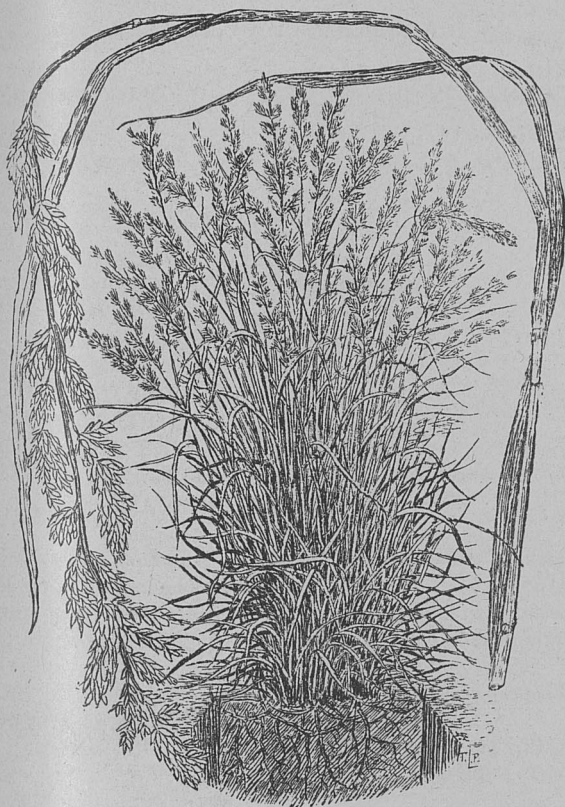


UNIVERSITY OF TENNESSEE
Agricultural Experiment Station
BULLETIN



Texas Blue Grass.

VOL. XI.

DECEMBER, 1898.

No. 4.

GRASSES AND FORAGE PLANTS

By J. B. KILLEBREW, A.M., Ph.D.

PART III.—MEADOWS AND WILD PASTURES

KNOXVILLE, TENN.
THE UNIVERSITY PRESS
1899

THE AGRICULTURAL EXPERIMENT STATION

OF THE UNIVERSITY OF TENNESSEE.

CHAS. W. DABNEY, *President.*

EXECUTIVE COMMITTEE.

O. P. TEMPLE.
JAMES COMFORT.

TREASURER:
JAMES COMFORT.

T. F. P. ALLISON.
J. W. CALDWELL.

SECRETARY:
J. W. GAUT.

STATION OFFICERS:

DR. CHAS. W. DABNEY, President.
ANDREW M. SOULE, Agriculturist.
R. L. WATTS, Horticulturist.
CHARLES A. MOOERS, Chemist.
S. M. BAIN, Botanist.
J. B. KILLEBREW, Grass Expert.
F. H. BROOME, Librarian.
JOHN R. FAIN, Farm Manager.
P. O. VANATTER, Assistant for Plat Work.
GEORGE A. FLICKENGER, Dairyman.

The Station has facilities for analyzing and testing fertilizers, cattle foods, milk and dairy products; seeds with reference to their purity or germinating power; for identifying grasses and weeds, and studying forage plants; for investigating the diseases of fruits and fruit trees, grains and other useful plants.

Packages by express, to receive attention, should be prepaid.

All communications should be addressed to the

AGRICULTURAL EXPERIMENT STATION.

Knoxville, Tennessee.

 The Experiment Station building, containing its offices, laboratories and museum, and the plant house and horticultural department, are located on the University grounds, fifteen minutes walk from the Custom House in Knoxville. The Experiment farm, dairy barn, stables, milk laboratory, etc., are located one mile west of the University, on the Kingston pike. Farmers are cordially invited to visit the buildings and experimental grounds.

Bulletins of this Station will be sent, upon application, free of charge, to any Farmer in the State.



SHEEP IN THE MEADOW.

PART III.

MEADOWS AND THEIR MANAGEMENT.

Upon the proper selection of soils and situations for meadows will depend largely their permanency and their productiveness. The soil, its condition and situation are the most important elements of success. Above all things the soil must be fertile, or it should be made so by abundant fertilization. Poor soils will not produce rich grasses. Stable manure must be freely used on the soil if it is sterile in its character. Before such an application, however, the land must be deeply broken and underdrained if very dry or very wet. It is a well known fact that underdraining dries wet soils and gives the capacity to dry ones of retaining humidity. It stimulates plant growth earlier in the spring and keeps it up later in the fall, because it carries away the cold subterranean water, and by doing so the lower portion of the soil is warmed by diminishing evaporation. Droughts are never so disastrous upon well drained soils as upon undrained ones. When the soil is saturated with water, plant food becomes so much diluted that the roots must take in a larger quantity of fluid to nourish the plants, and the hay is greatly injured by this excess of moisture. Many soils that are intractable may be made mellow and well fitted for the growing of grasses by thorough draining. Drainage also makes all fertilizing matter have a better effect. The productiveness of the land when drained is largely increased, for the reason that the roots are enabled to range through a wider extent of soil in search of plant food. By permitting the roots of the plants to penetrate deeper, drainage makes them more independent of the moisture of the surface soil, and so has the same effect as a rain fall.

Another great advantage which meadows receive from proper drainage is in the prevention of the formation in the soil of acids which are injurious to vegetation. Another is that it arrests or checks the heaving out of grasses in winter by freezing. Drainage also lessens the tendency to the formation of a hard crust on the surface after rains with supervening hot weather. Above all, drainage greatly facilitates that reaction which prepares the organic and mineral matter in the soil for plant food. All soils saturated with water are placed in a condition that stops the decay of vegetable matter incorporated with it. The mineral matters also require to be exposed to the air before they are put in a condition to be readily assimilated by plants.

Underdraining is but little practiced in the South and yet there is no work that is more essential to a good meadow. Drains should be made from forty to sixty feet apart and should be put at least three feet beneath the surface of the ground, with an outlet that will carry the water from

the field. Tiles make the best drains, though drainage is often affected by subterranean channels made of stone or even logs and brush. Low lands lying on creeks or rivers should have the drainage tiles placed in lines perpendicular to the general course of the stream. It must be understood that these drains shall have an inclination sufficiently great to carry off the water to the outlet. Nor should there be any low depressions in the drain where water will stand and stagnate.

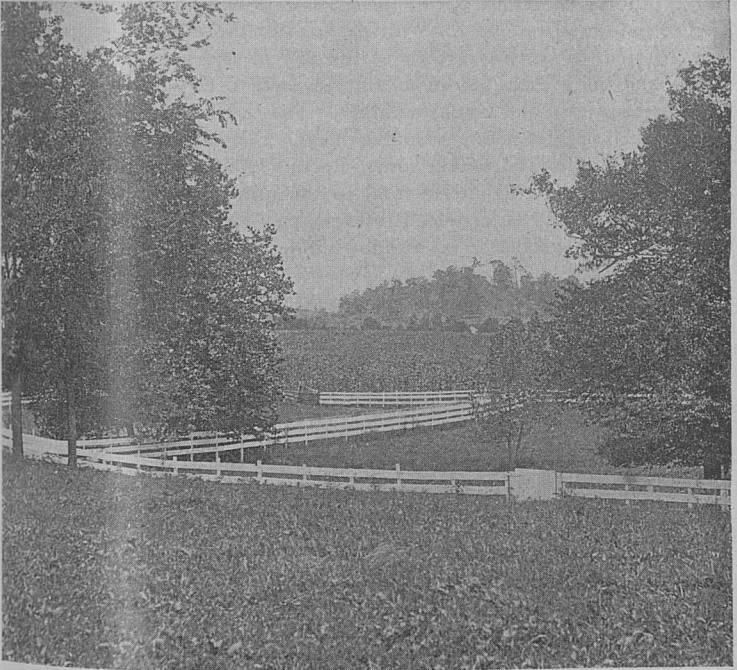
If the soil is neither very wet nor very dry in its character it will not be necessary to go to the expense of underdraining to secure good meadows. Select a low lying situation on a stream if possible. If this cannot be done take an upland valley in which the silt from the surrounding acclivities may be gently deposited from time to time upon the grass. The surrounding hills must not be so high nor so abrupt as to cause large quantities of silty material to be deposited at once. The deposit should be just sufficient to cover the base of the grass but not enough to cover the crowns. In the latter case much of the grass will perish; in the former the silty material will act as a fertilizer and as a mulch for the retention of moisture. Grass must have plenty of water but it must not be in excess. Nothing is more hurtful to a meadow than standing water, for after it retires many vacant spots will be seen. Argillaceous soils are often so compact as to prevent a healthy growth. In very loose soils the roots of grasses frequently suffer for want of moisture. In the selection of lands for either meadows or pastures the depth of the underlying rocky strata must be taken into consideration. If the underlying rocks come near the surface the grass will parch up during a dry season. The united depth of the soil and subsoil should be not less than four feet, and the subsoil should be a retentive clay capable of conserving moisture.

