

supervision, and has been almost entirely carried out by Mr. Miles Fuller and myself."

From the foregoing statements, we conclude that grasses of the better grazing districts, when grown in a dry season, make the best feed, but usually less in quantity. Grasses grown in sunny weather are better than those grown in cloudy weather or in the shade. Woodland pastures are proverbially lacking in "heart" or nourishment. Grasses grown on marshes or wet land are not so nutritious as those grown on dry land. Grasses grown on rich loam or clay, in fine condition, are more nutritious than those grown on poor, thin soil.

Further statements in regard to the chemistry of plant growth will be found in the chapter on red clover.

---

## CHAPTER IV.

### CLASSIFYING, NAMING, DESCRIBING, COLLECTING, STUDYING.

**Plant Affinity.**—In the plant kingdom there are certain genera so closely related to each other that the botanist calls them *families* or *natural orders*. The plants of a family resemble each other in many respects.

"That which really determines affinity is correspondence in structure. It may be said that those plants are most nearly related which correspond in the greatest number of points, and those the most distantly in which we find the fewest points of correspondence. The organs of vegetation are of very different degrees of value in determining resemblance of structure. All constant characters of whatever nature, require to be taken into account in classifying plants according to their natural affinities. Whatever points of structure are variable in the same species, or in species nearly allied to each other, are unessential and should

be set aside, or be regarded as of comparative unimportance." (Lindley's Vegetable Kingdom.)

Those who have given little attention to the subject are liable to make mistakes in judging of natural affinity, because they draw conclusions from unimportant circumstances, the chief of which are size, form, color, and minute details.

An artificial classification is founded on some one or a few characters, disregarding all others. For example, it would place all trees by themselves in one group, all shrubs in another; all those which had five stamens together, in distinction from those which had any other number of stamens, while a natural classification aims to consider all structural features while young as well as when mature, placing plants together which resemble each other in numerous particulars, and show real relationship.

**Families of Greatest Worth.**—All the flowering plants growing in the United States are included in about one hundred and seventy families. In this portion of country, most of the plants which are cultivated to supply man and his domestic animals with food are included within sixteen of these families.

*The Cruciferæ* (Mustard Family), includes peppergrass, water cress, horse-radish, mustard, sea kale, turnip, ruta-baga, cabbage, kale, broccoli, brussels sprouts, cauliflower, coleworts, kohlrabi.

*The Rutaceæ* (Orangeworts), includes the orange, the lime, the lemon, the shaddock.

*The Vitaceæ* (Grape Family), gives one species of grape to Europe and eleven to North America, besides the beautiful Virginia creeper.

*The Leguminosæ* (Pulse family), is second in size to the *Compositæ* and is one of great value. It includes peas, beans, and the clovers, and is noticed in the appendix, which treats of the clovers.

*The Rosaceæ* (Rose Family), is not a very large one, but is of

much importance on account of the great value of many plants which it contains. Here belong the *pomes*, such as apples, pears, quinces, medlars, service berries; and here are the *drupes*, such as peaches, almonds, apricots, nectarines, plums, prunes, and cherries. Here are found strawberries, red raspberries and black raspberries, and blackberries. This may well be called the "fruit" family. There are also many choice flowers, including the rose, potentilla, spiræa, hawthorn, and Japanese quince.

*The Saxifragaceæ* (Saxifrage Family) affords currants and gooseberries, mock orange, deutzia, hydrangea, and saxifrage.

*The Cucurbitaceæ* (Gourd Family) contains squashes, pumpkins, melons, musk melons, gourds, and cucumbers.

*The Umbelliferæ* (Parsley Family) includes the carrot, chervil, celery, turnip-rooted celery, parsley, parsnip, caraway, coriander, fennel, lovage, and sweet cicely.

