

KENTUCKY  
AGRICULTURAL EXPERIMENT STATION

OF THE

State College of Kentucky.

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BULLETIN NO. 87.

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1. Kentucky Forage Plants—The Grasses.
  2. Analyses of Some Kentucky Grasses.
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LEXINGTON, KENTUCKY,

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**KENTUCKY**  
**Agricultural Experiment Station.**

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ADDRESS:

KENTUCKY AGRICULTURAL EXPERIMENT STATION,  
LEXINGTON, KY.

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### I. Kentucky Forage Plants—The Grasses.

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BY H. GARMAN, ENTOMOLOGIST AND BOTANIST.

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The State produces her fair proportion of the forage product of the United States. She is just within the wheat belt, and while this is not her characteristic crop, some regions of the State are largely occupied with wheat growing and produce a winter wheat of very good quality. Oats do not thrive as generally here as in some other states, yet the crop is not a small one (1,725,596 bushels in 1898), and at times the quality is first-class. Barley and rye do well in the State. Most of our soils produce excellent corn, which is the leading forage crop. It is grown in every one of the 119 counties, the lowest yield, in 1898, according to our State Commissioner of Agriculture, being 32,380 bushels, while five counties produced more than a million bushels each. Sorghum grows well everywhere, and is employed both for green forage and for making syrup. Timothy, clover and orchard grass are extensively grown for meadow, 361,696 tons of hay, mostly of these grasses, being produced by Kentucky in 1898, and in addition 142,875 bushels of grass and clover seeds were harvested.

The fame of Kentucky does not rest on any of these products especially. It is her blue-grass pastures that give her standing in the world, and their charm that gives the State its peculiar hold on the affections of those born and reared upon her soil. The phrase "Down in Old Kentucky" conveys to the wandering Kentuckian a picture in which are sunny slopes of soft green grass; grazing horses and cattle, sleek and beau-

tiful beyond the belief of those who have not seen them ; together with memories of humming bee, and piping lark, and smell of clover and locust blossoms. Blue-grass Kentucky is a delightful bit of the world in May and June ; and all that her children say and believe of her, and more, is then true. And it is largely the result of the profusion with which the little plant, blue-grass, grows in her limestone soil. If it grew everywhere in the State as it grows here about Lexington we should have little occasion to discuss forage plants in these bulletins. But Blue-grass Kentucky includes only about one-fifth of the area of the State, and outside this section we have yet much to hope and labor for in the matter of forage for stock.

#### NATURAL FORAGE REGIONS.

Years ago, when the old Transylvania University was at the zenith of its fame and influence, a man, dark of feature and with something in expression and carriage that marked him a foreigner, might often have been encountered trudging along country roads about Lexington or threading his way through forests and along streams searching for plants and shells and fossils. Breaking off a fragment from a rocky ledge here, turning over a stone yonder, to expose the lurking salamander or lizard, he went his way absorbed in study of the nature about him, unmindful of self, unmindful of scoffing neighbor and wondering country folk, bent solely on learning the truth and proclaiming it. This was the naturalist Rafinesque, at one time Professor of Botany and Natural History at the University, a man whose great misfortune it was to have been half a century ahead of his associates, and who suffered for it later by dying unattended and in poverty in a garret in Philadelphia. But Rafinesque is still an influence in the world, and the scoffer who gorged himself while the naturalist toiled, and lolled in his chair and smiled at the thought of his importance, has disappeared and left no trace—the natural end of self-sufficiency in all times.

These and similar reflections have been suggested to me from time to time as I have encountered traces of this man while studying the zoology and botany of Kentucky. For he

is remembered very well by people yet living in this vicinity. There is probably not a nook or corner of interest within ten miles of Lexington which he did not visit, always, I am told, traveling afoot and carrying a pack for rocks and plants at his back. His acquaintance with Kentucky plants seems to have been particularly good, and the natural botanical regions\* into which he divided the State are based upon real knowledge, which could only have been acquired by arduous out of door work such as he is known to have done. The regions he proposed are the following, and are presented in this connection because of their bearing on the distribution of forage in Kentucky.

1. The Fluvial or River Region, characterized by such species as the sycamore, catalpa and cottonwood.

2. The Central or Limestone Region, characterized by the buckeye (*Æsculus glabra*), pennyroyal (*Isanthus*), boneset (*Eupatorium*), etc. Of this region Rafinesque says it is poor in species. Until reading his statement I had been accustomed to regard this relative scarcity of species as the result of close cultivation and grazing, but in his time doubtless there was much virgin land that showed what the flora had been before the advent of the white man.

3. The Hilly Region—a series of knobs that starts at the Ohio river in Lewis and Mason counties, encircles the Central Region, reaching the river again in Jefferson county near Louisville. This is still one of the best collecting grounds in the State, and is characterized by the small hill iris (*Iris cristata*), by the red cedar, and by the pines.

4. The Barren Region—The open section of the western and southern parts of Kentucky, with a flora like that of the northern prairies, including such genera as *Rudbeckia*, *Silphium* and *Ruellia*.

A consideration of the whole flora of Kentucky would perhaps require some modification of the boundaries of Rafinesque's regions, but as laid down by him they serve in a general way to indicate characteristic forage regions of the State.

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\* See the Western Review and Literary Magazine, published at Lexington by W. G. Hunt in 1819-20, Vol. I, p. 97.

The hill region I would extend to include the mountains of Eastern Kentucky. Some trace of it may be detected to the westward of the central region even in Edmonson, Grayson and Hardin counties, indicated by the presence there of the great-leaved magnolia (*Magnolia macrophylla*), the umbrella tree (*M. tripetala*), holly (*Ilex opaca*), and mountain laurel (*Kalmia latifolia*). At present it is characterized by its deficiency in cultivated forage, and marked by the abundance of forest trees and native leguminous plants.

While the central region produces most of the commonly cultivated forage crops, its blue-grass is what gives it distinction at the present time.

The fluviatile region, of course, follows the rivers. It is marked by extensive bottom-land corn fields. The establishment of permanent meadow and pasture is made difficult over much of it by spring overflows.

The name barren region does not imply sterile soil, but was applied in early days to a portion of the State that was largely free from forest growth. As here used it includes our best wheat and corn counties, Christian county producing more of both of these crops than any other county in Kentucky. It is characterized, besides, by orchard grass and red-top meadows. Some portions of it are adapted to southern forage crops, such as Bermuda grass, which seems to be worthy of more extended trial than it has yet been given. I have extended this region to include all of the State lying west of the Tennessee river, which seems not to have been visited by Rafinesque, although the bottom lands, especially, show so many species characteristic of the far South, that it might well form a separate botanical division. I need only refer to the presence of Mississippi hackberry (*Celtis mississippiensis*), the pecan (*Hicoria pecan*), the red buckeye (*Aesculus pavia*), bald cypress (*Taxodium distichum*), the red iris (*Iris fulva*) and the water locust (*Gleditschia monosperma*), in illustration.

#### KINDS OF FORAGE PLANTS.

Our forage plants may for convenience be separated into three groups: (1) The grasses (Gramineæ), including blue-grass, crab-grass, timothy, Johnson grass, wheat, corn, rice

and a large number of other species ; (2) the clovers (*Leguminosæ*) and their allies, such as alfalfa, cow peas, soy beans, and the like ; (3) a small number of plants of other families, of value for some kinds of stock, or adapted to special situations, such as dwarf essex rape and the Australian salt bush. In this bulletin only the true grasses, native and introduced, are included, the observations both in the text and in the tables following coming largely from grasses grown in plots on the Experiment Farm. These plots have numbered about thirty-two during the past eight years, and have given us a means of estimating the value of the species for this region, which could not have been obtained in any other way. But it must be added that the soil on which the plots were situated is rather poor, on which account I do not feel disposed to pass final judgment on some of the species. New plots on better soil have already been started, and will serve to correct and extend the observations now presented.