The soil best adapted to the growth of the leading meadow grasses is a calcareous loam with clay enough in its composition to give it a considerable degree of adhesiveness, and that will hold the grasses firmly, but not enough to give the soil so much compactness as to prevent it from being aerated and the roots from penetrating to a good depth. The soil must be neither too compact nor too porous. When too porous the manure applied to the meadow sinks too rapidly to a plane beneath the feeding depth of the roots. If too compact the roots are not able to go deep enough to secure the proper moisture; nor can the fertilizing material sink deep enough to be within the plane of moisture.

Some sandy soils make excellent meadows, especially when resting upon a clayey subsoil which retains moisture. Strong clay soils with a large admixture of sandy material in the form of chert, or of calcareous matter in the form of limestone gravel, make good meadows in proper situations. It is not unusual to find little strips of bottom lands lying on mountain streams in which the soil is largely composed of silty deposits with about an equal proportion of humus, sand and clay. Such meadows are very productive both of timothy and herd's grass hay. River bottom lands having black soils, which are liable to crack into deep fissures with the advent of hot weather, however fertile they may be, are unfit for meadows. Nor are those lands suitable for meadows that are liable to have a thick slimy deposit of vegetable matter left on them after over-

flows, for though they may be excellently well adapted for the growth of corn, the grasses will soon wither and die in such situations.

Good meadows are found in the latitude of Tennessee upon suitable soils, with every exposure and in almost every situation. The earliest meadows and those that produce the most nutritious hay have slightly southern exposures but not enough to absorb heat from the sun to such a degree as to wither the grasses at noon tide. A slight southern inclination, especially if facing a water course having a fringe of trees between the stream and meadow, is in all respects the best situation. Large quantities of hay may, as a general thing, be harvested from meadows having



BLUE GRASS PADDOCKS, MAURY COUNTY, TENN.

a northern exposure. The soils in such situations will retain moisture longer and moisture is indispensable to a heavy growth of grass. Though the growth will not be so quick or so early as upon southern exposures, it will be continued later in the fall months and in general the grass will be ranker and denser. Soils on northern exposures are also more fertile in a region having the same general character of soils. An eastern exposure will grow larger quantities of hay than a western one, because the growth of the grasses on the latter is checked to a greater extent by the heat of the afternoon sun. The earliest and most nutritious hay crops are harvested from meadows having a southern exposure; the largest yields

from those having a northern exposure. The meadows with eastern exposures will yield more hay upon similar soils than those having western exposures, but at the cost of a slightly inferior product. From the sun hay derives its sweetness and to the sun it is largely indebted for its rich stores of nutritive juices. Experience and analyses have demonstrated the fact that hay grown on well-prepared, well-drained and well-manured soils is more valuable than that grown on prairie or other unimproved lands in the larger content of its flesh-forming material; in the diminution of its indigestible matter; in the amount of its saccharine and other soluble constituents; in its succulence and fatty matters, and in its comparative freedom from dust, trash and noxious weeds. Every observing farmer knows that stock prefer the grasses grown on rich, well-prepared land to the grasses of the highway pastures or those grown on poor land. They prefer the grasses grown in the sun to the grasses grown in the shade, and the grasses grown in a dry season to those grown during the prevalence of rain and cloudy weather. The unerring instincts of domestic animals suggest many valuable ideas. Shade in a pasture, though desirable to a limited extent for protecting stock from the fervor of a mid-day sun, is highly detrimental to the nutritiousness of the grasses. Some shade should be provided in every pasture but never in a meadow, for all grasses grown in a meadow under shade are injured for hay making.

Lands intended for meadows should be prepared in the very best manner. Not only should the drainage be made perfect, if not so naturally, but the soils should be as well prepared as for the growing of the most highly cultivated crops. It should be put in the finest mechanical condition. Every trace of wild growth and of unimproved land should be effaced. Stumps should be extracted so that mowers and horse rakes may be used. All bushes, roots, stones, trash, brush and the turf of wild grasses and weeds, should be removed or destroyed. The cultivation of the land for a few years in crops requiring clean cultivation and high fertilization is probably the best preparation for a meadow. A crop of annual grass such as millet fits the land for a perennial meadow by destroying the weeds. New land with fertile soils, however, when put in good tilth, grows the meadow grasses to perfection. If old land is selected it should be deeply plowed and, if possible, sub-soiled; for deep tillage is essential to the luxuriant growth of the perennial grasses. Their roots constantly seek a lower level, and if the land is at first drained and afterwards fertilized year after year, and kept free from noxious weeds, the meadow will grow stronger and better with time.

There is a great difference in the duration of grasses and in their time of maturing. Some live but a short time; others are more permanent. Some mature in one year; others do not become firmly established for several years. Some are very nutritious; others are more showy than useful. Different species require different soils and in sowing a meadow some regard must be had for these differences. A much greater amount of hay may be made by sowing several species that ripen together. This arises from the fact that some grasses will grow in one situation but not in another and by the further fact that a plant of one species is a greater

enemy to another plant of the same species than to a plant of a different species. Among the grasses that may be most profitably sown for meadows in Tennessee are timothy, herd's grass, perennial rye grass, meadow oat grass, and tall fescue grass, with a slight sprinkling of clover. In sowing a meadow each kind of seed should be sown separately. If the seeds are mixed together the weight of some will prevent them from being uniformly distributed with the lighter seeds. He who desires a good meadow should not spare the seed. A wise plan is to sow nearly as much of each kind of seed upon the meadow as is required when only one kind is sown.

The best time for sowing meadows in Tennessee is the last of September or the first of October. After the seeds are sown they should be covered with a roller or a light brush and all stock kept out. Farmers more often than otherwise sow grass seed in the fall of the year with wheat. This is poor economy. A meadow should be sown for its own sake. In trying to save the cost of preparing the land a second time there results in a majority of instances, the total loss of the grass seed. At any rate in sowing grass seed with wheat, rye or barley a whole year and a half must elapse before any returns can be realized from the meadow. Another objection to this method is the temptation to pasture the stubble lands during the heated term and so destroy or impair the vitality of the grasses. If the soil has been properly prepared and a sufficient amount of good grass seed sown alone in the early fall one may expect with the greatest confidence a good crop of hay the succeeding summer. Oftentimes the heaviest crop of hay is the first one. This arises from the fact that close mowing the first year frequently kills a portion of the meadow grasses, leaving bare spots. Grasshoppers often eat the crowns of the fresh grass in the fall of the year, and so thin it out. Grazing the aftermath, which many farmers practice, does much damage to the meadow, to say nothing of the injurious effects resulting from the heavy tread of cattle, especially when the ground is soft and wet. Tramped in this condition the soil becomes, after exposure to the sun, little better than a sun dried brick.

It frequently happens that a meadow becomes "hide-bound;" that is to say, the soil and subsoil run together and become very compact either from tramping of stock or from standing water. When this is the case the grass will show a diminished vitality by turning yellow. Under these conditions it will rarely grow tall enough to be mowed. The best remedy for this "hide-bound" condition is to take a very narrow subsoil plow with a coulter attached and run it at intervals of two feet through the meadow and as deep as possible. This will roughen some places but by running a fine toothed harrow over it it may be made sufficiently level for the mower. The best time for this subsoiling is early in the spring, as soon as the ground becomes dry enough to plow. Old meadows may be made productive by pursuing this plan and top-dressing with manure directly afterwards. This same treatment should be given to pastures after they have ceased to be productive.

MANURING OF MEADOWS—The farmers of Tennessee rarely cut the aftermath. Sometimes it grows high enough during a wet sum-

mer to mow but they usually depasture it. In fact meadows are put to their severest trials after they are mowed in June or July in consequence of the dry, hot weather which supervenes. It is best not to apply stable manure during the continuance of hot, dry weather for such manure has the effect of making the meadow still dryer and of attracting a number of insects that cover and feed upon the small green blades. The best treatment after mowing is to top-dress with about 100 pounds per acre of the nitrate of soda. This preserves the verdure of the grass. In two or three weeks an application of an equal quantity of bone meal or the superphosphate of lime should be added. Some ammonia in the form of sulphate will have a beneficial effect. Where there is clover gypsum may always be applied with good results. After the fall rains begin stable manure should be applied freely. It is the best of all manures, on our soils, for grass lands.

