

Lessons  
in  
Botany

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THE  
Protection of Woodlands

Authorized translation from the German of Kauschinger-Furst's "Waldschutz." By John Nisbet, D'Ec., of the Indian Forest Service, author of "British Forest Trees, and their Sylvicultural Characteristics and Treatment."

1 vol., 8vo, with colored plates, - \$3.50

The various portions are dealt with tersely, and from a thoroughly practical standpoint. As there is no special work on Sylvicultural Entomology in English, the chapter on noxious Forest Insects has been somewhat amplified.

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EDMUND B. SOUTHWICK, Ph.D., Entomologist of the Parks of New York City, and Secretary of the New York State Forestry Association, says:—

*"To the forester, 'The Protection of Woodlands' is invaluable in that it cares for his possessions in hot and cold, wet and dry conditions; protection against plants and animals, forest offences and forest fires, and, what is of great economic importance, protection against forest insects. Over one-half of this valuable treatise is devoted to insects alone, and no entomologist should be without it. The illustrations are exceedingly valuable, and I cannot too highly recommend it to all naturalists, for the subjects have been handled in a masterly manner."*



# LESSONS

—IN—

# BOTANY

ARRANGED BY

CAROLINE E. <sup>✓</sup>HILLIARD,

OF THE BREARLEY SCHOOL, NEW YORK.



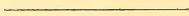
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NEW YORK.

## INTRODUCTION

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THE following exercises have been arranged for use in connection with Gray's "How Plants Grow." So far as is possible the lessons are based upon careful study of specimens. Blank pages are inserted for drawings and records of observations.

The work is designed for children twelve and thirteen years of age, but it can easily be adapted to older pupils.

The first four lessons are spent in the study of typical forms of seeds and seedlings. In Lesson III space is left for further work if desired. If the lessons are begun in the spring, leaves and their modifications are reached in May and form good subjects for summer work. Lesson XIII suggests several topics for reading and simple experiments.

In the autumn and winter months, material is easily obtained for the study of buds and branches, flowers and fruits. Simple descriptions of plants are begun with the early bulbous plants. Lesson XXV is intended for a summary of terms made by the pupil, to which may be added any technical terms needed for identification of our common flowers.

Newell's "Botany Readers" furnish valuable supplementary reading throughout the course. The "Outlines of Lessons in Botany," by the same author, are very helpful to the teacher.

In the arrangement of topics and choice of subject matter an earnest attempt has been made to work out a practical course in Botany under the ordinary limitations of science work in a city private school whose sessions are held chiefly during the winter months.

Thanks are due to Miss Howell of Barnard College for her criticisms and suggestions, and also to Mrs. Jane Newell Moore for the careful directions for experimental work contained in her books.

THE BREARLEY SCHOOL.

*February, 1896.*



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    TWENTY-FIVE FORMS FOR PLANT DESCRIPTION.

**LESSON I.—Study of the Seed and Seedlings of the Squash.**

Describe the shape, surface and color of the seed. Open a seed that has been soaked in water over night and find the seed-coats. Separate the seed into halves and sketch, showing the tiny connecting stem and the little leaf-bud. Compare these parts with a squash seed which has just begun to grow and with another which has been growing some time. What changes do you notice in the halves of the seed? Mark these the seed-leaves or cotyledons. The little bud is called the plumule and the connecting stem the caulicle. What happens to the cotyledons as the plant goes on growing? Can you give a reason for this?



**LESSON II.—The Bean.**

Describe the shape, color and surface of the bean. Sketch, showing the little scar where the bean was attached to the pod. Open the seed which you have soaked and sketch the little plant. How many seed-coats has the bean? Study the plant in different stages of growth and make drawings, marking the cotyledons, plumule and caulicle. What happens to the cotyledons as the plant grows? How do the leaves following the cotyledons differ from them and from one another in form and arrangement on the stem?





**LESSON III.—The Pea.**

Describe the seed. Name its parts. In what ways is it like the bean? Sketch at different stages of growth and mark the parts of the plant. In what ways is it unlike the bean and squash in its growth?



**LESSON IV.—The Corn.**

Describe the seed. Make sketches of both sides of the kernel. Compare with a seed that has sprouted and mark the parts of the embryo. How many cotyledons has the corn? How is the food arranged in the seed? What is the shape of the leaves? What is their veining? How do they differ from those of the bean, the pea and the squash? Which part grows first in all these seeds? From which part do the roots grow?