*The Compositæ* (Sunflower or Aster Family) is the largest family of flowering plants, and contains about one-eighth of all those in the United States. It affords a large number of weeds, such as thistles, ox-eye daisy, rag-weed, May-weed, yarrow, fire-weed, dandelion, burdock, cocklebur, flea-bane, and many more. It contains a large number which are valuable for ornament, as asters, zinnias, dahlias, feverfews, cinerarias, chrysanthemums, and sunflowers. Considering the enormous size of the family, about 10,000 species, we should expect something profitable in the line of field and garden products. The best it can do is to furnish lettuce, two kinds of artichokes, dandelion, salsify, chicory, endive, and sunflower. There is not a fruit nor a valuable vegetable, properly so-called, nor a good forage plant, so far as we know, in the entire list.

*The Ericaceæ* (Heath Family) is one of much interest to the florist. It includes the cranberry, blueberry, huckleberry, rhododendron, azalea, laurel, heath, and trailing arbutus, or May-flower.

*The Convolvulaceæ* (Convolvulus Family) affords the sweet potato, morning glory, and cypress vine.

*The Solanaceæ* (Night-shade Family) furnishes the potato, tomato, egg-plant, pepper, ground-cherry, tobacco, belladonna, bittersweet, petunia.

*The Chenopodiaceæ* (Goosefoot Family) affords the beet, spinach, orache, Swiss chard, and several weeds.

*The Polygonaceæ* (Buckwheat Family) contains buckwheat, rhubarb, knot-grass, sorrel, several docks, and swartweed.

*The Scitamineæ* (Gingerworts) includes the cinnamons, gingers, bananas, and arrow-roots.

*The Liliaceæ* (Lily Family) gives us the lily, hyacinth, tulip, asparagus, chives, garlic, leek, onion, shallots.

There are several other families which contribute more or less to the crops of the field, orchard and garden.

*The Gramineæ* (Grass Family) is by far the most important of any, and is noticed on the succeeding page.

For making clothing, there are two families of much value, viz:

*The Malvaceæ* (Mallow Family) containing okra, mallow, hollyhock, hibiscus, abutilon, and the cotton plant, and

*The Linaceæ* (Flax Family) including the flax, valuable for its fiber as well as the seeds which furnish linseed oil.

*The Labiatæ* (Mint Family) is quite remarkable for aromatic herbs, and contains basil, balm, sweet marjoram, pennyroyal, lavender, spearmint, peppermint, horehound, hyssop, thyme, summer savory, rosemary, bergamot, cat-mint, motherwort and sage.

*Our leading trees* belong to about twelve families, including the tulip-tree and magnolias, the basswood, the holly, the maples, the catalpas, the ashes, the elms, the buttonwood, the walnuts, and hickories, the oaks, chestnuts, beech, the birches, and alders, the willows, and poplars, and last, but by no means the least,

the cone-bearing trees. The latter contains the cedars, cypresses, sequoias, balsams, firs, spruces, larches, and pines.

**Gramineæ (The Grass Family).**—Tufted annuals or perennials, usually herbaceous and evergreen; with fibrous roots, often stoloniferous or with a creeping rhizoma. *Stem* (culm) endogenous, simple or branched, cylindric, rarely compressed, usually hollow, and closed at the joints, sometimes solid, especially when young; the nodes solid, mostly swollen. *Leaves* parallel veined, rarely net veined, narrow, undivided, alternate, rarely two or more at a node, distichous; *petiole* dilated, usually convolute, sheathing the culm, margins free or often united, especially in the lower leaves; *ligule* adnate to the sheath at the base of the blade, scarious, sometimes only a cartilaginous ring or a fringe of hairs. *Inflorescence*, spicate, capitate, racemose or paniculate.

The *Spikelets* consist of two, three or more, distichous, chaff-like concave scales or bracts (*glumes*), their concave faces towards the axis (*rhachilla*), the 2, or sometimes 1, or rarely 3 or more lower ones, and sometimes 1 or more upper ones empty, the other one or more with one sessile flower in the axil of each.