Baron Lawes writing in 1858 thought that "a dressing of dung once in five years with two hundred weight of the nitrate of soda each year for the other four years" was the very best manure that can be used. Dr. Voelcker was of the opinion that good barnyard manure is "the most efficacious and economical manure both for seeds (of clover) and permanent pasture." The effect of bone dust on meadow lands is not thought to be as great as on pasture lands. "Bone meal is usually wasted when applied on cold clay soil." Dr. Voelcker also says: "unfortunately the application of artificial manures to permanent pastures is often disappointing in an economical point of view. As a rule, no artificial manure gives so favorable a return as good farmyard manure, and I cannot help thinking that it would be more profitable for a farmer to apply the larger portion of his yard manure rather to his pasture land than to the arable land; for there is no difficulty in growing roots and cereal crops economically with artificial manures."

A writer in the Journal of the Royal Agricultural Society in 1869 says: "After much experience, I think manuring grass lands is one of the worst subjects to treat. I have seen bones applied and produce no good whatever; and on the other hand, I have seen them used with immense advantage. I have seen guano produce a splendid crop, while the year following the crop has been worse than before guano was applied. It is impossible to give any definite rules without knowing the kind of land to be manured, and other attendant circumstances. Still, money judiciously laid out in the improvement of grass land brings in a more certain return than when expended in the growth of wheat."

In the manuring of clover fields gypsum will greatly increase the forage but not the seed. Superphosphate of lime, nitrate of potash and stable manure are much better for increasing the yield of seed and should be applied to the clover after the first crop has been cut off for hay or depastured by stock. All manures will, as a general proposition, so increase the strength and vitality of the better grasses as to diminish the weeds. This may be seen by the application of stable manure to a broom sedge field: the broom sedge disappears and the better grasses assert their sway.

In some famous experiments conducted by Lawes at Rothamsted in

England it was clearly shown that superphosphate of lime was favorable to the growth of the true grasses, but not to the leguminous plants. Ammoniacal salts were of but little benefit to the grass when applied to the meadow. Nitrate of soda increased the grasses and kept them green for a longer period, more leaves and fewer stems being the result of the application. A mixture of superphosphate of lime and ammonia had precisely the same effect as the superphosphate alone. Mineral manures alone increased the leguminous plants and diminished the grasses. Mineral manures and ammonia increased the grasses but not the leguminous plants. Mineral manures and nitrate of soda had the same effect as mineral manures and ammonia. Gypsum produced its greatest effect upon leguminous plants but its effect on the grasses was slight. The most potent application was farmyard manure, which increased the hay grasses and the leguminous plants and encouraged the growth of many good grasses and some bad ones, as well as some noxious weeds. It was by far the best application, though attended with some undesirable results. The general conclusion reached was that drainage is highly important. The application of mineral manures, such as potash, lime, gypsum and marl, is followed by good results, though attended with too much expense. The use of bones was discouraged. "The grasses proper appear to be the most strikingly independent of any artificial supply of carbon. The hay crop is more exhaustive of potash than wheat or barley. A predominance of mineral elements in the fertilizers increased the proportion of the culms of grasses, while a predominance of ammoniacal salts increased the proportion of leaves. Those manures which much increased the produce of hay, at the same time very much increased the proportion of graminaceous plants. The total miscellaneous herbage (chiefly weeds) were the most numerous in kind and nearly in the greatest proportion on the unmanured land, viz: 16 per cent., while on the manured plat they decreased to 2 per cent."

In summing up the results of these painstaking and suggestive experiments, Baron Lawes says:

"We learn from these results that good pasture grasses can never thrive upon a poor soil; and if a soil does not contain in itself the elements of fertility they must be added from external sources. I may add that if the pasture of a rich soil deteriorates from bad treatment the good grasses do not die out, but only retire from the contest to wait for better times. Under invigorating treatment it will be found that the good grasses soon reassert their supremacy.

"The general result, comparing the product by the different manures in one and the same season, seems to be that the more the produce is graminaceous the more it goes to flower and seed, and the more it is ripened the higher will be the percentage of dry substance in the hay. Under the same circumstances, the higher will be the percentage of woody fiber and the lower will be that of the nitrogenous compounds and of the mineral matter. On the other hand, in a large proportion of the non-graminaceous herbage the reverse of these things is true."

TROUBLESOME PLANTS IN MEADOWS—The proper care of meadows after they have been mowed must not stop with the application of manures. There are many noxious plants and weeds that spring up

when the grasses are enfeebled by mowing, especially if the mowing followed by dry weather. The most pestiferous of these is broom seed (*Andropogon Virginicus*). If left alone it will grow to the height three feet after the hay has been cut. If permitted to seed, the meadow will show a largely increased number of these plants the following season. Each tussock of this vile grass before it goes to seed should be cut up with a sharp sprouting hoe. If permitted to grow the meadow will be destroyed in a very few years.

Another troublesome plant is the fleabane (*Erigeron Philadelphicus*) known as "white top" in Tennessee. This will thicken on suitable soil very rapidly. There is no remedy for this except running the mower over the meadow before the seeds ripen.

The trumpet flower (*Tecoma radicans*) infests meadows on rich bottom lands and it is especially troublesome on strong limestone soils. When cut off by the mower it forms hard knots which will arrest the action of the sickle. This vine should be dug up "root and branch." While white clover and blue grass are both great enemies to the meadow grasses, their presence will have the effect of rapidly converting the meadow into a pasture.

THE HAY HARVEST—The first grass that ripens for the harvest in Tennessee is the Italian rye grass. There is only a small quantity of land, however, laid down in this early meadow grass. The red clover crop demands the earliest attention from a majority of farmers. This is cut for hay from the time it blooms in the middle of May until the middle of June. Varieties of soils exert a perceptible influence upon the period of inflorescence. On strong limy soils clover is usually ready for the mower two or three weeks earlier than when grown on cold or heavy clay soils. Timothy and herd's grass follow soon afterwards and the harvesting of these usually continues until the middle of July. Millet grown on strong soils is harvested in about sixty days after it is sown. It is not possible to define the precise stage in which grasses should be cut, for this depends upon the uses to be made of the hay and upon the character of stock to be fed. If the object is to produce the greatest quantity of milk, grass should be cut before coming into blossom, for at that stage it contains the greatest amount of succulence and will produce the largest flow of milk. If the richness of the milk is desired rather than quantity, grass should be harvested while in blossom. For work horses, mules and oxen and for fattening cattle the harvesting should be deferred until the seed is in the milky state and the blades of the grass are still green, or at least but slightly spotted. For "roughness" or "distending" forage the hay should be cut when only a portion of the flowers have fallen. At this stage it is filled with starch, gum and sugar. After the seeds become ripe these ingredients are changed into woody and indigestible fibre. The seeds themselves, indeed, after ripening contain a large amount of very nutritious matter but the value of the hay grasses with ripened seed is greatly lessened and the juicy stalks and blades will be worth no more than wheat straw. With wheat, corn, barley, rye and oats the reverse is true, as the seeds are worth much more than the forage from such crops would be if cut when in flower.

Prof. Armsby comes to the following conclusions as to the best time

for cutting hay: "Young plants while rapidly growing contain relatively more protein and less fibre than more mature ones; consequently early cut fodder must be of better quality than that cut late. It is more digestible.

"Three elements enter into the problem of selecting the best time for cutting, viz.: the quality of the fodder, its quantity, and the amount of labor expended upon it. While any grass is ripening a large part of the protein and starch passes from the leaves and stem to the seeds, which are so small that they are seldom masticated or digested. Moreover, they are easily lost in curing. The hay made from fully ripe grass is essentially straw.

"If only one crop is to be obtained, probably the best time for cutting is usually when the plants are just beginning to blossom. At this time a larger crop is obtained than if cut earlier, while the digestibility is not seriously impaired."

If cut early there is a great advantage to the second crop, as shown by an experiment at Hohenheim:

	PERCENTAGE OF PROTEIN	TOTAL POUNDS OF PROTEIN	TOTAL DRY MATTER, POUNDS
One cut.....	16.3	434	2,662
Two cuts.....	24.4	668	3,274

One cut—Percentage of protein, 16.3; total pounds of protein, 434; total pounds dry matter, 2,662.

Two cuts—Percentage of protein, 24.4; total pounds of protein, 668; total pounds dry matter, 3,274.

"The legumes are characterized by the large proportion of protein contained in the plant as a whole, and in the seeds. As fodders, when properly cut and cured, they are very rich, but have the disadvantage of being rather bulky, and of being easily subject to deterioration by mechanical losses. As a general rule clover is richer in nitrogenous matters than grass. Compared with meadow hay, which is made from the true grasses, its protein is about equally digestible, its crude fibre decidedly less digestible."