**LESSON V.—Arrangement of Food in the Seed.**

Where is the food stored for the first growth of the seedlings you have studied? Examine a seed of the four-o'clock. How many seed-coats do you find? Where is the albumen placed? Separate the embryo and sketch, marking the parts. Where is the albumen stored in the almond, walnut, flax, acorn, apple and castor-oil bean? Make a list of the seeds we use for food and try to find out whether the albumen is stored within or around the embryo. How does the arrangement of the albumen influence the growth of the cotyledons?



**LESSON VI.—Roots.**

Draw and describe the roots of the onion, turnip, carrot, radish and beet. Why do plants which live only one year have fibrous roots? Why do plants which live two years have fleshy roots? What changes take place in these roots during the second year? What differences have you found between the stem and the roots? Examine a potato which has sprouted. Is it a root or a stem? Give a reason for your answer. Can you name any plants which bear roots on their stems in the open air?





## LESSON VII.—Leaves.

Description of Simple Netted-veined Leaves. Pinnately-Veined.

*Name of leaf.*

Arrangement on the stem.

Blade.	}	Shape.
		Apex.
		Base.
		Margin.
		Surface.

Petiole.

Stipules.

REMARKS :



**LESSON VIII.**

Simple Netted-veined Leaves. Palmately-Veined.

*Name of leaf.*

Arrangement on the stem.

Blade.	{	Shape.
		Apex.
		Base.
		Margin.
		Surface.

Petiole.

Stipules.

REMARKS :



**LESSON IX.**

## Pinnately-Compound Leaves.

*Name of leaf.*

Arrangement on the stem.

Blade. }	{	Shape of leaflets.
		Apex.
		Base.
		Margin.
		Surface.

Petiole.

Stipules.

REMARKS :



**LESSON X.**

## Palmately-Compound Leaves.

*Name of leaf.*

Arrangement on the stem.

Blade.	{	Shape of leaflets.
		Apex.
		Base.
		Margin.
		Surface.

Petiole.

Stipules.

REMARKS:





**LESSON XI.**

## Parallel-veined Leaves.

*Name of leaf.*

Arrangement on the stem.

Blade.	{	Shape.
		Base.
		Apex.
		Margin.
		Surface.

Petiole.

Stipules.

REMARKS :



## LESSON XII.

## Parallel-veined Leaves.

*Name of leaf.*

Arrangement on the stem.

Blade.	}	Shape.
		Apex.
		Base.
		Margin.
		Surface.

Petiole.

Stipules.

REMARKS :



**LESSON XIII.—Leaves.***Peculiar forms of leaves.*

Without distinction of blade and petiole.

Needle-shaped, as in the pines and spruces.

Thread-shaped, as in the onion.

Equitant, as in the iris.

With shape or surface adapted to catching insects, as in the pitcher-plant and sundew.

*Movements of leaves in*

Climbing, as the nasturtium.

Turning toward the light.

Change of position at night.



**LESSON XIV.—Buds and Branches.****THE HORSE-CHESTNUT.**

Describe the color, shape and surface of the buds. Open a bud, noticing the form and arrangement of the scales. Are the scales alike in color and thickness? Can you explain any difference? What do you find within the scales? Examine the largest buds for flower-clusters. Where are they placed? In how many ways are the leaves and flower-clusters protected? How are the buds arranged on the stem? Where were the terminal buds of last year? What scars did they leave? How many inches has your branch grown this summer? Find the age of the whole branch and of each twig. What scars were made by the leaves? Is there any correspondence between the dots on the leaf-scars and the number of leaflets? What causes this? What do the leaf-scars show about the leaf-arrangement? Look for the round, flower-cluster scar at the forking of two branches. Why did blossoming affect the growth of the branch?





**LESSON XV.—The Beech.**

How do the leaf-buds differ from those of the horse-chestnut in shape, color and surface? How are the leaves arranged in the buds? What protection have they? What scars are made by the leaves? How were the leaves arranged on the stem? How old is your branch? Which were the best years for growth? How does the spray of the beech differ from that of the horse chestnut? What causes this difference? Try to find out where the flower-clusters grew. What kind of a flower has the beech? What fruit?