*Floral glume* terete or laterally compressed, enclosing a 1-2-sexual flower, and a flat, often 2-nerved scale (*palea*) with inflexed edges. *Perianth* of 2 (rarely 0 or 3 or more) minute scales (*lodicules*), placed opposite the palea. *Stamens* (*androcium*) usually 3, sometimes 1, 2, 4, 6 or more, even to 30, one of which alternates with two lodicules, filaments very slender, anthers versatile, 2-celled, linear, pendulous; pollen mostly yellowish-white, sometimes purple or red. In rare cases the stamens are monadelphous, as in *Streptochaeta*. *Ovary* simple, free, sessile, sometimes stipitate, 1-ovuled; *styles* 2, rarely 3, free or more or less united; with hairy or feathery stigmas; ovule anatropous.

*Fruit* (*caryopsis*), erect, free or often adherent to the palea, and sometimes to the floral glume.

*Seed* usually adnate to the pericarp (free in *Sporobolus*) testa membranous, *endosperm* farinaceous, or somewhat horny. *Embryo* at the inner side of the endosperm at its base; *cotyledon* scutellate; *plumule* well developed; *radicle* thick, obtuse, endorhizal (with a sheath).

The embryo contains one, (often three as in wheat) or more rudimentary roots.

The peculiarities of the styles, stigmas, lodicules, and the caryopsis are of great value for describing grasses, but on account of their small size and the difficulty of always finding grasses in flower, they have not been much employed for that purpose.

It is not botanically correct to call any plants *grasses* unless they belong to this family (*Gramineæ*). There are many widely different plants which in popular language have the name "grass" attached to them, such as knot-grass, rib-grass, cotton-grass, sea-grass, eel-grass, sedge-grass, the clovers, and others, but these do not belong to the family here under consideration.

The plants most likely to be mistaken for grasses are the *Cyperaceæ* (sedges), of which there are two thousand species or more. They are abundant on wet land, and often constitute a large part of what is known as bog or marsh hay. Sedges have three ranked leaves, or leaves spreading in three directions.

The *Gramineæ* (grass family) contains Indian corn, wheat, oats, barley, rye, rice, doura, sorghum, broom-corn, sugar-cane, millet, Hungarian grass, bamboo, Timothy, red top, June grass, fowl meadow grass, blue joint, buffalo grass, orchard grass, meadow fox tail, the fescues, rye-grass, oat-grass, sweet vernal, Bermuda grass, and many more which contribute to the food of domestic animals.

The grass family heads the list of food producing plants, which are the foundation of all agriculture. The cereals, such as sorghum, rice, doura, maize, wheat, rye, oats, barley, furnish a large part of the food of the human race, while the meadow and

pasture grasses, together with the cereals, largely feed our domestic animals.

Along the low lands of India and some other tropical countries, many millions of people subsist mainly on rice, while further back on the higher lands, a much larger number feed on several varieties and species of sorghum. Sorghum feeds the most people of any cereal, while wheat outranks them for making the best quality of food.

To assist in comprehending their great importance, let us glance at the figures as they appear in the last census of the United States:

	Bushels.	Value.
Corn.....	1,750,000,000	\$822,000,000
Wheat.....	512,000,000	500,000,000
Oats.....	407,000,000	130,000,000
Barley.....	43,000,000	29,000,000
Rye.....	19,000,000	11,000,000
Total.....	2,731,000,000	\$1,402,000,000

To these figures must be added, as belonging to the grass family:

	Amount.	Value.
Hay, tons.....	35,000,000	\$300,000,000
Rice, pounds.....	110,000,000	4,400,000
Sugar, hds.....	179,000	9,000,000
Molasses, gallons.....	14,000,000	4,200,000
Total.....		\$317,600,000
Add the cereals.....		1,402,000,000
Grand total (roundly).....		\$1,800,000,000

To these figures we might add the immense products of grazing, including meats, horses, cattle, swine, hides, wool. Live stock alone foots up \$1,500,000,000. The estimate for hay most likely includes the clovers.