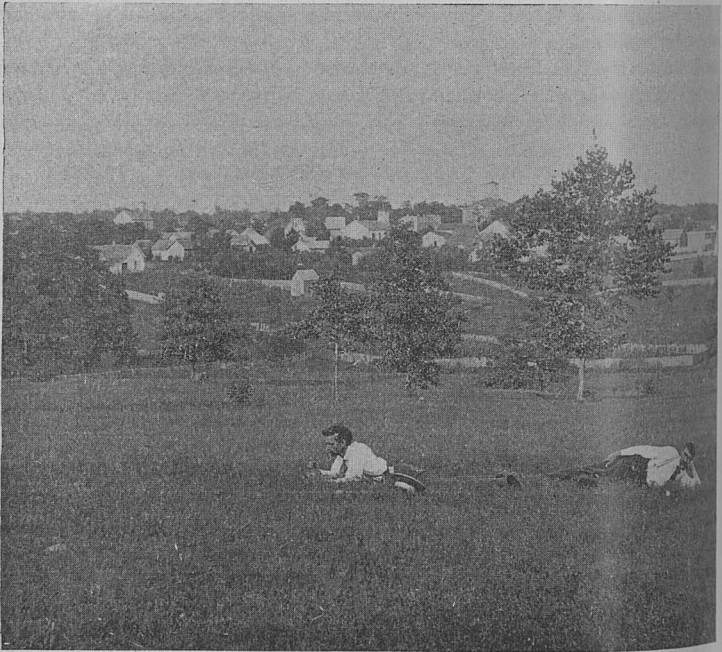
Full instructions have been given in Parts I and II as to the proper method of curing the different varieties of hay and forage plants. With the improved harvesting machinery and implements now in general use consisting of the mower, tedder, horse-rake, six-tined pitchfork and hay wagon bodies, the expense attendant upon saving a crop of hay is not one-fifth as great as it was when farmers had to rely upon the scythe, wooden pitch-forks and hand-rake. This great reduction in the cost of harvesting the hay crop has increased the product many times throughout the Southern States.

In 1880 the production of hay in these states was 1,412,358 tons; in 1898, 4,386,669 tons. The yield has increased from .82 of a ton per acre in 1880 to 1.45 tons per acre in 1898. The increase in the State of Tennessee has been still more rapid as may be seen by the following table from the census report:

HAY PRODUCED IN TENNESSEE.

1870.....	116,582 tons
1880.....	186,698 tons
1890.....	630,417 tons

The extraordinary increase during the past ten years in the acreage sown in cowpeas is one of the most favorable signs in southern agriculture. It will be one of the marked changes that will appear in the report of the twelfth census. Throughout the State of Tennessee this increase has been within the present decade fully 500 per cent. The haulm of the pea is now largely employed for the feeding of cattle and sheep during the winter months. Those varieties of peas that produce seed not subject to early decay from humidity are left ungathered, and they form no in-



PASTURE, CAMDEN, BENTON COUNTY, TENN.

considerable item in reducing the expense of fattening swine and of carrying stock through the stress of winter. This change was one greatly needed, for, in addition to furnishing nutritious food for stock, the pea crop is a good fertilizer. Nor is the pea crop subject to the disastrous failures of the clover crop, though yielding a forage and a fruitage equally as valuable to the farmers of the South.

PASTURES—Much land that is totally unfit for meadows may profitably be laid down in pasture. Such lands as are too rough for cultivation often make the very best pastures. The utilization of the rough limestone lands of Southwestern Virginia for making pastures has made

them as valuable as the best arable lands of that state. On these pasture lands hog-back ridges are often seen, making it impossible to grow any tillage crop, and yet these lands make the finest blue grass pastures in the South, not excepting those in Central Kentucky, and are worth from fifty to a hundred dollars per acre for the raising of cattle. Likewise in some of the rough lands of East Tennessee may be seen strong growing, nutritious grasses upon lands that are worthless for any other purpose except for pasture.

In selecting grasses for the pasture an opposite course must be pursued from that pursued for a meadow. In the latter only such grasses should be sown as mature about the same time. In a pasture, on the other hand, the grasses selected should form a succession of green forage from early in the spring until late in the fall. Some pasture grasses also die out after the first year, while others do not reach their greatest value for several years after being sown. In selecting pasture grasses regard must be had to their turf-making qualities. A grass may be eminently adapted to the making of hay and yet be totally unfit for the pasture. Our best meadow grass, timothy, will not survive as a pasture grass because it cannot bear the close cropping and heavy tread of cattle.

Some grasses are relished by one kind of stock and not by another. The author of British grasses, M. Pleues, put the case happily thus: "Sheep have strong likes and dislikes. They will hasten to a kind of grass which is a favorite with them, tramping down all the other grasses as unfit to taste. Horses, again, have their preference and cows theirs, and we have even seen swine exercise considerable cunning to secure a feed of a favorite grass. So the agriculturist has as much to consider as a master of ceremonies; he must consult the capabilities of situation, the qualities of his provision, and the various tastes of his company."

In the selection of a situation for pasture it is highly important that the soil be naturally moist in its character. Pastures suffer more in the South from dry than from cold weather or heavy grazing. When they occupy a thirsty soil they may furnish good grazing during the wet spring months, but the grasses parch to a crisp when the hot weather of July and August comes on. Early pastures do well on southern slopes, but low level bottom lands or north hillsides having rich soils can only be depended upon for good pasturage during the heat and dryness of summer.

The best grasses for pasture lands in Tennessee are the following:

- Blue grass—(*Poa pratensis*.)
- June grass—(*Poa compressa*.)
- Orchard grass—(*Dactylis glomerata*.)
- Meadow fescue—(*Festuca pratensis*.)
- Hard fescue—(*Festuca duriuscula*.)
- Herd's grass—(*Agrostis alba*.)
- Bermuda grass—(*Cynodon dactylon*.)
- Meadow foxtail—(*Alopecurus pratensis*.)
- Sheep's fescue—(*Festuca ovina*.)
- White clover—(*Trifolium repens*.)
- Red clover—(*Trifolium pratense*.)

Four or five of these grasses, the names of which are given above, should be sown together in the fall of the year on land intended for a per-

manent pasture. The larger the number of grasses sown on a pasture the longer the pasture will last and the fewer the vacant spots, especially if it is on land capable of retaining moisture. In Holland, one of the finest grass countries in the world, the meadows are often depastured during one year and cut for hay the following year, and so on alternately. In that country it requires about two acres of pasture land to fatten a large ox. In the bottoms of the greatest fertility along the Rhine an extent of surface equal to 1800 square yards is calculated to keep a cow.

The farmers of Tennessee should have more permanent pastures than they have at present.

GRASSES SUITABLE FOR LAWNS—Many people with suburban places and farmers wishing to beautify and adorn their homes have asked for a mixture of grasses suitable for lawns and woodland pastures. To gratify this desire the subjoined mixtures with the amount of seed to be sown per acre are recommended. A few of these grasses are unfit for general cultivation in the State of Tennessee, and yet as a mixture in lawns they may be sown with almost a certainty of securing a good stand. If it is intended to mow the lawn or yard frequently the following mixture may be used:

Kentucky blue grass.....	10 lbs.
Hard fescue	5 lbs.
Wood meadow grass	5 lbs.
Sheep fescue	2 lbs.
Meadow fescue	4 lbs.
Sweet scented vernal grass	2 lbs.
Red top	15 lbs.
Yellow oat grass	4 lbs.
Crested dog's tail	6 lbs.
Orchard grass	5 lbs.
Meadow foxtail	5 lbs.

63 lbs.

Flint recommends as a mixture for permanent lawns and pastures lying within the vicinity of dwellings or public highways the following, to which I have added one or two other grasses:

Meadow foxtail	3 lbs.
Sweet scented vernal	2 lbs.
Orchard grass	3 lbs.
Hard fescue	2 lbs.
Sheep's fescue	2 lbs.
Meadow fescue	2 lbs.
Italian rye grass	3 lbs.
Perennial rye grass	4 lbs.
Timothy	3 lbs.
Red top	3 lbs.
English blue grass	5 lbs.
Rough-stalked meadow	3 lbs.
Yellow oat grass	1 lb.
Red clover	2 lbs.
Perennial red clover	2 lbs.
White clover	4 lbs.
Fowl meadow grass	3 lbs.
Kentucky blue grass	14 lbs.

61 lbs.

In the selection of these grasses for lawns the idea of beauty should be preserved as well as the nutritiousness of the grasses. Some grasses will grow and maintain their verdure throughout the dry season, giving a freshness to the lawn, and yet will be of but small value for the grazing of stock.

