: Perianth, Calyx, Corolla	79
Essential Organs: Stamen, Pistil	80
Torus or Receptacle	81
§ 3. PLAN OF THE FLOWER	81
When perfect, complete, regular, or symmetrical	81
Numerical Plan and Alternation of Organs	82
Flowers are altered branches	83
§ 4. MODIFICATIONS OF THE TYPE	85
Unisexual or dichlinous	85
Incomplete, Irregular, and Unsymmetrical	86
Flowers with Multiplication of Parts	88
Flowers with Union of Parts: Coalescence	89
Regular Forms, 89, Irregular Forms	90
Papilionaceous, 91, Labiate, 92, and Ligulate Corollas	93
Adnation or Consolidation	94
Position of Flower or of its Parts	96
§ 5. ARRANGEMENT OF PARTS IN THE BUD	97
Ætivation or Preëfforation, its kinds	97
SECTION IX. STAMENS IN PARTICULAR	98
Androecium, 98, Insertion, Relation, &c.	99
Anther and Filament. Pollen	101
SECTION X. PISTILS IN PARTICULAR	104
§ 1. ANGIOSPERMOUS OR ORDINARY GYNERCIUM	105
Parts of a complete Pistil	106
Carrels. Simple Pistil	106

CONTENTS.

vii

Compound Placil with Cells and Axile Placentæ	107
One-celled with Free Central Placentæ	108
One-celled with Parietal Placentæ	108
§ 2. GYMNOSPERMIC GYNÆCIUM	109
SECTION XI. OVULES	110
Their Parts, Insertion, and Kinds	111
SECTION XII. MODIFICATIONS OF THE RECEPTACLE	112
Torus, Stipe, Carpophore, Disk	113
SECTION XIII. FERTILIZATION	114
§ 1. ADAPTATIONS FOR POLLINATION OF THE STIGMA	114
Close and Cross Fertilization, Anemophilous and Entomophilous	115
Dichogamy and Heterogony	116
§ 2. ACTION OF THE POLLEN AND FORMATION OF THE EMBRYO	117
SECTION XIV. THE FRUIT	117
Nature and kinds	118
Berry, Pepo, Pome	119
Drupe and Akene	120
Cremocarp, Caryopsis, Nut	121
Follicle, Legume, Capsule	122
Capsular Dehiscence, Silique and Siliole	123
Pyxis, Strobile or Cone	124
SECTION XV. THE SEED	125
Seed-coats and their appendages	125
The Kernel or Nucleus, Embryo and its parts, Albumen	127
SECTION XVI. VEGETABLE LIFE AND WORK	128
§ 1. ANATOMICAL STRUCTURE AND GROWTH	129
Nature of Growth, Protoplasm	129
Cells and Cell-walls. Cellular Structure or Tissue	130
Strengthening Cells. Wood, Wood-cells, Vessels or Ducts	132
§ 2. CELL-CONTENTS	136
Sap, Chlorophyll, Starch	136
Crystals, Raphides	137
§ 3. ANATOMY OF ROOTS AND STEMS	138
Endogenous and Exogenous Stems	139
Particular structure of the latter	140
Wood, Sapwood and Heart-wood. The living parts of a Tree	141
§ 4. ANATOMY OF LEAVES	142
Epidermis, Stomata or Breathing pores	143
§ 5. PLANT FOOD AND ASSIMILATION	144
§ 6. PLANT WORK AND MOVEMENT	149
Movements in Cells or Cycloids	149
Transference from Cell to Cell	150