Of the staple crops of the United States, the grass family contains about five-sixths of the total value.

The cereals and the pasture grasses the world over, are of more value to man and his domestic animals than all other plants taken together! Vastly more than half of the value to man of all vegetation belongs to one family, the grasses. "Grass is king. It rules and governs the world. It is the very foundation of all commerce, without it the earth would be a barren waste, and cotton, gold, and commerce all dead."—(Solon Robinson.)

Grasses are remarkably and evenly distributed in nearly all parts of the habitable globe, in every soil, in society with others and alone; under the equator or in Greenland, wherever moisture and sufficient heat favors the earth, there grasses are a leading feature of the flora.

In the whole world the family ranks fifth in size; the *Compositæ* ranking first, the *Leguminosæ* second, the *Orchidaceæ* third, the *Rubiaceæ* fourth, the *Gramineæ* fifth. This does not convey an adequate idea of the value or number of grasses in unwooded regions, because the number of individuals of many of them is exceedingly large. Doubtless there are more individual plants in the grass family than are found in all of the others named above.

In the words of Dr. Bessey, of Nebraska:

"When we come to the inquiry as to what proportion of plants of a given area are grasses, we find the number varying very much from those just given. For example, in forest regions the actual number of grass plants is much lower than it is in the same region after the forests have been partially cut off; and if again we compare the latter with the prairies we observe a still greater increase. There are many great tracts in Nebraska, miles and miles in extent, over whose whole surface the grasses constitute fully nine-tenths of the actual vegetation."



“Of the individual plants on the great prairies of the Northwest, 90, yes, 99 per cent are grasses!”—(Scribner).

There are about 300 genera and 3,100 to 3,200 species. They are the most abundant in the temperate zones, where they often clothe large tracts with a growth which is fine, soft, and thick. Here the *Poaceæ* predominate. In the tropics the *Panicææ* are prominent; many of which are more isolated, growing singly in tufts or small groups. In the temperate zones grasses are slender, and seldom more than a few feet in height; in the tropics they become giant bamboos, 60 or even 170 feet high, and eight or ten inches in diameter, approaching a tree in size.

In the United States, east of the Mississippi, the grasses constitute about one-twelfth of all the species of flowering plants. A State like Michigan, Illinois, or Massachusetts, has been found to contain not far from 130 species of grass. It is not uncommon in the northern States to find 60 species within a distance of a few miles of each other.

Although very few grasses possess brilliant or aromatic flowers, and look so humble and so much alike, there are few plants which are more beautiful in “all stages of growth, whether examined one by one or in masses; with the naked eye or with the microscope.”—(American Agriculturist, 97, 1852.)

Who has not admired a gently rolling field as the wind swept over the even tops of thick grain? What view surpasses a field of waving grass, or a closely shaven lawn? Grass is “a thing of beauty and a joy forever.” It even beautifies the grave, spreading a green carpet over the remains of friends gone before.

“Here I come creeping, creeping everywhere;

By the rusty roadside,

On the sunny hillside,

Close by the noisy brook,

In every shady nook,

I come creeping, creeping everywhere.”—(Sarah Roberts.)

In very early spring, some of the grasses begin to put forth their green leaves, which are soon succeeded by the culms, which carry the flowers. In the northern States *Poa annua* is the first to unfold its spikelets, and spread its flowers, which are soon followed by *Oryzopsis*, *Poa sylvestris*, sweet vernal and meadow foxtail. In central Michigan, these and perhaps a few more, blossom in May, while June is as profuse of grasses as it is of roses. Quite a number flower in July, and some delay till August and September. The annuals are usually late in flowering, though some of the perennials are very late; for instance the *Muhlenbergias*, *Andropogons* and *Chrysopogon nutans*.