The following mixture is also suggested, which will probably do better on argillaceous soils thinly shaded than the first mixture named:

Tall oat grass	1 $\frac{1}{3}$ lbs.
Tall fescue	1 $\frac{1}{4}$ lbs.
Meadow fescue	1 $\frac{1}{4}$ lbs.
Meadow foxtail	1 lb.
Orchard grass	2 lbs.
Hard fescue	1 lb.
Sheep's fescue	2 lbs.
Quaking grass	$\frac{1}{2}$ lb.
Comb grass	$\frac{1}{2}$ lb.
Sweet scented vernal	1 lb.
Timothy	$\frac{1}{2}$ lb.
Kentucky blue grass	14 lbs.
Red top	10 lbs.
Tufted hair grass	$\frac{1}{4}$ lb.
Red clover	5 lbs.
White clover	3 lbs.
Fowl meadow	2 lbs.

44 $\frac{1}{3}$ lbs.

For orchards and shady places the following mixture of grasses and the quantity of seed per acre will be found suitable:

Orchard grass	20 lbs.
Hard fescue	2 lbs.
Tall fescue	2 lbs.
Italian rye grass	3 lbs.
Perennial rye grass	3 lbs.
Timothy	6 lbs.
Red top	10 lbs.
Wood meadow grass	4 lbs.
Rough-stalked meadow grass	2 lbs.
English blue grass	4 lbs.
Perennial red clover	3 lbs.
White clover	4 lbs.

63 lbs.

For rocky or gravelly lands the following mixture is recommended:

Red top	2 lbs.
Tall oat	2 lbs.
Crested dog's tail	3 lbs.
Orchard grass	3 lbs.
Red fescue	4 lbs.
Meadow soft grass	2 lbs.
Perennial rye grass	6 lbs.
Timothy	6 lbs.
Wood meadow grass	3 lbs.
English blue grass	2 lbs.
Rough-stalked meadow grass	2 lbs.
Black medic	3 lbs.
White clover	8 lbs.

46 lbs.

Lands liable to be overflowed with fresh water will do best if sown with the following mixture:

Fiorin	4 lbs.
English Bent	3 lbs.
Tall fescue	5 lbs.
Slender fescue	2 lbs.
Manna grass	5 lbs.
Reed canary grass	3 lbs.
Timothy	4 lbs.
Red top	3 lbs.
Rough-stalked meadow grass	4 lbs.
Fowl meadow grass	6 lbs.
White clover	3 lbs.

42 lbs.

Prof. Beal, of the University of Michigan, recommends the sowing of two bushels of Kentucky blue grass and two bushels of small bent



VIEW ON LAWN, UNIVERSITY OF TENNESSEE.

grass, known as Rhode Island bent, brown bent, or creeping bent, or red top, to the acre for lawns. He thinks a few ounces of white clover seed might be added, but it is by no means important. The bent grasses, so-called, correspond with our herd's grass. He, as well as Prof. Scribner, objects to the sowing of orchard grass in a lawn. My observation and experience convince me that when orchard grass is sown at the rate of three or four bushels of seed per acre in a woodland pasture where most of the trees are oak it does better than the finer grasses, because it is a

stronger grower and is able to withstand the damaging effects of the heavy oak leaves. Being sown thickly it covers the ground completely and will not appear in a tussocky form for two or three years. My opinion is that orchard grass in such situations is to be preferred to any other. Lawns should be sown with about double the number of seed that is used for a pasture. The object is to have the ground covered. The seed should be sown without any "nurse crop."

In the preparation of lands for a lawn the greatest care must be taken to have the soil enriched and raked until it is as fine as garden mold. No clods or stumps or rocks should be left on the surface. After the seed is sown the lawn should be rolled and as far as possible all the little inequalities in the surface filled. Frequent mowing of lawns is the only method of preserving their attractiveness and beauty. The grass should never be permitted to seed.

Bermuda grass makes a beautiful lawn, but is apt to turn brown the latter part of the summer. Where there is a sufficient supply of water to keep the ground moist by sprinkling it forms a beautiful covering for the yards and lawns of the Southern States.

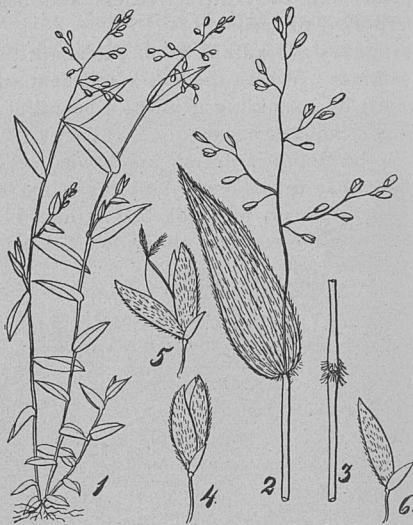
The question in the South is not so much what will make the most attractive lawns, but what grasses will best resist the heat of the long summers. Any grass, however, will look better than the bare earth, and every effort should be made to have the wooded lawns and the shady yards covered with verdure.

THE HIGHWAY PASTURES OF TENNESSEE AND THEIR NUTRITIOUS HERBAGE.

Probably no state in the Union, lying east of the Mississippi river, has such a wealth of highway pastures as Tennessee. These pastures are common in every division of the state. In East Tennessee the "balds" of the Unaka mountains, at an elevation of 5000 feet above the sea, are well watered and are supplied with rich soils upon which several grasses and leguminous plants grow luxuriantly and furnish good grazing for stock several months in the year. The areas of these natural mountain pastures are limited, but in their capacity for carrying stock they are not surpassed by an equal area of the best blue grass pastures of Kentucky. The frequent rains in the mountain district during the growing season with the fertility of the black granitic prairie soils induce a rapid growth of the wild grasses so that there is a continuous succession of nutritious herbage from April until October. During this period all kinds of stock—horses, cattle, sheep and swine, feed on these grasses unvexed by the flies that so often torment stock on valley plains. In many of the open woods of East Tennessee lying at the base of the mountains are found growing in spring and summer wild grasses and other plants of great value for grazing purposes.

But the most extensive highway pastures in the State are found on the Cumberland table-land at an elevation of 2000 feet above the sea. Broad, grassy stretches of open woods, and acclivities green with verdant turf, characterize the top of this table-land everywhere except in those places where the abundant underbrush has choked out the grass. In trav-

eling over the grassy undulations of the top of this natural division of the State in the spring of the year one is able to realize the description of the pastoral countries of the Orient "with cattle upon a thousand hills." Hundreds of streams with thousands of contributing rivulets furnish the purest of water, while the park-like landscapes with their beautiful arbo-real growth of pine, oak, chestnut, gum and other trees supply grateful shade to the stock during the heat of the day. The sun shines upon those airy heights with a splendor unknown elsewhere in the State, and breezes sweep over the mountain during the fervor of the day, tempering the air and making one of the most delightful summer climates to be found in America. The purity and elasticity of the air make this whole region one of greatest healthfulness to man and beast. When passing through the



Panicum latifolium.

silent forests of the mountain the earth covered with untrodden grasses and emblazoned with myriads of wild flowers—"born to blush unseen"—it requires no great stretch of the imagination to suppose the landscape to be now as it was before the discovery of America by Columbus, when it existed in all its primeval beauty. There are no natural pasture lands in America that surpass the pastures of the Cumberland table-land when the healthfulness of the region, its freedom from blizzards, its ample supplies of shade and water and its beautiful situation are taken into consideration. The grasses spring up in April, grow until late in November, and oftentimes supply some grazing throughout the winter months. The area of this division of the state is over 3,200,000 acres of which not less than 2,300,000 acres are given up to natural pastures.

Lying west of the Cumberland table-land is the region about 900 feet above the sea known as the Highland Rim that encircles the great central limestone basin of the State. This Highland Rim comprises nearly 6,000-

000 acres, one-third of which area is devoted to highway pastures. West of Nashville in the counties of Cheatham, Dickson, Hickman, Humphreys, Lewis, Wayne, Perry, Houston and Stewart, not over one-fifth of the land is in cultivation. Out of the 2,699,520 acres embraced in these counties only 481,456 were returned by the census of 1890 as improved lands. The remainder was in woodlands and natural pastures.

The highway pastures in West Tennessee are not so extensive as they are in the other two grand divisions of the State. These pastures are confined mainly to the Mississippi bottoms where a dense growth of cane keeps a large number of cattle throughout the year.

The wild grasses and legumes that are found in the highway pastures of Tennessee are numerous. The most valuable ones with their habitat are the following:



Barnyard Grass—*Panicum crus-galli*.

GRASSES IN HIGHWAY PASTURES.

Andropogons (beard grasses).—There are several species of these grasses. Among others may be named: *Andropogon scoparius*, *Andropogon provincialis*, *Andropogon argyraeus*, *Andropogon macrourus*, and *Andropogon Virginicus*.

Andropogon scoparius (mountain sedge) has long been known in the mountains of East Tennessee. By some it has been confounded with the *Andropogon Virginicus*. It is a good pasture grass when young and tender, but when it shoots up its culms it becomes hard and indigestible. It is not general over the State.