The clovers and other forage plants, of which we have had about twenty plots growing on the Farm for some years, will be treated in a bulletin to be printed later. It is hoped that it will be possible to give native species special attention in a final account of Kentucky forage, and with this in view I take advantage of the opportunity to request correspondents of the Station to call our attention, as occasion may arise in the future, to any native grass or other forage plant of which stock appear to be specially fond, sending us at the same time if possible specimens of the plant in flower. Wherever bluegrass, timothy and red clover grow well the question of forage for stock is in a way solved. But in sections of both eastern and western Kentucky they do not thrive, and, whatever the cause, the fact must be faced. Some of our native grasses and clovers may on trial prove adapted to cultivation in these sections. The hairy bush-clover (*Lespedeza hirta*) has already been pointed out to me by Col. Jay H. Northup, of Louisa, as relished by stock and otherwise adapted for forage in the mountains. A careful study of this and related genera would perhaps reveal others even more promising. What is wanted for the rather sterile mountain sections is a perennial that will

stand our uneven winters and our very hot summer sun. It is not unreasonable to hope to find among the native species growing in this region plants that after cultivation and improvement will meet these requirements as well or better than any to be found in foreign countries.

#### THE GRASSES.

Grasses may be known by their jointed stems, bearing very small flowers which are generally more or less green in color, and either form a loose head or panicle (as in blue-grass) or else are closely placed so as to produce a cylindrical spike or spike-like panicle, as in timothy. The flowers are often complete, that is, with both stamens and ovary in one flower, but occasionally the staminate flowers are separate from the pistillate and on a separate part of the panicle, as in wild rice, or even on a different part of the plant, as is true of Indian corn (maize). As the flowers are not brightly colored and do not produce nectar, they are not much visited by insects, the wind being the important agent in carrying pollen from one flower to another. Besides well-known plants employed for pasturage and hay, the family includes others that provide the most valuable vegetable food of man, so that it can be said that the grasses furnish us with both meat and bread. In corn, wheat, oats, rye, barley, rice, blue-grass and timothy we have a group that has no equal in its importance to us elsewhere in the vegetable kingdom.

*Agropyron cristatum* (Crested wheat-grass). This grass, which is about 30 inches high, produces a short spike-like head resembling that of wheat. It has been observed but once, July 5, 1895, when a specimen was collected among grass plots on the Experiment Farm. No doubt it was introduced among grass seeds bought of an eastern seedsman. It is a native of Northern Asia, and is reported to have been observed in Scotland.

*Agrostis alba* (Red-top). Where the soil holds water well red-top thrives in Kentucky and has a value for meadow. It is not commonly grown in the limestone soils of Eastern Kentucky, but may be seen here growing spontaneously along



water courses. In porous soils and on high ground it suffers in August and September from drought. On the Experiment Farm at Lexington, on rather poor soil for this region, it reaches a height of two feet about June 20, when its panicle is fully expanded. On wet ground along ponds and streams it has been noted at times as about three feet in height. The head or panicle is contracted and green at first, but expands and assumes the characteristic purple (not red) color later. When fully expanded, heads measure from six to eight inches long and are about three inches in expanse. The blades are rather short and flat, those of the stem (culm) measuring from about three to five inches long and one-fourth inch in greatest width. A plot started in the spring of 1893 and left to itself very largely after the first season, lasted only until 1896, when but few tufts remained, the rest of the ground having been occupied by weeds. The grass of this plot became perfectly brown in winter, and would not then have furnished any grazing. In the latter part of March the green blades began to appear and by the last of April a very nice growth six inches high was generally visible, when it would have furnished very good grazing. In the latter part of July the growth stopped, and the grass remained stationery until September, when green blades began to appear and during October the plot was again in a condition to furnish some grazing. The first cold weather, however, turned all parts of the plants above ground brown. The portion of the State beginning with Jefferson and Nelson counties and extending westward to the Tennessee River seems to be better adapted to red-top than eastern Kentucky, and I have seen some very good crops of hay cut from fields in that region.

It is a very nutritious grass, ranking in this regard with timothy and blue-grass, but is said not to be relished by stock in some localities.

It has been observed from time to time growing spontaneously at the following places: Crab Orchard, Junction City, Brooklyn Bridge, Lexington, Clay's Ferry, Maysville, Dickey's Mills.

*Agrostis canina* (Rhode Island bent-grass). This grass,

planted side by side with red-top, has proved a more hardy and durable species. It soon forms a close-knit turf from which during most of the season cattle could get some grazing. But its blades are short and rather slight, and hence the amount of forage produced by it is relatively small. Because of the close turf formed it stands drought on dry ground better than red-top, though both grasses do best in damp soil. It can only prove of value for grazing. Produces rather small panicles, with a general resemblance to those of red-top, in late June, and then averages about twenty inches in height.

*Agrostis elata.* A native grass observed in Harlan and Bell counties by T. H. Kearney in 1893. A late-blooming species which, according to Scribner, reaches a height of about two feet.

*Agrostis elliottiana.* A very slender, insignificant native grass about 12 inches high. Stems thread-like. Blades very short. Not worth considering as forage. Observed at Nortonville, May 12, 1898; at Central City May 15, 1899; and at Auburn May 17, 1898.

*Agrostis hyemalis* (Rough hair-grass). A widely distributed native species, of slight habit such that it is not calculated for forage. Panicle very long with slender thread-like branches. A specimen in the Station collection measures twenty inches in height. Localities: Junction City, June 19, 1892; Nortonville, August 8, 1892; Aden Springs, October 22, 1892; Cave City, May 19, 1898; Central City, May 15, 1899; Prentiss, Ohio Co., May 17, 1900 (from Mr. E. G. Austin).

*Agrostis intermedia.* Grows in the mountains of Southeastern Kentucky, where it was collected by Kearney. The original description is in the Bulletin of the Torrey Botanical Club, Vol. 20, p. 476.

*Agrostis perennans* (Thin-grass). A slender grass inclined to be prostrate. Panicle scant, the branches very slender. Attains a height of twenty inches or more, but is so very slight as not to promise well for cultivation. Localities: Clay's Ferry, August 22, 1893; Hawesville, August 16, 1898.

*Agrostis stolonifera* (Creeping red-top). Regarded as a variety of red-top, but differs in producing a dense turf and in being more persistent in some situations as a consequence. It is not so well adapted for meadow as for pasture.

*Alopecurus agrestis* (Slender foxtail). Of European origin. The seeds are sometimes offered for sale by American seedsmen. In general the plant resembles timothy, having flat blades sometimes one-fourth inch in diameter and 5 inches or more long, with at flowering time a cylindrical head 3 to 4 inches long and three-sixteenths inch in diameter. In a plot on the Experiment Farm the heads appeared from May 12 to May 21, and the grass then averaged about two feet in height. In England it is known as black grass and is said to have the character of a weed in some soils. It showed but poor staying qualities on the Farm and when left to itself soon disappeared.

*Alopecurus geniculatus* (Marsh foxtail). A low growing grass 10 inches or less in height, observed growing in tufts in wet places at Clinton, Ky., May 12, 1898. The heads are from one to one and a half inch long with a diameter of rather less than three-sixteenths inch. The plant is too slight to be of value on the farm. It has probably been introduced from Europe with seeds of other plants.