**The Name of a Plant** consists of two words, first the *generic* second the *specific*. These must have the Latin form. The generic name is substantive and singular, and very nearly answers to the surname of a person; the specific name is most generally an adjective (rarely a noun), and agrees with the noun in *gender* and *number*. The specific name is followed by a name or the abbreviation of the name of the person who applied that name to the plant under consideration.

Latin names are often objected to by persons who cannot see why the common English names will not answer every purpose. But suppose the Germans and the French should say the same thing of the plants they described? German and French names are not so easy for us as those in the Latin form. Those in Latin are often short and easy, and have been adopted as the common names, such as *Dahlia*, *Crocus*, *Ixia*, *Orchis*, and *Iris*. There is certainly an objection to using such names as *Kraschenninikovia*, *Andrzejofskya*, and *Pleuroschismatypus*, names which have actually been thrust onto plants.

In the use of common names, many take the liberty of making their own name, and then the same name is applied to more than one plant.

A certain well known tree in some parts of the United States

is called "White-wood," in others, "Tulip-tree," in others, "White Poplar," in others, "Yellow Poplar." *Acer rubrum* is known by several names in various States, as "Red Maple," "Soft Maple," and "Swamp Maple." *Poa pratensis* goes by the name of "Blue grass" in Kentucky; in other places it is called "Kentucky blue grass," "green grass," "green meadow grass," "June grass," "spear grass," and very likely several other names. One species is known as "Timothy," "Herd's grass," "Cat's tail;" another is known in different places as "red-top," "herd's-grass," "Burden's grass," "red bent," "summer dew grass," "small red-top," "fine red-top," "fowl-meadow grass." Other illustrations appear in connection with the consideration of the species most cultivated. It is quite necessary, for accuracy, that only one name be used for each kind of plant.

**Collecting and Preserving Grasses.**—No person can make satisfactory progress in this study without frequent reference to species with which he has formerly met. For this purpose specimens can easily be pressed, poisoned, dried, labelled, classified, and arranged in order, convenient for future reference. A very simple, and in some respects quite desirable method, is to preserve the grasses in the form of dried bunches. In this way they become brittle, and cannot well be handled without damage, but they preserve their appearance, better than those which are submitted to pressure between folds of paper. Even though these dried bunches may not be kept very long, their use is to be recommended.

If it is within the means of the student, he will find it of great advantage to transplant bunches or grow seed in his garden. In this way he can often see the several kinds and study their peculiarities at every stage of growth.

On account of scattering seeds which produce young plants that cannot be identified till they have become well established,

the writer has found it best to separate kindred species by some others which are quite different. It is very natural and seems quite desirable to the systematic worker to want his Poas all in adjoining plats, and his Fescues in other adjoining plats, but if he can succeed in keeping them separate when thus planted, he will do better than the writer has ever been able to do with his twelve or more years of experience. Another word of advice: plant the seeds in rows, never broadcast, as this will much facilitate weeding when the plants are yet small. No agrostologist will be satisfied to study mere dried specimens, as they will not reveal many points to best advantage, but for permanent use at all seasons of the year, the mode adopted in the herbarium will be the best for preserving grasses. To save time in arranging thoughts for the following account in reference to preserving grasses, the writer has taken hints from an article of L. H. Hoysradt in the bulletin of the Torrey Botanical Club for 1878.

Have a tin vase made of oval cylindrical shape, 17 inches long, four by six inches wide. It is provided with a light strap to throw over the shoulder, and so attached to the box near the front narrow side so as to have the lid open from the person when hung on the shoulder. The lid opens nearly the whole length of one of the flat sides,—15 by  $4\frac{1}{2}$  inches, with  $\frac{1}{4}$  inch lap,—made to fit as tight as possible, and fastens with a simple spring catch.