Andropogon provincialis, var. *furcatus*, *Tennesseensis* and others, (big blue stem) though growing taller and stouter than the *Andropogon Virginicus*, does not so readily take possession of old fields and meadows but prefers open woods and retired nooks and dry soils. The stems are



very leafy. It supplies good grazing and is not so troublesome as the *Andropogon Virginicus*. When cut young it makes a very good hay. It is not worthy of cultivation but it answers a very useful purpose in the highway pastures in every part of the State. Samuel M. Ramsey, of Warren county, tried it for butter-making as against some of the domesticated grasses and claimed that it made butter of better flavor and quality, and more of it than herd's grass or blue grass.

Andropogon argyraeus (silver beard grass.) This is a native grass, found in East Tennessee among the mountains and on the borders of woods. It is rarer than either of the other species mentioned and probably is of no importance as a grazing grass. It is easily recognized by its dense silky and silvery white flowers in September.

Andropogon macrourus (cluster flowered beard grass). This grows on wet or swampy lands and very much resembles the next to be men-



Setaria viridis.

tioned. It is found at intervals all over the State. It is not so valuable for grazing as the broom sedge, though cattle will eat it in early spring.

Andropogon Virginicus (broom sedge). This grass is very palatable to stock when young and tender but totally worthless when its culms begin to shoot up. It is the best known grass in the State and grows in almost every locality. It is a great enemy to meadows and will soon take possession of them if not resisted vigorously. It is the grass that takes possession of all "old fields" in every part of the State. While furnishing good grazing in early spring for all classes of stock, during the summer after its stems shoot up the grass becomes so tough and indigestible that no stock will touch it. After frost it turns brown and is an eyesore to every landscape where it makes its appearance. Its only value consists in its capacity to furnish early grazing and its agency in the stopping of

gullies. By many it is regarded as the flag of sterility, but this is not true as it will grow more vigorously upon rich than on depleted soils. It is one of the leading grasses in open woods and highway pastures.

Panicum latifolium (broad leaved panic grass). This grass is frequent in the open woods of the Highland Rim. It grows to the height of one to two feet but it grows intermixed with other plants and does not seek companionship of its own kind. It is a good pasture grass, bears close cropping and grows rapidly and constantly.

Panicum clandestinum (hidden panic grass). Much like the last but coming in a month later. It grows in a solitary manner and is found along the banks of the Cumberland river and in bottom lands in East and West Tennessee.

Panicum crus-galli (barnyard grass). Stock will eat this as greedily as any other species of grass whatever. It is a coarse grass and its favor-



Paspalum distichum.

ite habitat is in drained ponds and marshes. It will grow with great vigor in ditches and low bottom lands and furnishes good grazing for stock.

Setaria (foxtail grass). There are several wild species of this grass that furnish some grazing when young and tender. *Setaria viridis* (green foxtail) is common to all stubble lands and consorts with crab grass (*Panicum sanguinale*.) *Setaria verticillata*, or bristly foxtail, is probably the best wild species for grazing. The millet grasses belong to this genus. They have been treated in Part I.

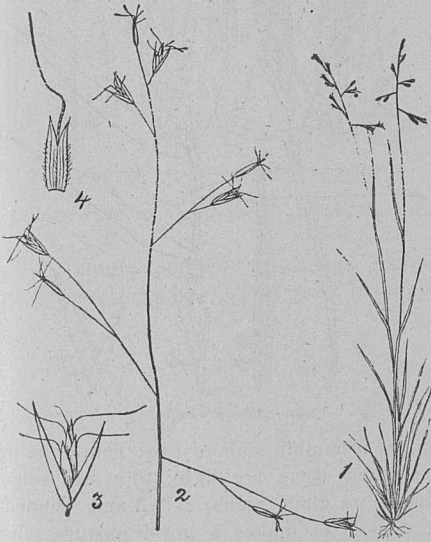
Paspalum. Among the wild indigenous grasses there are several species of this genus that are held in high repute as grazing grasses. *Paspalum distichum*. *Paspalum digitaria* and *Paspalum angustifolium*

are all numbered among the grasses found in cultivated fields and frequently in the highway pastures of the "barrens" and indeed in nearly every natural division of the state.

Elymus Virginicus (lyme grass), grows abundantly in Middle Tennessee on strong, limy soils but it forms no turf. It is found near woods and thickets, and stock is fond of it. There are three or four species belonging to the genus *Elymus* but only one other is eaten by stock and that is *Elymus Canadensis*, or Terrell grass. This is usually found on the banks of streams.

Danthonia compressa (mountain oat grass). This is one of the principal grasses on the "balds" of the mountains in East Tennessee. They will bear the closest grazing and are highly esteemed in the mountain region.

Danthonia spicata is another species of this grass found growing on the Harpeth hills of Middle Tennessee and over parts of West Tennessee. It is one of the grasses furnishing grazing on the highway pastures of the Highland Rim.



Mountain Oat Grass—Danthonia compressa.

ARUNDINARIA (cane). There are two species of this grass found in Tennessee, viz: *Arundinaria gigantea* and *Arundinaria tecta*. It is possible that these two are really varieties of the same species. In the first settlement of the State cane was the principal dependence for stock grazing in the summer and in many sections the whole face of the country was covered with it. The shoots of the young cane are both succulent and nutritious. It grows best on the richest land, but if the poorest soil is once set with it, it acts as a fertilizer. This is to be attributed to its wonderful net-work of roots, the immense foliage it deposits on the soil, and to its dense shade. It is a very difficult matter to break up cane land,

but once broken, the roots quickly rot and add to the fertility of the soil. The roots run to a surprising length and depth, and serve as pumps to raise dormant fertilizing material from below the reach of any plow.

The farmers living near the Mississippi bottoms find the immense cane-brakes in that region exceedingly useful. They are in the habit of driving their stock to them, and the most luxuriant pasturage is obtained, both summer and winter. Cane will not grow in standing water, as the presence of water destroys its roots. Therefore, it is only found on land elevated above the swamps.

FESTUCA—The genus *Festuca* contains many species that are highly valued for grazing purposes. Several of the fescue grasses have been already treated in Part I. The sheep fescue is one of the principal grasses



Cane—*Arundinaria tecta*.

found growing on the mountain soils of East Tennessee and in other portions of the State where there are light, thin and siliceous soils. The red fescue (*Festuca rubra glaucescens*) called also Tennessee fescue, is an admirable native grass. It makes a good pasture where many other grasses would fail. Nodding fescue (*Festuca nutans*) is most frequently seen about thickets. Sheep will eat it but do not relish it so much as they do the sheep fescue. Short's fescue (*Festuca Shortii*) is probably a variety of the same grass.

POA—Many species of this genus have already been treated in full in Part I. Several of them grow with great luxuriance among the high mountains of East Tennessee. The writer has seen the densest turfs of low spear grass (*Poa annua*), leafy meadow grass (*Poa alsodes*) and short meadow grass (*Poa brevifolia*) growing in the elevated valleys of Johnson county and on the crests of Iron and Roane mountains. Kentucky blue grass also grows well in the same situations and gives richness to the mountain pastures.

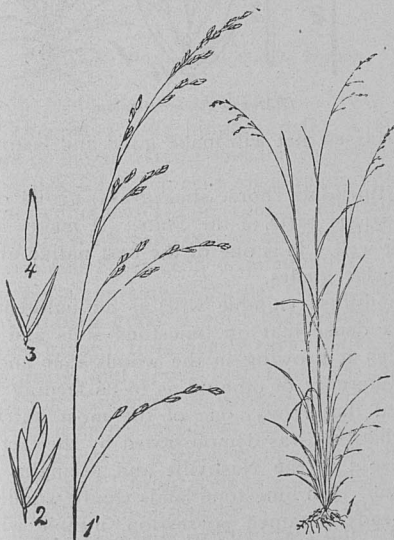
Other species of this family are common along the river banks of East, Middle and West Tennessee. The genus *Poa* is probably the most valuable of all genera of grasses for grazing purposes. Scribner mentions



Tennessee Fescue—*Festuca rubra glaucescens*.

fourteen species as growing in Tennessee. Every species is more or less valuable.

EATONIA—But a single species of this genus, *Eatonia Pennsylvanica* is of any value for grazing purposes. This grass is found in abundance in



Nodding Fescue—*Festuca nutans*.

Middle Tennessee and in moist, open places on the borders of woods in all parts of the state. It is a valuable addition to the native grasses and cattle seem to relish it more than any other wild grass. A species known as *Eatonia filiformis* grows on the dry hills of the cretaceous formation in West Tennessee, but while cattle will eat it in the absence of other grasses it is not of much agricultural value.