*Alopecurus pratensis* (Meadow foxtail). This is a handsome introduced species that we have grown for some years on the Experiment Farm, where at times it has presented a very fine appearance. The head resembles that of timothy, but is shorter, ranging from about 2 to 2½ inches in height and having a diameter of ¼ inch, or a trifle more. The seeds at the tip ripen and fall first, the central axis becoming gradually bare from the tip. It grows in large tufts, with numerous, rather large, green blades at the base, the stems with heads measuring from 2 ft. 5 inches to 3 ft. 5 inches high. The blades themselves are often 8 to 9 inches long and ¼ inch in diameter. Growth starts very early in spring, often as early as March 6, and by the last of March the dense tufts of blades would make excellent grazing. It is ready to cut by the first

of May and would doubtless make a moderate yield of good hay, though it strikes me as better adapted to pasture. While it is one of the most attractive species we have grown, it lacks the spreading habit that goes to make our best pasture and meadow grasses. In England it is highly valued for pasture, and is said to do best on clay soils, and I judge on rather low ground.

*Andropogon halepensis* (Johnson grass). A coarse grass adapted to damp situations and rich soil. It spreads by thick underground stems, which remain in soil over winter and send up a new growth late the following spring, the time at which it appears varying with the season, but ranging from about the last of April until the middle of May. By the middle of June it is two feet high, with blades 22 inches long and as much as  $1\frac{1}{4}$  inch wide, with the panicles just appearing. About July 20 it is at its best, the panicles being fully developed, sometimes with a length of 18 inches and an expanse of 8 inches, the plants themselves averaging  $5\frac{1}{2}$  to 6 feet in height. On the Experiment Farm in 1894 some plants measured 75 inches in height. The panicles soon assume a purple hue, and later become dark brown. The grass presents a thrifty appearance throughout the fall months, until frost comes, when it is killed to the ground at once, and nothing but dead remnants is seen until the following spring. Sometimes, as in 1895, it is cut down also by late spring frosts. It is a near relative of the common sorghum, and furnishes nutritious food which seems to be greatly liked by all browsing animals. The amount of forage it yields is not as great as would be expected, this being the result of the large space occupied by individual plants. The most serious objection to it is the fact that once established it is rather difficult to eradicate, but this objection has not the same force in Kentucky as farther south, because it can be killed here by plowing at such time as to expose the underground roots to the frost.

Johnson grass is not as hardy in Eastern Kentucky as it is in the western counties. It grows spontaneously throughout the State, however, though nowhere very common. Specimens have been collected by me at Lexington, Bowling Green

and Clinton. It was received at the Station July, 1894, from Mr. O. E. Bowles, of Pikeville, in the extreme southeastern end of the State.

*Andropogon nutans*, var. *avenaceus* (Indian grass). A coarse native grass, with long blades and rather close spike-like panicle. A specimen in the collection from Livingston, Ky., measures about 40 inches in height, with the panicle 9 inches and blades about 12 inches long. It is said to reach a height of 8 feet. Observed only in Southeastern Kentucky.

*Andropogon provincialis* (Forked beard-grass). A prairie grass of the Middle States, where it is sometimes cut for hay. Native throughout most or all of Kentucky and not uncommon. Possibly worth cultivating in sections where timothy does not thrive. Height in good soil about five feet, the slender spikes resembling small heads of rye,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  inches long, in pairs at intervals along the stem, or sometimes three at the summit. Blades broad, and 12 inches or more long.

*Andropogon scoparius* (Broom beard-grass). This is related to the preceding, but is more slender, with narrower blades and slight short heads, the spikelets of which are covered with silky hairs. Blades about 10 inches long. Heads 1 inch, or a trifle more. Clay's Ferry, Ky. R., Aug. 22, 1893; Kearney records it from Southeastern Kentucky.

*Andropogon sorghum* (Sorghum, Broom-corn, Kafir corn). This well-known species is cultivated everywhere in the State as sorghum and broom-corn. Kafir corn has not been seen in cultivation, excepting in a small plot on the Experiment Farm. Sorghum stands drought better than corn, but on the whole cannot be considered the equal of the latter as green forage. When cut before it becomes too tough, it makes very fair silage. Kafir corn is a dwarf variety, and has not proved with us in any way remarkable. Common sorghum appears to have all its good qualities with some additions.

*Andropogon virginicus* (Broom-sedge). No plant occurring in our fields is better known than this. In blue-grass Kentucky it is not as common as elsewhere, yet can be found close to the edge of Lexington on bits of particularly poor ground. In western Kentucky it often occupies meadow and pasture land to the exclusion of most other grasses. Late in fall and in winter its tough stems are to be seen over large tracts of land, attracting attention because of their peculiar reddish brown color. When young they are eaten by stock to some slight extent, but later become so tough and dry that they are untouched even when forage is scarcest and everything else is grazed close to the ground. Occurs throughout Kentucky. Aden Springs, Lexington, Bardwell.

*Anthoxanthum odoratum* (Sweet scented vernal-grass). An attractive little grass worth cultivating among more productive meadow grasses because of the pleasant fragrance it imparts to hay. It grows in dense clumps six or seven inches across finally, but this is about the extent to which it spreads after becoming established. The dropped seeds do not germinate as a rule, and hence if one fails to get a stand at the start, vacant ground is not likely to be occupied by it. It is only moderately hardy. Our plot was badly injured by freezing during the winter of 1895-96, but revived in great part later, though it did not produce heads in 1896, and is still alive. Excepting this sensitiveness to cold it is quite persistent, standing drought splendidly, and throughout the season presenting a growth of rather short, light green blades that would make good grazing. When cut it sends up a fresh growth promptly, but does not grow tall enough to make it profitable for meadow. The heads develop from about May 1 to May 15, are rather thick and about  $1\frac{1}{2}$  to  $2\frac{1}{2}$  inches long. It has not been observed growing spontaneously anywhere in the State.

*Aristida gracilis* (Slender aristida). A very slight native grass observed to be common on poor land in the vicinity of Bremen, Muhlenberg County, Sept., 12, 1899. The species

was collected in the mountains of Southeastern Kentucky by Kearney. Of no possible value for stock.

*Aristida oligantha* (Few-flowered aristida). Collected in Muhlenberg county with the preceeding, on dry, clayey soil along country roads ; a thin wiry growth, with a poor hold on the soil, of no value for stock.

*Aristida purpurascens* (Purplish aristida). Collected in the mountains of southeastern Kentucky by Kearney.

*Aristida ramosissima* (Branched aristida). Credited to the State by Dr. Asa Gray, by Britton and Brown, and by Kearney.

*Arrhenatherum elatius* (Tall oats-grass). Among from forty to fifty forage plants kept growing on the Kentucky Experiment Farm for a number of years, this has always, winter and summer, been one of the finest in appearance. In the matter of hardiness and productiveness it has had no equal on the Farm. It stands drought better than timothy. It has not been affected by the severest cold weather we have had during the past six years. It grows rapidly on poor soil.

When fully grown about the middle of June it is often five feet in height, with a panicle somewhat like that of oats, and inclined to droop a little, but not so coarse. After flowering it soon becomes rather woody and should on this account be cut promptly before the panicles mature. After cutting, a new growth of blades appears, that might furnish either pasture or hay.

The experience of American farmers who have tried this grass is in its favor, but British farmers say it is bitter and unfit for either hay or pasture. It is at least worthy of trial in Kentucky. As showing more fully the character of the grass, the following is quoted from notes made on the plot grown on the Experiment Farm.

June 13, 1893. Recently replanted. A regular growth of a bright green color.

Aug. 8, 1893. A fair growth. About 8-10 inches long. Coarse ; grayish green, like timothy.

Jan. 20, 1894. A very good green growth in dense tufts.

June 16, 1894. Averages five feet high. Some stalks five feet four inches. Heads 7-14 inches long, a little inclined to droop. Chiefly past its flowering season. Not a very good mat of blades at base, but those well up the stems are of considerable size and sufficiently abundant to make good fodder. Growth still confined to lines in which seed was drilled. Blades  $5\frac{3}{4}$  to 7 inches long and  $\frac{3}{8}$  inch wide, resembling those of oats and with a gray bloom. Panicles green at first, but finally becoming whitish with a purplish cast.