Procure some thin, unsized paper, without printing on it, in the form of folded sheets, about 11 by 17 inches. A poor quality of printing paper is suitable. The driers are half sheets 12 by 18 inches and are thick and free from sizing. The specimens are left in the thin sheets through all changes of driers, till they are thoroughly dried. Change the driers every 12 hours or oftener at first, and submit them to fire heat or direct sunlight. Press the pile with a weight of fifty to seventy pounds. Several pieces of thin board 12 by 18 inches will be needed.

Always preserve some of the roots, lower leaves and rhizomas,

if there are any, as a part of a specimen. Some part of the plant should be in flower. If too long to preserve in its natural form, double the culm in a zigzag manner, so that it shall not be too large. Bite the angles with the teeth to make them submissive. The stem of June grass, or a small thread, or the angle pressed through slits in pieces of paper, are convenient to keep the grass from spreading till it is dried. Short pieces of fine annealed wire are still better.

It is of first importance as grasses are collected and placed in the portfolio or press, to be particular to write on a label the name of each species if known, but by all means, the locality and date of collection.

Instead of changing the driers, plants can be well dried by binding them in a portfolio with sides of wire-netting.

A plant is well dried when it rattles, will not stay bent, or does not feel cool when applied to the cheek.

For safe and long keeping the grasses must be poisoned. Use 95 per cent. alcohol nearly saturated with corrosive sublimate, and apply with a flat brush, and place the specimens again in driers for half a day or more. Common white arsenic in alcohol is just as good and perhaps better.

Procure some white paper  $11\frac{3}{4}$  by  $16\frac{1}{2}$  inches, which is thick enough to stand on edge without doubling up. On this paper fasten a specimen of one species only, by pasting over it several narrow strips of gummed paper. Many prefer to fasten the plants to the paper with a fine quality of glue. Fasten the specimen directly above the label which is stuck fast to the bottom of the sheet. Specimens of the same species from different localities may be placed on the same sheet, each over its own label. The label contains the generic and specific name, perhaps the common name also, the locality, date of collecting, and name of collector. There are as many styles of labels as there are persons who preserve plants.

The sheets of all the species of the same genus, when not too numerous, or of a section of it, should be placed in a *genus-cover* which consists of a folded sheet of firm manilla paper, 12 by 17 inches. The generic name should appear on the cover at the lower left hand corner after it is folded, with the folded portion to the left.

The sheets are placed on the sides in pigeon holes, arranged in the order as treated or described in our standard books. Begin with the first genus at the upper left hand pigeon hole and go downward to the bottom of the case, then begin at the top of the next column of pigeon holes.

When a sheet of the herbarium is wanted for study, open the door, find the name on the genus-cover and draw out for a few inches the one needed with all above it in the same hole, then remove the genus cover needed, leaving those above in the position described, to show at a glance just where to replace the specimens.

*Grasses found in certain Localities.*—The following grouping of the grasses is founded on their habits and localities, and will hardly rank as a classification. It is essentially the one proposed in a prize essay by Prof. James Buckman.—(Jour. Royal Agrl. Soc. 1854.)

1. *Jungle or Bush Grasses* are those which generally grow isolated, in bunches or a few plants here and there. The bamboos are examples for the tropics. In the northern countries many of the smaller grasses have a similar disposition of growing in tufts; of this kind we have *Deschampsia (Aira) cæspitosa*, L. (hair grass), *Avena pratensis* (Narrow-leaved Oat-grass). *Festuca elatior*, L. (Taller Fescue).

A few others, if sown alone and not very thick, not closely fed or rolled, will assume the same habit. Of such we have *Festuca ovina*, L. (Sheep's Fescue), *Festuca duriuscula*, L. (Hard Fescue), *Dactylis glomerata*, L. (Cocksfoot or orchard grass.)