Diarrhena Americana (American *Diarrhena*) is found growing on the rich soils among limestone rocks. Its feeding value is about equal to that of cheat.

Eleusine Indica (yard grass: dog's tail) is frequent in all places where there are human habitations or have been. In many abandoned places on the Highland Rim it grows very rank. It constitutes one of



Eatonia Pennsylvanica.

the wild pasture grasses that will make good and lasting pickings for all kinds of stock.

Bouteloua curtipendula (horse shoe grass) grows on dry soils and in pine barrens in various parts of the State. It makes a dense turf which will bear tramping well. It is one of the best native grasses for highway pastures among cedar glades.

Muhlenbergia diffusa (nimble will) is an indigenous and perennial grass. It forms a dense mat on limestone soils and in river bottoms. The writer has seen it growing in the woods four and a half feet high. There is a great difference of opinion as to its feeding value. Dr. F. H. Gordon maintained that it was one of the most nutritious of the wild grasses and said that this was demonstrated by the fact that much of the beef and mutton sold in the Nashville and Memphis markets was fattened on nimble will. On limestone lands thinly wooded and where blue grass has not already obtained possession, nimble will furnishes good pasturage for five or six months in the year. Dr. Gattinger, on the con-

trary, thinks all species of the Muhlenbergia make very poor forage and are not eaten by stock unless they are compelled to do so by the absence of more nutritious grasses. The writer is inclined to think that the quality of this grass is affected by the soil upon which it grows.

Mexican Muhlenbergia is another species that is highly commended by some writers. Dr. C. E. Bessey, of Nebraska, says this grass has been known in the West for many years as a valuable one. "Chemical analyses," he continues, "show that Muhlenberg grass is highly nutritious. In the years 1878 and 1879, at my suggestion, Mr. W. K. Robinson, a graduate of the Iowa Agricultural College, made analyses of this grass, with results which showed that in nutritiousness it ranked with red top and



● Nimble Will—*Muhlenbergia diffusa*.

blue grass, and, in some instances, timothy. More recent analyses by the government chemist at Washington make a still better showing. Taking an average of the analyses I find the following results:

"Timothy contains 4 1-3 per cent. of albuminoids.

"Orchard grass contains 6 1-2 per cent. of albuminoids.

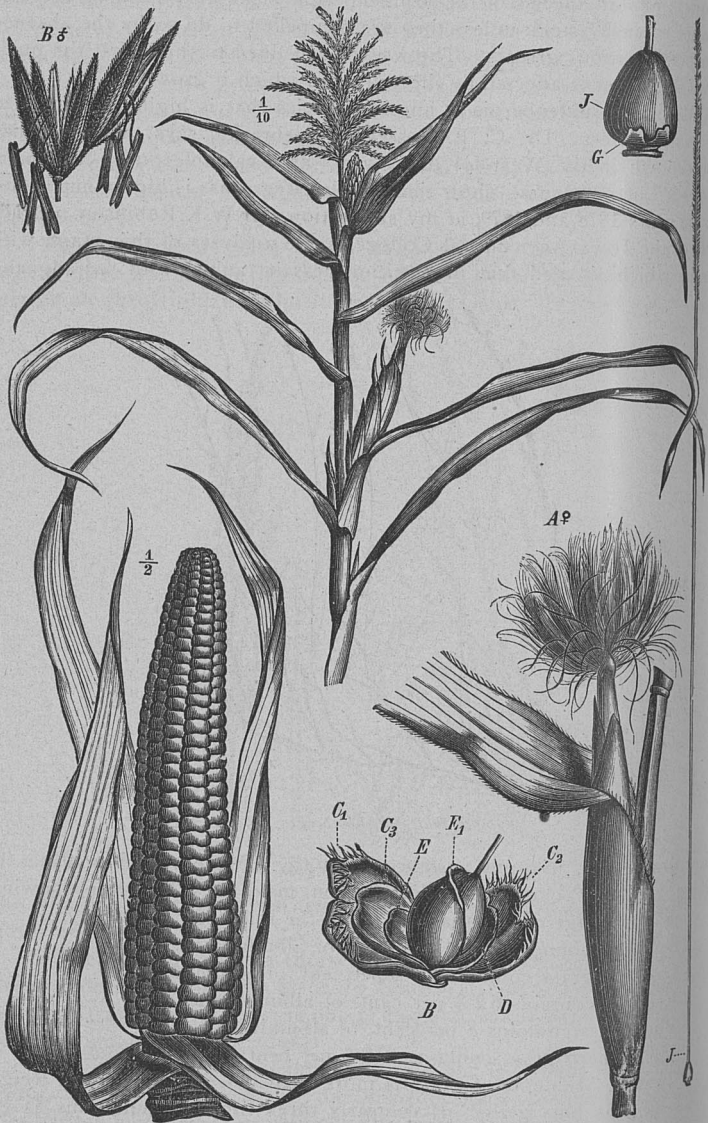
"Red top contains 6 2-3 per cent. of albuminoids.

"Blue grass contains 8 per cent. of albuminoids.

"Muhlenberg grass contains 17 2-5 per cent. of albuminoids.

"That is, Muhlenberg grass is more than twice as nutritious, weight for weight, as blue grass. It is nearly three times as nutritious as red top and orchard grass, and about four times as nutritious as timothy. Now I would not for a moment be understood as considering these analyses as settling the relative merits of these grasses. It is well known, however, that the analysis of a grass is one of the important factors in determining its value, and I bring it in here as simply corroborating what the feeders of hay have been saying for a long time."

There are four or five species of this grass found growing on wooded lands in Tennessee. All of them remain green until winter. In their



Indian Corn—*Zea Mays*.

BOTANICAL DESCRIPTION OF INDIAN CORN—(*ZEa* MAYS, L.)—In the center above is single stalk, reduced to 1-10th its natural size, showing the terminal male (the "tassel"), and in the axil of the third leaf from the base is the female inflorescence enveloped in broad, leafy bracts. At the base of the figure on the right side this female inflorescence is shown more clearly; the hair-like tuft is formed by the projecting slender styles (the "silk.") To the left at the base of the figure is shown an "ear" of corn, the kernels being the matured ovaries from which the styles have disappeared. In the upper left-hand corner of the figure are two spikelets. The flowers of Indian corn are unisexual, the one male or staminate, the other female or pistillate; both are born upon the same plant, but each is in a separate inflorescence.

general appearance they resemble small cane from the hardness and enamelled surface of the stalks and the stiff aspect of the leaves. They furnish pickings to stock until December. Their creeping rootstocks are very troublesome on cultivated grounds, especially on newly opened bottom lands and much resemble those of Bermuda grass.

Sporobolus Indicus (drop seed grass) is said to be a good grass in wild pastures. It is soft and succulent, springs up quickly after being grazed and will last from May until October. It usually grows in patches and in low and small tufts. It is very palatable to cattle. In the West several species of *Sporobolus* furnish good winter pastures. *Sporobolus asper* is another species found in Tennessee and grows mainly on the Cumberland table-land on sandy soils and in the oak barrens of the High-