July 10, 1894. Had this cut yesterday. Weight at present, 40 pounds.

July 26, 1896. Since cutting, this has sent up a good growth of fresh green blades, in places six inches long.

Aug. 23, 1894. A splendid growth of blades. Fresh and green. Would make good pasture. Blades 6-12 inches long.

Nov. 6, 1894. Very good. Uniform. Would make fine grazing. 8-12 inches high. A very slight trace of injury from recent frost.

Dec. 4, 1894. Good, but some brown.

March 6, 1895. Very fair. Generally brown, but with a good appearance of green mixed with it. A dense growth in drills. Does not spread much.

March 30, 1895. Very good. Would make excellent pasture.

April 29, 1895. A fine growth, 12-18 inches high. Growth green, like timothy. No trace of stems yet. The tallest and rankest among the grasses planted.

May 24, 1895. A fine growth just heading out, stems with heads often 44 inches high. Leafy to the top. Would make fine hay. Nodes (joints) dark purple. Heads with a silvery sheen and purple cast,  $9\frac{3}{4}$  inches long in some cases. Longer blades  $7\frac{1}{4}$  inches by  $\frac{3}{8}$  inch.

June 29, 1895. Cut this on the 27th. Weight, 42 pounds.

July 25, 1895. A splendid growth, 8-10 inches high. A very fine grass.

March 26, 1896. Splendid. Green growth looks well. Several inches long. Best-looking plot of all.



April 17, 1896. Very good. Growing rapidly.

April 27, 1896. A fine stand of green blades 10 inches high. Has not spread from lines in which seed was drilled, but persists in a most vigorous fashion.

July 6, 1896. A very good growth, but not as good as it was last year. Stems 36 inches high. A good growth of blades at base of stems, this growth forming a dense mass about 18 inches high. Stems brown and dry.

July 28, 1896. 18–20 inches high, mostly blades. Few heads this season. Looks well for the season, but is not as good as last year.

June 20, 1897. Seeds ripe for some time.

May 23, 1899. Averages 34 inches high. Headed out. Still shows lines in which it was drilled, but a fine growth notwithstanding, and I cannot see that it has deteriorated in the slightest degree since the first year it was grown here.

August 23, 1899. This old plot still in splendid condition. Now fresh and green and looks like fine grazing.

*Arundinaria macrosperma* (Cane). The larger growth of this plant furnishes the fishing rods often seen for sale in stores. The small variety from 4 to 8 feet in height is most commonly seen growing in this State, generally in swamp land or along rivers. It is likely to be encountered anywhere within our borders. It has been observed and collected at Bryan Station, Clay's Ferry, High Bridge, Greensburg, and elsewhere. Kearney reports it from the mountains in southeastern Kentucky. The tall variety occurs chiefly in the southern counties. The blades are eaten by stock to some extent.

*Bouteloua curtipendula* (Racemed bouteloua). A native grass credited to Kentucky by Britton and Brown in their Illustrated Flora.

*Brachyelytrum erectum* (Brachyelytrum). A slender-stemmed grass with numerous rather short, broad and rough leaves. Grows in rocky woods. Brooklyn Bridge, July 22, 1892; Nortonville, Aug. 7, 1892; also reported from the mountains by Kearney.

*Bromus ciliatus* (Wood chess). A native grass reaching a height of five feet, with a drooping panicle somewhat like that of English blue-grass, but coarser. Blades numerous, 10 inches long or more, and  $\frac{1}{2}$  inch wide. In woods in spring; common. Banks of Kentucky River, Clay's Ferry, May 30, 1892; Tyrone, June 9, 1892; mountains of eastern Kentucky (Kearney).

*Bromus erectus* (Hairy brome-grass). A tall grass with downy blades and rather coarse panicles, somewhat resembling those of cheat. Encountered in cultivated ground, where it is commonly introduced with seeds of other plants. It is of European origin. Specimens in the herbarium of this Division were collected on the Experiment Farm, May 2 and May 21, 1890.

*Bromus inermis* (Smooth brome-grass). An introduced perennial of fine appearance, reaching on the Experiment Farm a height of 44 inches, with numerous long blades and an open panicle, slightly inclined to droop,  $7\frac{1}{2}$  to 9 inches long and with an expanse of 6 inches. Blades 8-11 inches long and  $\frac{1}{2}$  inch wide. It remains green until late in the fall, and starts promptly again in spring, a decided new growth being apparent by the last of March. After cutting it comes up promptly and would furnish grazing during the latter part of summer and in fall. It spreads to some extent by underground stems, and on the Farm the dropped seeds germinated and grew in fall in large numbers. The grass has received extravagant praise, and undoubtedly has some very desirable qualities. Three plantings have been tried on the Experiment Farm. The first one, started in 1892, did remarkably well and lasted until 1897. The second lot was started in 1895 and is still alive, but has never done well, though it generally stands during most of the summer months with a good growth of blades. The third lot of seed was received from the U. S. Department of Agriculture and was sown in the spring of 1898. None of it germinated.

While it seems to be a promising grass, my experience with it is not such as to warrant recommending it without reservation

to Kentucky farmers as a substitute for timothy. It is well worth trying however, especially in sections where timothy does not grow well, for, once started, it seems to be the more persistent and vigorous of the two grasses. The yield per acre, calculating from the product of our plot, is from  $1\frac{1}{2}$  to 2 tons. A yield of three tons per acre has been reported by others. It should be cut as soon as the panicles are fully developed and before the seeds have ripened. The seed may be sown either in spring or fall, but from the uncertainty of seed sown in spring, and the fact that the dropped seeds germinate spontaneously in the fall, I am disposed to regard fall as the proper time to plant. It is sometimes planted with winter wheat. About forty pounds of seed to the acre should be sown. Contrary to what has sometimes been asserted, it has not with us shown a disposition to assume the character of a weed.

*Bromus racemosus* (Upright chess). An introduced grass resembling cheat, sometimes found growing about cultivated ground. Lexington, May 19 to June 5; Cave City, May 19.

*Bromus secalinus* (Cheat). This notorious grass is the subject of strange beliefs among farmers in the United States. It is held that under some circumstances good clean wheat seed produces nothing but cheat. It is even asserted that after wheat comes up as such, certain kinds of weather will cause it to produce stems bearing cheat instead of wheat. Timothy seed, it is said, sometimes produces cheat. One variation of this transmutation theory has not thus far been encountered in Kentucky, namely that clean cheat seed will under some circumstances produce a crop of wheat. The writer cannot hope to say anything that will kill beliefs that have persisted so long. They are simply curiosities to be classed with the imagined snake that takes its tail in its mouth and pursues a man by rolling like a hoop; with the notion that the number 13 is unlucky; or that a horse shoe placed above the door brings good luck.

Cheat was at one time recommended under various names as a forage plant. Its nutritive value is low, and when fed with almost any other forage plant cultivated in this country

it will be rejected by stock. It is said, however, to be preferred to straw. Lexington, May 22; Pineville, June 16.

*Bromus squarrosus* (Corn brome)? This is another cheat-like grass, sometimes found growing in Kentucky fields. Introduced with European seeds. Of no value for forage.