2. *The Aquatic or Water Grasses* are those which elect to grow by the margins of rivers, in brooks or ditches, or around the edges of ponds. With few exceptions they are of little value agriculturally. Their presence is a sure indication of lack of drainage. The following are examples: *Phalaris arundinacea*, L. (Reed Canary-Grass), *Phragmites communis*, Trin. (Reed-Grass), *Glyceria aquatica*, Smith, (Reed Meadow-Grass), *Glyceria fluitans* R. Br. (Floating Meadow-Grass), *Leersia oryzoides*, Swartz, (Rice Cut-Grass), *Zizania aquatica*, L. and *Z. miliacea*, Michx. (Indian Rice).

3. *The Marine or Sea Side Grasses*, which are chiefly found near salt water or the Great Lakes. They are generally very coarse and distasteful to cattle. A great proportion of the plants in these situations, which are cut and cured by the farmers of New England and Long Island, and the Jersey coast, and known as salt marsh hay, are not grasses, but belong to other families of plants, such as the *Juncaceæ* and *Cyperaceæ*. The *rhizomes* of some are very useful in preventing the water from washing away the soil. Of marine grasses the following are examples: *Spartina juncea*, Willd. (Rush Salt-Grass), *Glyceria maritima*, Wahl. (Goose-grass), *Psamma arenaria*, R. & S. (Sea Mat-weed.)

4. *The Meadow or Pasture Grasses*.—Most of the grasses of much value to agriculture belong to this section. They are the leading grasses of our best meadows, pastures, and the grazing lands of the prairies, and have received the most attention in this work.

Some of these are especially suited to,—

- a. Upland pastures, thin soils.
- b. Poor, stiff soils, hungry clays.
- c. Rich, deep loams.
- d. Meadows on the banks of rivers, subject to perennial floods.
- e. Irrigated meadows, in which the water can be entirely con-

trolled. Long lists have been given, but there is much risk in prescribing for such a great country as the United States.

5. *The Agrarian Grasses* are more properly those which occur in land under tillage. They are weeds such as *Bromus secalinus*, L. (Chess), *Agropyrum repens*, L. (Quack or Couch Grass), *Setaria viridis*, Beauv. *S. glauca*, Beauv. (Fox tails), *Panicum sanguinale*, L. (Finger Grass).

*The various Uses of Grasses.*—These are,—

1°. For the grain as food, cereals, or drink as whisky, etc.

2°. For pasture.

3°. For hay.

4°. For manufactures, paper, substitute for lumber, sugar, mats, hats, etc.; bamboos for many things.

5°. For fuel; the tops in close ovens, Indian corn in stoves.

5°. For preventing the washing of banks and drifting of sands.

**How to begin the Study.**—We will suppose the learner has but a very limited knowledge of botany and is possessed of some enthusiasm, a good stock of patience and perseverance. The latter quality is of the greatest importance, and without it, success cannot be attained. A diligent pursuit of the subject is sure to crown the student with success, and this, for several good reasons, is worth all its costs.

This book contains many good illustrations, but a study of pictures alone, with a few superficial glances at plants, will never make a botanist. There may be a hundred names, rather uncommon and technical, to become familiar with, but this should discourage no person of good ability. All of these words are defined in the glossary at the end of the volume.

To have the use of a good, simple microscope magnifying ten to twenty diameters is absolutely essential. This should be mounted on a stage or block on which the flowers or other small parts may be laid, while both hands are free for dissecting with



needles mounted in handles. Common number five needles, broken in two, and with forceps pushed blunt end first into the pith of a one-year-old stem of European larch, are cheap, nice, and durable. There should be some means of adjusting or varying the focal distance of the microscope. A small, sharp knife, and a pair of fine-pointed forceps will be very useful.