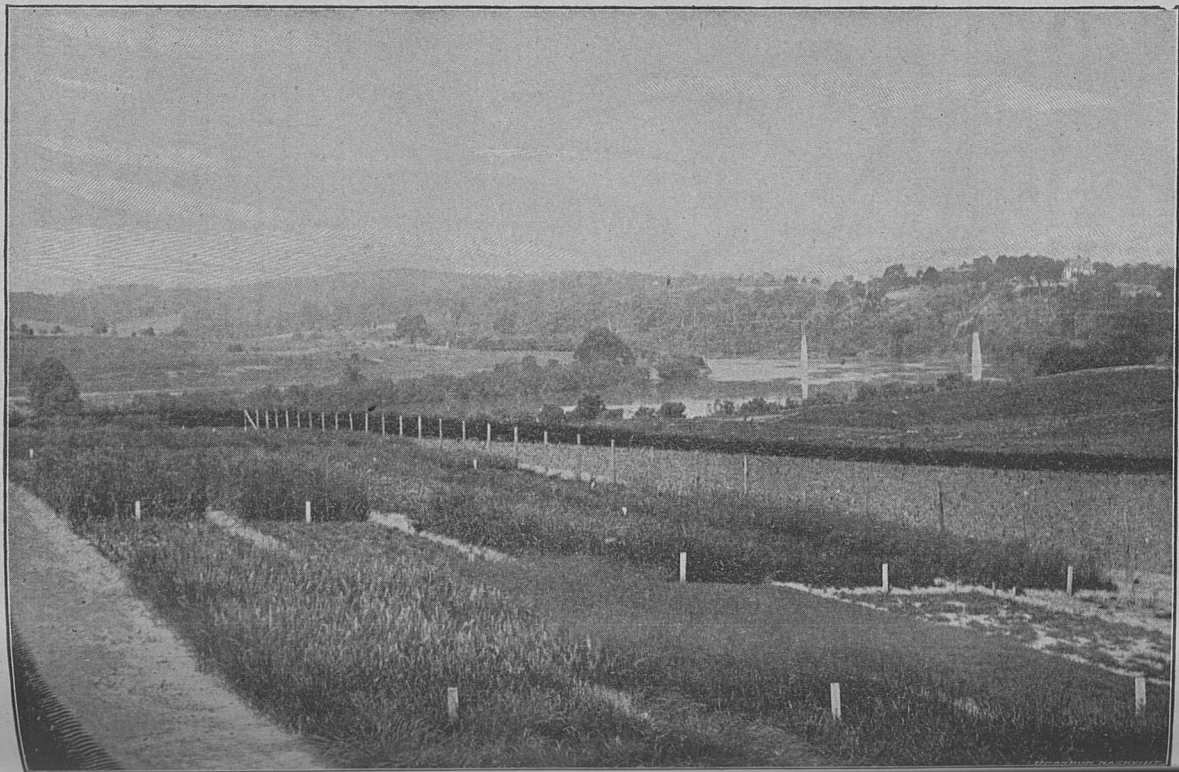


Muhlenbergia Mexicana.

land Rim on siliceous soils. It forms one of the least nutritious wild grasses in the highway pastures of these regions.

Zizania aquatica (water or Indian rice grass) is found in the swampy regions of West Tennessee. It has flat leaves two to three feet long and its culms grow to the height of three to nine feet. It is found in swamps and on the borders of sluggish streams. In some pastures of the west the seed is gathered by the Indians and made into a species of mush or bread which they relish greatly. Cattle are fond of the herbage and Dr. Gattinger states that in its feeding value an acre of it is equal to an acre of wheat. The seed is eaten by red birds.

The foregoing, with the grasses described in Part I constitute the principal economic true grasses in the State. A few of the domesticated grasses have been found growing in the wild pastures. Among the most valuable of these are the Randall grass (*Festuca elatior*); meadow oat or evergreen grass (*Arrhenatherum elatius*); Tennessee fescue (*Festuca rubra glaucescens*); various species of *Paspalum* and *Panicum*; blue grass (*Poa pratensis*); annual spear grass (*Poa annua*); English blue grass



(*Poa compressa*) and other species of *Poa*. All these are found intermingled with the wild indigenous grasses to a greater or less extent in the highway pastures of the State. The beard grasses (*Andropogons*) form by far the largest number of grasses that occur in the natural pastures on the Cumberland table-land and on the Highland Rim.

WILD LEGUMINOUS AND OTHER FORAGE PLANTS FOUND IN THE HIGHWAY PASTURES OF TENNESSEE.

There are many species of wild vetches, beans, peas and nuts, and several grazing plants belonging to the leguminous family that are found in the highway pastures and woods and in old fields, fence corners and waste places that furnish forage, seeds and nuts highly nutritious for stock. The wild vetches are especially abundant. Among the most valuable are the small flowered vetch (*Vicia micrantha*), Carolina vetch



Drop Seed Grass—*Sporobolus Indicus*.

(*Vicia Caroliniana*), American vetch (*Vicia Americana*), Tennessee milk vetch (*Astragalus Tennensiensis*), Canada milk vetch (*Vicia Canadensis*). These vetches are found in most of the highway pastures of the State, sometimes abundant, sometimes scarce, adapting themselves to the character of the soil, some preferring a limestone soil, others a sandy soil. Some of these make excellent food for cattle, sheep and hogs.

The pencil flower (*Stylosanthes elatior*) is found on the sandy soils throughout the State. It is a lowly herb, growing in tufts and the stems are downy on one side. It has an orange yellow flower. Cattle are very fond of it.

Bush clover (*Lespedeza*). There are six or eight species of this genus known to grow in Tennessee. The *Lespedeza repens*, *Lespedeza*



Herd's Grass—*Agrostis alba*.



Timothy—*Phleum pratense*.



Tall Meadow Fescue—*Festuca elatior*.



Meadow Oat Grass—*Arrhenatherum avenaceum*.



Perennial Rye Grass—*Lolium perenne*.

FIVE IMPORTANT MEADOW GRASSES.

Stuei, *Lespedeza capitata*, *Lespedeza violacea*, *Lespedeza hirta* and *Lespedeza striata* or Japan clover, are all valuable grazing plants. The last named is an introduced plant and has been treated at length in another place. It is believed that the indigenous varieties found in America are equally as valuable, though probably lacking in the diffusive qualities of Japan clover. All the native species are found growing on dry soils and in barrens, though they are not averse to good soils.

Tick trefoil, beggar's ticks, beggar's lice. There are sixteen species of tick trefoil growing for the most part on uplands and siliceous and sandy soils of the State, though a few cling to the limestone soils and to rich woods. These furnish a large bulk of the pea vine forage found in uncultivated regions. They enrich the herbage of all the natural pasture lands of Tennessee.

The wild "clovers" are numerous and nutritious. Among the best are several species of the *Petalostemon* and the *Trifolium* genera. Leafy prairie clover (*Petalostemon foliosus*), Buffalo clover (*Trifolium reflexum*), white clover (*Trifolium repens*), and black medick (*Medicago lupulina*) are all valuable forage plants.

The *Psoraleas* supply good food for cattle. This genus prefers uplands and open piney woods. *Psoraleas melilotoides*, for instance, is quite abundant in the open, sandy woods of the southern counties of West Tennessee. It is a vigorous perennial with stout, deeply growing roots.

Ground nut or wild bean (*Apios tuberosa*) grows wild in the woods in various parts of the State, generally in low grounds. It has subterranean shoots bearing tubers which are greatly sought after by swine. It grows with a climbing vine and its flowers are a brownish purple with a faint odor of the violet. It bears legumes from three to five inches long which contain from eight to ten seeds. Dr. Gattinger thinks this is one of the wild leguminous plants that ought to be introduced into cultivation.

The wild kidney bean (*Phaseolus perennis*) is a very common plant in every part of Tennessee. It grows in woody places. It has slender climbing stems and scimitar-shaped drooping pods with four or five seed each. It forms one of the valuable wild beans of the wooded pastures. Another species of this same family is the long stalk kidney bean (*Phaseolus helvolus*) which grows on sandy soils. The stalks are several times larger than the leaves. One single plant makes a large quantity of herbage for stock.

Still another member of this family is the creeping kidney bean (*Phaseolus diversifolius*) which grows in the cedar glades with a prostrate spreading stem and supplies valuable forage for hogs, sheep and cattle.

There are several wild peas that are held in high esteem by those who depend during the summer and fall months upon the woodland pastures for carrying their stock. The best are: The Virginia butterfly pea (*Centrosema Virginianum*), the milk pea (*Galactia mollis*), the smooth milk pea (*Galactia glabella*), and the butterfly pea (*Clitoria Mariana*). All these produce foliage and fruit that are eaten by cattle.

The hog peanut (*Amphicarpaea monoica*) grows on rich soils and is a common plant in the wooded lands around Nashville. The herbage is good for cattle and the subterranean nuts for hogs.

Several sensitive plants grow in the woods on dry or siliceous soils in every part of the State, and are eaten by all kinds of herbivorous animals. The best of these are the *Desmanthus brachylobus*, the *Schrankia uncinata* and the *Schrankia angustata*, the two latter being creeping briars.

Besides the leguminous plants herein mentioned as furnishing, in highway pastures, sustaining food for domestic animals, beggar's lice (*Cynoglossum Morisoni*) may be added. This belongs to the borage and not to the leguminous family. It grows in fields and woods and the ripened fruit, which consists of convexed-barbed, flat nutlets slightly joined together, is greedily eaten by cattle. These nuts ripen about the time of the first autumnal frosts and are highly nutritious. Cattle often fatten upon them during the latter months of the year.

For the raising of swine the pasture lands of the mountain districts offer unusual advantages, for, besides the nutritious grasses and leguminous plants there are succulent and aromatic roots in which these animals delight. There is also an abundance of mast, which supplies food for cattle as well as hogs from early fall through the winter until the grasses and forage plants spring up with the warmth of the season. The mast is both bitter and sweet. The bitter mast is composed of the acorns of the oak trees; the sweet mast is composed of the nuts of the beech, hickory, chestnut and walnut trees and hazel bushes. Persimmon, haw, pawpaw, huckleberry, blackberry, dewberry, mulberry, service berry, wild grapes and other fruits and berries are greedily devoured by hogs. Thousands of head of these animals are kept fat throughout the entire year by the food which they get from natural pastures.