*Bromus unioloides* (Rescue-grass, Schrader's brome-grass). An introduced perennial grass with the general character of smooth brome-grass, but with the panicle coarser, heavier and more inclined to droop, the weight finally becoming so great that it is liable to be prostrated by wind. A plot from seed sown in the spring of 1892 lasted only until 1896, when the last plants were observed, the others having been gradually crowded out by crab-grass and other weeds. Its flowering season was about June 1, and by the 12th the panicles were brown and the seeds ripe. When cut, a very nice growth of new blades appeared before fall that would have afforded good grazing. It would not have furnished winter forage, but started very early in spring, and on January 20, 1894, had produced a fine growth of blades in the path alongside the plot where the seeds had dropped during the preceding season. Fully matured plants taken from the plot June 19, 1894, measured 40 inches in height, the panicle constituting  $7\frac{1}{2}$  inches of this. The blades are of a dark sea-green color, with a yellow cross band at the base, are 7-10 inches long,  $\frac{1}{2}$  inch wide, the ensheathing portion and the under side of the blade itself, when young, finely pubescent.

It did not stand drought well, and this, I believe, explains its failure to keep possession of the ground. On less porous soils than ours it might do better in this regard. When in bloom it presents a fine appearance. Thirty pounds of seed are sown to the acre. In Georgia it does well when sown in November and December. Here it is best perhaps to sow either in fall or early spring.

*Capriola dactylon* (Bermuda-grass). Farther south this grass is valued both as a hay-producer and for grazing. It resembles in a general way our crab-grass, so troublesome in

cultivated ground, and has the same habit of spreading by runners which send out roots at the joints (nodes). Seed sown on the Experiment Farm has never germinated, and the only plants I have seen here were grown from material kindly furnished some years ago by Col. J. Stoddard Johnston, of Louisville. These plants lasted only one season and were killed by frost the following winter. When introduced in soil in Western Kentucky, Bermuda grass persists, the climate there being more nearly that of the southern states. I have seen on the lawn of the late J. M. Samuels, of Clinton, Hickman county, a tolerably dense growth of the grass, in flower, and about one foot high. For most of Kentucky it cannot be considered a rival of blue-grass. Its capacity to withstand summer heat and thus furnish green forage when blue-grass is at its worst, would render it useful were it not for the fact that it must be grown by chopping up the stems or roots and sowing them in drills, for it appears not to produce perfect seeds at this latitude.

Prof. Tracy, of Mississippi, says that Bermuda-grass is to the South what blue-grass is to the North, and rates it the best hay and pasture-grass for that section, excepting for wet land. The product is, he says, from two to four tons to the acre. To start a meadow he advises cutting the sod formed by the grass into small pieces about an inch square, and dropping these about two feet apart each way, pressing them into the soil with the foot. When the ground is too hard for this procedure a hoe is made use of to dig small holes, a second man dropping the pieces and covering them. The seed is sown in March, six pounds per acre being used.

*Cinna arundinacea* (Wood reed-grass). A coarse grass reaching a height of 4 feet, with rough broad blades and a panicle about 7 inches long, resembling somewhat that of red-top, but not spreading, the branches bearing the small flowers extending close along the axis of the panicle. A native species perhaps worthy of trial for forage. Clay's Ferry, Aug. 22, 1893; Nortonville, Aug. 7, 1892.

*Dactylis glomerata* (Orchard-grass). This well-known grass

has qualities that should commend it to Kentucky farmers who fail with other forage. It is persistent, enduring heat and cold better than timothy. It grows rapidly, is moderately productive, and will thrive either in sun or shade. I have observed some indications that stock in this region do not like it very well, having more than once seen inviting-looking tufts of blades left untouched in pasture where everything else was cropped close to the ground. Yet I am familiar with published statements to the effect that all kinds of stock are fond of it, sheep being said to prefer it to all other grasses. It is nutritious, judged by the chemist's test, ranking in this respect higher than timothy. Sown thickly it will make very good meadow by itself, though the yield is apt to be disappointing because of the few stems and heads produced. It is often planted in mixtures for meadow. It requires a good soil. Grown in a plot on the Station Farm the quality that has especially attracted my attention is the large number of long blades it produces throughout the growing season. From January 20 until October these would furnish grazing. 3-4 bushels of seed are sown to the acre.

A plot of this grass started in the spring of 1892 is still in good condition. Some notes made on the growth from time to time will show among other things its time of flowering and its hardiness compared with timothy, a plot of which lies by its side.

May 13, 1893. A good growth, 7-8 inches high.

June 13, 1893. A fine growth. Blades with a tendency to turn brown at tips, otherwise not very different in appearance from timothy. Along paths especially fine and of a deeper green color than elsewhere. Heads in midst of plot rather scattering. Tallest stems, with panicles, 4 feet 3 inches. Others measure as little as 3 feet 3 inches. Panicles 4 to 6 inches long. Blades at base of plants from 1 foot 4 inches to 1 foot 10 inches long.

August 8, 1893. A very good growth of blades over whole plot. Has stood drought remarkably well.

January 20, 1894. Good; green, might make fair pasture.

June 18, 1894. A good growth of blades giving the appear-

ance of covering the ground completely, but plants still confined to lines in which seed was drilled; unlike timothy in this respect. Many culms as much as 42 inches tall. Panicles 5 to 7 inches long. Blades 8 inches to 1 foot long,  $\frac{1}{4}$  inch wide. At the outside along paths and next adjacent plots the growth is better, the blades assuming a darker and more thrifty color and reaching a length of 18 inches.

July 10, 1894. Cut this yesterday. A good growth of blades left that would furnish some pasture.

July 26, 1894. This has grown perceptibly since cutting, and would now make good grazing. Very much superior to the timothy plot.

August 23, 1894. Good. Would make first-rate pasture. No decided recent growth, however.

September 22, 1894. A uniform growth of blades here, some as much as 13 inches high. Would make fine grazing

November 6, 1894. Very good over whole plot. Would make excellent grazing. Growth dense, about 8 inches high.

December 4, 1894. Largely brown, from frost.

March 6, 1895. Very brown, but with green blades in midst of tufts, showing that the roots are everywhere alive.

March 30, 1895. Good. Green and brown evenly mixed. Would make some pasture.

April 29, 1895. *Very good.* A uniform growth of grayish green blades, 10 inches high on an average. In places at edges 14-16 inches high. Much finer than timothy plot at present.

May 23, 1895. Very good. Heading out. Stems with heads 36 inches high. Some heads much less advanced and not showing stamens. A good growth of blades, some of them 10 inches long and  $\frac{1}{4}$  inch wide, keeled on the back. Some heads 10 inches long, with an expanse of 5 inches.

June 29, 1895. Cut this on the 27th. Could be used for grazing now. Culms with panicles average 42 inches; some reaching 52 inches.

July 25, 1895. The orchard grass plot now presents a good appearance. Recent rains have caused it to freshen up and the whole plot is now green.

March 26, 1896. Good. Some green.

April 17, 1896. Good. Growing rapidly. 6 inches high.

April 27, 1896. Growing rapidly. In advance of timothy.

July 6, 1896. Very good. Ground appears to be covered, but the rows in which it was drilled can still be seen. Stems rather scattering, but growth of blades good;  $11\frac{3}{4}$  inches long, 5-16 inch wide. Stems brown and dry, about 32 inches long.

July 28, 1896. A good growth of blades. 8-10 inches long. Few heads.

June 20, 1897. Seeds ripe. Heads becoming brown.

May 23, 1899. Average height about 34 inches. Headed out. A splendid stand on this old plot. Will make a good yield of hay.

August 23, 1899. The grass in this plot has been cut, but is now looking fresh and green again.

The grass grows spontaneously throughout Kentucky, being frequently encountered along roadsides and in fence corners where it has come up from seed scattered by passing wagons. It is not so commonly sown in Blue-grass Kentucky as it is outside this region, and I am informed by local seedsmen that most of the demand for seed comes from the mountain and western sections of the State. According to one of our dealers, Mr. D. C. Frost, this grass stands first among forage plants sown by farmers outside the Blue-grass region, while within it ranks only sixth.