Take in hand a complete specimen of some grass, the name of which is well known. We will suppose it is a sample of Timothy (*Phleum pratense*, L.). If dry, the flowers or top can be made soft by soaking in water, if warm all the better. The roots are fibrous; the stalk, *culm*, has solid joints, *nodes*, from each of which starts a leaf. Towards the base of the stalk, the nodes are close together, and one or more may be enlarged or swollen into a simple *tuber* or *corm*, sometimes improperly spoken of as the *bulb*. For some distance above each node, the sheath of the leaf rolls like a scroll around the stem, one edge covering the other closely, but usually not growing fast together. At the upper end of the sheath, the blade of the leaf spreads away from the culm. Just where the blade leaves the stem, at the throat of the sheath, is a delicate ring, fringe, or often a thin, scarious appendage. This is the *ligule*, the form of which is usually constant in all the plants of one species.

The leaves are alternate, one at each node, and two ranked, i. e., there are two rows of leaves alternating with each other on opposite sides of the stem. The leaves are *parallel veined*, and may be stripped or torn lengthwise into narrow pieces. The beginner may consult the chapter which treats of leaves.

The top of the stem bears a cylindrical *spike* of spikelets, some of which on close examination, it will be seen, have very short branches. Select a small portion of the material from the spike and place in a drop of water, while it is seen with the microscope. With one needle hold a portion fast, and with the other or with the forceps separate the parts of the specimen.

Figure 62 illustrates what should be seen. At 2 are the *outer glumes*, looking much alike in shape and size. At the base one appears to be a trifle inside of the other. They are tipped with a *mucronate* awn, and are *ciliate* on the back. If cut in two crosswise, the section of a glume appears in shape much like a broad letter V. At the base of the letter is a rib. Such glumes are *keeled*.

At 3 is the flowering glume, covering the *palea*, which is rather smaller. Still within the *palea*, if the specimen be in flower, may be seen three slender *filaments*, each bearing an *anther* at the extremity. At the center is a small ovary, from the top of which spread two feathery *stigmas*. Turn to the page where *Phleum pratense*, L. is described, if you have not already done so.

Do not hurry, but try hard to understand everything as you proceed, and whenever you come to a word which is not understood, consult the glossary or some other portion of the book. In a note book make a list of all the new technical words, perhaps with their definitions, and frequently study them over like a spelling lesson, till they become familiar. With this thoroughness on the start, you will very soon master the difficulties and progress will be certain and satisfactory. Review often and thus become well acquainted with the first lessons. This review may not be so interesting as advanced lessons, but it is time spent in a very profitable manner.

The beginner is likely to hurry and run over too much ground. He is almost certain not to understand what he looks over. He becomes superficial, and often fancies he is learning a good deal, when in reality he possesses scarcely any definite information of value.

The following are suggested as desirable grasses for the beginner to study: Ray or rye-grass, *Lolium*, quack grass and wheat, barley, rye, wild rye. It makes no difference which is taken up first. The reader will soon see that those last named

agree in several respects, and belong to the same tribe, *Hordeæ*. In each case, free use can be made of the excellent illustrations, but the careful examination of each species *must not* be omitted.

Another lot of closely related species are sweet vernal, canary-grass and vanilla grass. One genus contains June grass, wire grass, fowl-meadow grass and a few others which are common. Orchard grass is of fair size and well suited to the beginner.

It is an excellent plan, where possible, to take up in connection with each other, especially in reviews, grasses which are nearly related. Any two such species may very profitably be critically compared.

“There is no way for the student to do but to take the thing described in his hand, and patiently compare it with the definition given, until he distinctly sees the application of every part. He must, therefore, take a cornstalk or some other grass, and study its structure until he has made out every statement in the definitions given.”—(Gould).

---

## CHAPTER V.

### NATIVE GRAZING LANDS.

**Effects of Over-Feeding Dry Districts.**—The grazing of sheep and cattle often change the character of vegetation for the worse instead of better.

Every farmer knows the value of sheep to exterminate wild raspberries, blackberries and most other bushes, but many times they also introduce troublesome weeds as well.

Dr. A. Gray, in *Am. Jour. Science* in 1874, notices a contribution by Dr. Shaw to the Linnean Society, in reference to the ill effect of overstocking the dry grazing districts of Southern