**LESSON XVI.—The Lilac.**

Describe the leaf-buds as to shape, color and position. Draw and describe a leaf. What scars are left by the leaves? How does the branching of the lilac differ from that of the beech and horse-chestnut? What causes this difference? How old is your branch?



**LESSON XVII.—The Norway Spruce.**

What causes the roughness of the stem? How are the leaves arranged? What is their shape? Why are there so many leaves? How old is your branch? What fruit has the Norway Spruce?



**LESSON XVIII.—The Structure of Stems.**

Sketch a cross-section of a horse chestnut branch showing the pith, the surrounding rings of wood, the sap-wood and the layers of bark. How do the rings show the age of the branch? Examine a cross-section of a large branch and count the rings. Are they of the same width in all parts? Can you account for any difference? Why is the outer bark of an old tree full of ridges and cracks? Why does the birch bark peel off? Name two plants of which we use the woody fibres of the inner bark. How is cork obtained?

Sketch a cross-section of a cornstalk, marking the hard rind, the pith and the bundles of woody fibres. How does the arrangement of the pith and wood differ from that of the horse chestnut? How do these plants differ in the veining of the leaves and in their manner of branching?





**LESSON XIX.—Modifications of Stems for Storehouses of Food.**

Examine a hyacinth bulb and sketch. Cut the bulb in halves vertically, and make a drawing of the inside, naming the parts. In what ways is the bulb like the horse chestnut leaf-buds?

Sketch the root-stock of Solomon's-Seal. What evidences are there that it is a thickened stem?

Make a drawing of the potato, marking the leaf-buds. In what ways are the hyacinth bulb, the Solomon's-Seal and the potato alike? What important differences do you see?



**LESSON XX.--The Flower.**

Name the parts of the flower. Name the parts of each part. Define the receptacle. What is the purpose of the flower? Which parts are necessary? What is meant by Fertilization? By Cross-Fertilization? Name some ways by which this is accomplished. Why is Cross-Fertilization best for the plant? What is the important part of the seed? Name some dangers which threaten the embryo. How is the embryo protected in the bean, chestnut, apple, squash, cherry and cocoanut.



**LESSON XXI.—The Fruit.**

What parts of the flower usually disappear as the fruit is formed? What part remains on the apple? On the pear? In the raspberry? In the strawberry? Name some fruits which are colored to attract animals and thus scatter the seeds. Name some fruits which are protected from animals by their hard covering, by their color, prickles or by their disagreeable taste. Can you explain by differences in the seeds why some fruits are planned to attract animals and others are guarded against the attacks of animals?



## LESSON XXII.—Classification of Fruits.

- |  |   |   |    |   |    |  |
|--|---|---|----|---|----|--|
| I.<br>Dry<br>Fruits.   | Dehiscent Fruits. These open to discharge their seeds, and are called pods.                                       |   |    |   |    |  |
|  | Indehiscent Fruits remain closed.   | <table border="0"> <tr> <td data-bbox="435 297 452 407">1.</td> <td data-bbox="452 297 1081 407">AKENE—a small fruit with a single seed, which is formed by the ripening of the pistil. Examples—dandelion, maple.</td> </tr> <tr> <td data-bbox="435 407 452 501">2.</td> <td data-bbox="452 407 1081 501">NUT—a fruit usually with a single seed protected by a hard shell.</td> </tr> </table> | 1. | AKENE—a small fruit with a single seed, which is formed by the ripening of the pistil. Examples—dandelion, maple. | 2. | NUT—a fruit usually with a single seed protected by a hard shell.                        |
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| 2.   | NUT—a fruit usually with a single seed protected by a hard shell.   |   |    |   |    |  |
| II.<br>Fleshy<br>Fruits.   | 1. Simple Fruits formed by the ripening of one pistil.  | <table border="0"> <tr> <td data-bbox="435 517 452 595">1.</td> <td data-bbox="452 517 1081 595">BERRY—the wall of the ovary is fleshy throughout. Orange, grape, tomato.</td> </tr> <tr> <td data-bbox="435 595 452 674">2.</td> <td data-bbox="452 595 1081 674">STONE-FRUIT—the outer wall of the ovary is fleshy, the inner wall hardened. Peach, plum.</td> </tr> </table>                   | 1. | BERRY—the wall of the ovary is fleshy throughout. Orange, grape, tomato.  | 2. | STONE-FRUIT—the outer wall of the ovary is fleshy, the inner wall hardened. Peach, plum. |
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|  | 2.  | STONE-FRUIT—the outer wall of the ovary is fleshy, the inner wall hardened. Peach, plum.  |    |   |    |  |
|  | 2. Aggregate Fruits are clusters of simple fruits all of the same flower. Raspberry, blackberry.                  |   |    |   |    |  |
| 3. Accessory Fruits—the fleshy portion belongs to some added or altered part, outside of the ovary. In the pome, or apple-fruit, the fleshy part is the thickened calyx with the receptacle developed around the core in some cases.   |   |   |    |   |    |  |
| 4. Multiple Fruits are formed by the ripening of two or more flowers into a single fruit. The Partridge-Berry is formed by the ovaries of two flowers growing together into one berry. Pineapples and Mulberries are formed from clusters of flowers. Figs are hollow receptacles grown pulpy and lined with many small flowers. |   |   |    |   |    |  |