*Dactyloctenium ægyptium* (Egyptian grass). I have seen nothing of this grass in Kentucky, except a small plot obtained in 1896 from seed furnished by the United States Department of Agriculture. It produced a very scant growth, averaging, when fully grown, about one foot high, with the tallest plants about 14 inches. The stems terminate in from two to five rather thick spikes, the axes of which are free from spikelets at the tips and project in the form of a short spine. In some respects it resembles the common yard-grass. It does not impress me as a promising grass for this region. Plants from seed sown in the spring of 1896 were fully developed and in flower on April 25. It is an annual.



*Danthonia compressa* (Wild oat-grass). A slender-stemmed native grass, with narrow blades and few-flowered panicles. Observed only in the mountains at Pineville, in 1892. A specimen in the Station collection measures about 29 inches in height.

*Danthonia spicata* (Wild oat-grass). Also native of the State, but more widely distributed than *D. compressa*. Smaller and with the blades more slender and shorter. Pineville, June 15, 1892; Crab Orchard, June 18, 1892; Junction City, June 19, 1892; Jackson, May 26, 1895; Russell, June 9, 1898; Central City, May 15, 1899.

*Deschampsia flexuosa* (Wavy hair-grass). A few tufts of this grass have been observed by me about the grass plots on the Experiment Farm at Lexington, produced in all probability from seeds mixed with European grass seeds of other kinds. It appears to have no value for forage. The blades are small, slender and mostly at the bases of the stems. The panicle may be four or five inches long, the flowers, at length purplish with a satiny lustre, mostly out toward the extremities of rather long, hair-like branches. Plants in the collection measure 18 to 20 inches in length.

*Eatonia nitida* (Slender eatonia). A slender-stemmed grass with a rather long drooping panicle, flowering in early spring. Most of the blades are at or near the base. Height, about 2 feet. A perennial. Jackson, May 26, 1895; Natural Bridge, May 10, 1896; Cecilian, May 11, 1899; Central City, May 15, 1899; Prentiss, Ohio County, May 12, 1900 (from Mr. E. G. Austin).

*Eatonia obtusata* (Blunt-scaled eatonia). A native perennial, with slender panicle and rough blades  $\frac{3}{4}$  inches long and in some cases  $\frac{1}{4}$  inch wide, the sheaths finely downy. Cave City, May 19, 1898.

*Eatonia pennsylvanica*. Similar to the preceding, but with the panicle less compact, the branches being longer, less numerous, and the flowers fewer in number. High Bridge,

June 8, 1892; Central City, May 15, 1899; Cloverport, June 3, 1899.

*Eleusine indica* (Yard-grass, crab-grass). A tufted, leafy grass of dooryards, flourishing especially where water is thrown, with 4 to 6 one-sided spikes, diverging from or near the upper extremity of the stem. Annual, but persistent, growing again rapidly when cut, and liked by stock, though commonly looked upon as a weed. In moist rich ground, where not trampled by stock, it grows to a height of 33 inches or more. The stems bear numerous, rather broad leaves, 13 inches long in some cases, of a deep, glossy green color, with soft, scattered hairs on the upper surface and at the bases of the sheaths. The blades differ from those of many grasses, but resemble those of orchard grass, in being folded so as to produce a decided keel on the back. Yard grass stands heat remarkably well and seems to have qualities which might make it valuable for summer forage. West Point, June 27, 1892; Lexington, July 3, 1896; Lexington, August 1, 1889.

*Elymus canadensis* (Nodding wild rye). This is a coarse rough bladed grass with a head 4 to 5½ inches long, somewhat resembling that of bearded wheat. Blades often 12 inches or more long and ¾ inch broad. Occurs along Kentucky River. Clay's Ferry, Aug. 22, 1893.

*Elymus striatus* (Slender wild rye). Similar to the preceding grass, but the heads smaller, about 2½ inches long in herbarium specimens before me. Probably of little value as forage. Tyrone, July 14, 1892; Hopkinsville, Aug. 8, 1892; Lexington, Aug. 7, 1893.

*Elymus virginicus* (Lyme-grass, wild rye). A coarse wheat-like grass somewhat resembling the two preceding species and like them of no agricultural value. Not rare on damp ground along streams. Brooklyn Bridge, June 22, 1892; Maysville, June 27, 1892; Lexington, July 27, 1893; Clay's Ferry, July 27, 1893; Clay's Ferry, Aug. 22, 1893. It has been sent to the Station from Bowling Green by Mr. E. W. Slayton.

*Eragrostis abyssinica* (Teff). A plot of this annual was planted on the Experiment Farm in the spring of 1896, with seed furnished by the United States Department of Agriculture. The seed germinated well, producing a fine growth of a very pale green color, which on July 6 had reached a height of 32 inches, though not yet in bloom. The blades which were scattered along the stems measured at this date  $17\frac{1}{2}$  inches in length and  $\frac{1}{4}$  inch in width. On July 23 some of this grass, then with fully developed panicles, measured  $3\frac{1}{2}$  feet in height, the panicles themselves measuring in some cases 12 inches in length. The stems are rather slender, the panicles long and slender and disposed to droop, the branches thread-like. Yet from the closeness with which it grows it is calculated to produce a large amount of forage. We have been very favorably impressed with the grass, and though an annual, think it may prove of value. It stands drought well, and grows rapidly. When cut it produced a decided growth of blades again before fall. Professor Scribner wrote me under date August 24, 1896, that it was one of the most promising grasses grown at the Tennessee Station in 1895. It seems to be a native of northeastern Africa, where the seeds, which are produced in large numbers and are easily harvested, are used as food. It is not yet listed by our seedsmen, so far as I have examined their catalogues.

*Eragrostis capillaris*. A native annual, probably not valuable in any way, observed in the mountains of southeastern Kentucky by Kearney.

*Eragrostis frankii*. A strong scented grass reaching a height of about 14 inches, with a small-flowered panicle, sometimes 6 inches long and  $1\frac{1}{2}$  inches in expanse. Inclined to grow in tufts, on low ground along streams. Common from the mountains to the Mississippi River. Frankfort, July 30, 1892; Lexington, August 17, 1893; Clay's Ferry, August 22, 1893; Lexington, September 8, 1894; Clinton, 1898.

*Eragrostis hypnoides* (Creeping meadow-grass). A low grass, sometimes attaining a height of about a foot, which

spreads by runners which send out roots at intervals and from the same region produce more or less upright branches bearing small and rather compact panicles. A weed. Clay's Ferry, August 21, 1893; Clinton, 1899.

*Eragrostis major* (Stink-grass). While walking about cultivated ground in Blue-grass Kentucky one is frequently reminded of the presence of this grass by the peculiar buggy odor it exhales. For its genus it is a rather coarse species, attaining sometimes a height of two feet, the stems bearing compact panicles which, when fully developed, measure from about  $2\frac{1}{2}$  to  $5\frac{1}{2}$  inches in length and have an expanse of from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  inches. A weed, without any redeeming qualities. Lexington, August 13, 1889; July 3, 1890; October 6, 1894.

*Eragrostis pectinacea* (Purple eragrostis). Miss Sadie F. Price reports this grass as having been observed at Bowling Green. Professor Scribner says it is common in Tennessee in dry sandy soil, and is made use of for dry bouquets.

*Eragrostis purshii*. A tufted species growing to a height of 15 inches. A rather common weed, occurring in all parts of Kentucky. Lexington, July 3, 1890; Hickman, August 9, 1892; Clay's Ferry, August 21, 1893.

*Erianthus alopecuroides* (Spiral-awned beard-grass). A coarse native grass which may reach a height of eight feet or more, bearing at the summit of its stem a close spike-like panicle  $5\frac{1}{2}$  to 7 inches long and 1 to  $1\frac{1}{2}$  inch in expanse, becoming woolly and of a pale brownish cast when fully mature. Probably of no value for agriculture, but possibly worth cultivating for ornament, as it is one of the most imposing native members of its family. It has been observed by me only at the Sinks of Roundstone Creek, near Livingston.

*Erianthus ravennæ* (Woolly beard-grass). A tall grass somewhat resembling the preceding, but with a more spread-

ing panicle, often seen in cultivation about lawns. Introduced from Europe. Lexington and elsewhere in the State.

*Euchlaena luxurians* (Teosinte, Mexican forage plant). Teosinte makes as good forage as corn in Kentucky. Planted in April it continues to grow until killed by frost, for it comes from the South and requires a longer season than ours to reach maturity. I have thought sometimes that it endures drought better than corn, at any rate it furnishes excellent green fodder throughout late summer. Several plots have been grown on the Experiment Farm. The seeds invariably germinated well. The plants after coming up grew rapidly. Planted May 7, 1895, it was 15 inches high June 29 with blades 19 inches long and  $\frac{3}{4}$  to 1 inch wide, the general character of the plant so much like corn that it might have been taken for the latter. On August 31, 1895, the plants were  $4\frac{1}{2}$  feet high, the stems  $\frac{3}{4}$  inch in diameter at the base, the blades as much as 2 feet 10 inches long. It continued to grow until the latter part of September, reaching finally an average height of about 6 feet, and when finally killed by frost showed no trace of flowers. Planted a little earlier and given more room it grows here to a height of 8 to 10 feet, but I have never known it to produce seeds. It is a valuable plant for both green and dry fodder, but its failure to fruit must always render its cultivation somewhat costly, and I think at present corn or sorghum are to be preferred, excepting possibly for some of the counties of southwestern Kentucky, where it should at least be tried. It is better adapted to the southern tier of states, where, according to Professor Tracy, it gives the heaviest yields of any forage plant grown, "Georgia reporting 38,000 pounds of green forage per acre, Mississippi, 44,000, and Louisiana, the enormous amount of over 50 tons." The trial plots grown at the Experiment Farm were sown in drills, but it was evident that this method does not give the plants sufficient room to get from them the greatest possible quantity of forage. It is best sown in hills, like corn, but rather farther apart, using 4 to 5 pounds of seed to the acre. It has been tried at Louisa, Lawrence County, by Col. Jay H.

Northup, who wrote in a letter dated August 27, 1896, that his plants were doing exceedingly well, ranging at that date from 8 to 10 feet high, with as many as 25 shoots from a single hill.

Teosinte is a native of Central American countries, from which circumstance the name Mexican fodder plant is sometimes applied to it. An eastern seedsman's catalogue before me quotes seeds at 80 cents per pound.

*Festuca elatior* (English blue-grass). But few of the grasses tested on the Experiment Farm have done as well as this. It spreads by the roots so as to cover the ground closely in time, and afterward excludes everything else in the way of plants. A plot started in the spring of 1892 is still in good condition, though it has had no attention since the first year, beyond cutting it from time to time. About June 15 the grass in this plot averages about 4 feet in height, with some plants nearly 5 feet high. It is generally in bloom and ready to cut at this date, and by the last of the month the seeds are ripe. On a rather heavy soil that holds the water pretty well it will endure any drought we have, and produce good pasture in summer and fall after being cut. On the Experiment Farm it has suffered from drought only one season (1893), although the soil is poor and inclined to dry out very thoroughly in hot weather. It does not suffer from frost more than Kentucky blue-grass, and even after snows, some green blades can generally be found among the dense mat covering the ground. In the quality of durability we have grown nothing that surpasses it. From notes made on this plot the following are quoted:

May 13, 1893. A splendid growth 8 inches high. Uniform.

June 12, 1893. In flower and at its best. Averaging 4 feet 2 inches in height. A uniform growth with rather pale green blades and slender stems, swaying in the wind. Blades form a mat among bases of stems, averaging 18 inches high. Panicles about 11 inches long, ranging from 8 to 12 inches; inclined to be one-sided and not much spreading; pale green at first, becoming purplish later.

Aug. 8, 1893. A very good and uniform growth 6-8 inches

long. Stood the drought of July very well. This month the driest July in 9 of which Prof. Muncy, Meteorologist of the Station, has record.

Sept. 16, 1893. Very good at edges along paths and in places elsewhere, but a good deal has been dried out and is now dead as far as appearance goes.

January 20, 1894. Good. Green blades 6 inches long.

June 16, 1894. Grass uniformly good, averaging four feet high. Good growth of blades of a bright-green color. Fresh stamens exposed this morning. Blades 16 inches long,  $\frac{1}{4}$  to  $\frac{3}{8}$  inch wide, striate above and opaque; glossy below at length. Panicles 9–11 inches long, pale-green when the anthers are exposed and erect; the lower branches extending outward from axis; closes up when more mature, droops somewhat and assumes a purplish color; a part of the plants, probably a third, is now in latter condition. Presents a fine appearance. Lines in which seed was sown pretty well obliterated.

August 23, 1894. In good condition, showing a growth that would make excellent grazing. Blades 7 inches long on an average, many a foot or more long. (It was cut in July.)

September 22, 1894. A splendid growth of bright-green blades 8–12 inches long and  $1\frac{1}{4}$  inch wide; glossy.

November 6, 1894. Good. A fine growth of blades 10–14 inches long.

December 4, 1894. Good; some brown from frost.

March 6, 1895. Brown from snow and frost, but with some green blades among the others. Good.

March 30, 1895, second warm day of spring. Good; blades pushing up rapidly.

April 29, 1895. A fine uniform growth of glossy green blades, averaging nine inches high.

June 29, 1895. Stems as much as 57 inches long. Panicles  $7\frac{1}{2}$  to 11 inches long. Average height 42 inches, about. A fine growth of blades at bases of stems. A splendid grass. Seeds ripe and dropping. Stems green yet.

August 23, 1899. This plot is still in fine condition. A splendid growth of broad blades.

English blue-grass is thoroughly at home in Kentucky, often springing up along roadsides from scattered seeds. It is frequently grown in this part of the State, but is perhaps not made use of as much as it should be. One of our seedsmen places it tenth on the list of forage plants called for by farmers. It is both nutritious and palatable. Forty pounds of seed are sown on an acre. Seeds sell for from \$22 to \$25 per hundred pounds.

*Festuca nutans* (Nodding fescue-grass). A native perennial grass reaching a height of about 34 inches, with a few-flowered panicle, the spikelets at the extremities of the branches. Collected at Torrent, June, 1899.

*Festuca octoflora*. A slender-stemmed native grass, with contracted panicle of rather large spikelets. Height about 12 to 18 inches. Blades very narrow. Of no agricultural value. Nortonville, May 13, 1898.

*Festuca ovina* (Sheep's fescue). A plot of this species was started on the Experiment Farm in 1894 and is still in good condition. After the first season it occupied the ground very well, growing in tufts along the lines in which the seed was planted, and never spreading from them. The blades are very slender, folded, and are of a bluish green color owing to a gray bloom which covers them. By the middle of May or a little later its panicles are fully developed and in early June the seeds have ripened and the stems become brown. The quantity of forage produced is always small, the blades not often exceeding 7 inches in length, while the stems, which are exceedingly slender, with the panicles were not observed to surpass 22 inches in height, and were oftener in the neighborhood of 15 inches. Our plot on the Experiment Farm was started in the spring of 1894 and continues at the present time in good condition, although still growing in the lines as originally drilled. It is not adapted for hay, but may serve for grazing in sections where blue grass does not thrive. It has one very good quality for pasture, which is, hardiness in fall and winter, when it is generally one of our best plots in appear-



ance. Whether it will stand the trampling of stock I am unable to say. It does not spread by its roots, and the dropped seeds have never germinated in the plot. The following observations are from notes on the plot :

September 22, 1894. This has been growing since the recent rains and presents a good appearance. Blades very narrow ; 4-6 inches long.