**LESSON XXIII.—Study of Fruits.**

Sketch the pods of the pea, the lily and the pansy, showing the differences in their manner of opening.

Sketch a cranberry in cross-section. How many carpels has it? Are there any traces of parts of the flower?

Make drawings of the apple and quince in vertical and cross-sections, showing why these are Accessory Fruits.

Make careful drawings of the outside of the Rose-hip and of a vertical section. Mark the parts of the fruit.

Classify the following fruits: 1. Pea. 2. Cucumber. 3. Orange. 4. Grape. 5. Tomato. 6. Currant. 7. Cranberry. 8. Banana. 9. Apple. 10. Pear. 11. Plum. 12. Cherry. 13. Wheat. 14. Walnut. 15. Lily. 16. Pansy. 17. Strawberry, 18. Raspberry. 19. Blackberry. 20. Cone. 21. Squash. 22. Lemon. 23. Melon. 24. Date. 25. Quince.



**LESSON XXIV.—Inflorescence.**

The simplest form of inflorescence, or manner of blossoming, is that in which the flowers occur singly in the axils of the leaves or at the ends of the stem. These are called solitary flowers.

If the blossoms are more numerous and are brought more closely together a flower-cluster is formed. In this arrangement each flower grows from the axil of a leaf, but the leaves are usually very small and inconspicuous. The leaves of a flower-cluster are called Bracts. The stalk of the cluster is called the Peduncle, and the stems of the individual flowers are Pedicels.

The most common forms of flower-clusters are the Raceme, the Spike, the Head, the Umbel and the Corymb. The Raceme is a cluster with the flowers arranged on the sides of the stem, as in the Lily-of-the-Valley. If the flowers grow on the stem without pedicels the cluster is called a Spike, which we see in the Mullein.

The Head is a rounded flower-cluster with a very short body, as the Red Clover and Dandelion. An Umbel is a flat-topped cluster in which all the pedicels start from the same point, like the sticks of an umbrella. The Meadow-Parsnip and the Carrot blossom in Umbels.

The Corymb is a flat-topped cluster which is like the Raceme with the lower, pedicels lengthened so that all the flowers are brought on a level, as in the Hawthorn. In what ways do flower-clusters assist cross-fertilization?



**LESSON XXV.—Common Terms used in Plant Description.**

Plant—

Root—

Stem—

Leaves—

Blade—

Petiole—

Stipules—

Inflorescence—

Perianth—

Corolla—

Calyx—

Stamens—

Pistil—

Ovary—

Fruit—

Seeds—

REMARKS :—Any interesting peculiarities of the plant or adaptations to cross-fertilization.

Drawings—The plant as a whole, if possible. Vertical and cross-sections of the flower showing the connection of the parts. Enlarged stamen and pistil. Cross-section of the ovary.



## FORM FOR PLANT DESCRIPTION.

*Number of Plant*

*Date*

Family or Order.

Name. { Common.  
          { Scientific.

Locality.

Plant.

Root.

Stem.

Leaves.

Blade.

Petiole.

Stipules.

Inflorescence.

Perianth.

Flower.

Corolla.

Calyx.

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REMARKS :





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Fruit.

Seeds.

REMARKS :





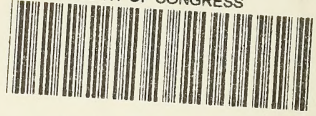








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