November 6, 1894. Very good. Color bluish, owing to a gray bloom. Tufts in lines often meeting.

December 4, 1894. Good. No brown.

March 6, 1895. With tufts of narrow blades ; only a little brown at tips.

March 30, 1895. Very good. Uniformly green. Dense tufts of narrow deep green blades.

April 29, 1895. Covers the ground fairly well, the tufts joining in the rows, with a diameter of from 8 to 10 inches. Now with contracted panicles ; 9 to 10 inches high.

May 20, 1895. Now at its best. A grayish purple aspect as one looks over the plot. Stems as much as 22 inches high. Average about 20 inches. Slender ; upright ; panicle  $4\frac{1}{4}$  to 5 inches long ;  $2\frac{1}{4}$  inches in expanse ; spikelets a decided purple on one side, green on the other, the branches purplish. Blades as much as 7 inches long, folded, flattened, about 1.25 inch wide, dark bluish green. Does not spread rapidly ; can now walk between rows in which seed was drilled ; but with the spreading of tufts gives appearance of a completely covered plot.

June 29, 1895. Stems completely brown and seeds ripe, mostly dropped. Blades much as in spring. Would not yield much hay, nor very much grazing.

June 25, 1895. Stems dead. Blades not much larger than in spring. Tufts not spreading.

The grass is reputed to be adapted to uplands where the soil is poor. 35 pounds of seed are sown on an acre of ground. It is believed to be native to both this country and Europe.

*Festuca pratensis* (English blue-grass). This grass and *F. elatior* are commonly regarded by botanists as varieties of one spe-

cies, but grown side by side with the other it shows so many differences that it is best to treat them separately. It is a much slighter, less vigorous grass, with a narrower shorter blade, and in our plot, never spread from the lines in which seed was sown. This is a very important character when the grass is considered as forage, and renders it much less desirable than the tall English blue-grass. The yield from the plot has never been much more than half that from the other. Some of my field notes are given below:

June 12, 1893. This grass averages less tall than *Festuca elatior*. It is less coarse, the blades at the base much more slender and standing erect, the tips being highest. Panicles more contracted, pale green, showing at no time the distinct purple color of those in the other plot. It is somewhat earlier in flowering, most of the panicles at the sides of the plots having pretty well developed seeds; in the center of the plot some are still flowering. Tallest stems, with panicles, measure 3 feet 8 inches; average about 3 feet 6 inches. Longest panicles, 10 inches; average about 8 inches. Longest blades at bases of plants about 1 foot 4 inches. A rather close growth of about the same color as in the other plot; both have a pale gray bloom on the upper side of blades when young, but become glossy on both sides when older.

January 20, 1894. In good condition. Some green, but mostly concealed by last year's growth.

June 16, 1894. A fair growth, but strictly confined to lines in which seed was drilled. Averages 35 inches high. Panicles  $5\frac{3}{4}$  to 7 inches long. Blades reaching a length of about 10 inches, averaging less than  $\frac{1}{4}$  inch wide; erect.

August 23, 1894. Condition good. Would make some grazing. Not as good as *F. elatior*, but has endured the evere drought of the past month very well.

September 22, 1894. A fair growth of slender blades  $8\frac{1}{2}$ -9 inches long; 1-16 inch wide. Plot invaded by yellow fox-tail at one side, and throughout to some extent by crab-grass. It does not hold its own against these as does *F. elatior*.

November 6, 1894. Improving since the weather became cool and the ground moist.

March 6, 1895. Brown, with some green blades appearing. Looks well, but does not form the same close mat as does *F. elatior*.

July 6, 1896. Not as good as usual this season. Original drills still apparent. Blades not more than  $10\frac{3}{4}$  inches long. Stems with panicles few, owing to drought of early spring. Does not approach *F. elatior* in amount of forage. Growth so scant that weeds are coming up between rows.

May 23, 1899. Can still see lines in which this plot was drilled, although they long ago disappeared in the adjoining plot (occupied by *F. elatior*). Average height not more than 8 inches. Mostly not in flower.

I find seeds advertised for \$13 per hundred pounds.

*Festuca rubra* (Red fescue). Our plot of this grass was started in 1892, and is still good. In the quality and amount of forage it does not differ much from sheep's fescue, but there is one important difference, namely, its disposition to spread at the roots. The lines in which it was drilled were long ago obliterated.

It is in bloom about May 20, when the stems with panicles average about 26 inches high, the panicles ranging in length from about  $3\frac{1}{4}$  to  $4\frac{3}{4}$  inches, and expanding from  $1\frac{1}{2}$  to 2 inches. The largest blades do not exceed 9 inches, while they are more often about 5 inches long.

Like sheep's fescue, it is reputed valuable for dry gravelly uplands. Its habit of spreading may render it valuable for binding soils liable to wash badly. It is sold for \$20 per hundred pounds of seed. 25 pounds serve for an acre.

*Holcus lanatus* (Velvet grass). Velvet grass has not proved itself in any way remarkable in our plot. It has been replanted several times, but winter kills badly, and soon disappears. The plot was on rather low ground, however, where water sometimes stands for short periods in winter, and it is probable it would have done better on higher ground, where the surface drainage was better. It seems to be well adapted to this region, and may be found growing spontaneously in eastern Kentucky, though it is not common.

April 23, 1898, Mr. John Pearl, of Fariston, Laurel county, wrote me enclosing a specimen of this grass from a meadow at London, Ky., on the place of Mrs. S. E. Hardin, where he reported it had been growing for many years and appeared to "get better every year."

The grass is peculiar in having the broad blades and their sheaths covered with a soft velvety down. On the Farm it has grown to a height of 26 inches, the rather close gray panicles measuring from 2 to 5 inches, and expanding an inch or somewhat less. The blades are rather short (about 3 inches long), but broad, and are produced in large numbers. The panicles are fully developed during the last week in May. It is a native of Europe, being known in England as Yorkshire fog. It has no very good reputation there, being commonly regarded as a weed, to be got rid of as speedily as possible. It has been observed growing spontaneously in Jessamine county, and at Pineville.

*Homalocenchrus oryzoides* (Rice cut-grass). A coarse native grass, common in wet places along ponds and streams. The edges of the blades are very rough and harsh to the touch. It produces an open panicle in September, often 8 inches in length and 6 inches in expanse. It produces in midsummer a large quantity of bright green blades, which are sometimes cut for hay by colored people, who render it a little more palatable by the addition of salt.

Lexington, Sept. 2, 1889; Lexington, Aug. 7, 1893; Lexington, Oct. 6, 1894.

*Homalocenchrus virginicus* (White grass). A native species similar to the preceding, but with the panicles smaller and simpler, the stems more leafy; the blades not so harsh. Grows on wet ground.

Nortonville, Aug. 7, 1892; Lexington, Aug. 29, 1892; Lexington, October 6, 1894. Observed also by Kearney in the mountains.

*Hordeum pusillum* (Barley grass). Specimens of this, collected by me at Bowling Green, May 18, 1894, measure about

16 inches in height and bear spike-like panicles resembling those of cultivated barley, from  $\frac{3}{4}$  to 3 inches long. The grass is said to be liked by cattle.

*Hordeum vulgare* (Barley). A well known cultivated grain of eastern origin, where with wheat it has been grown for many centuries. It produces a two or six-rowed spike somewhat like that of wheat, but rather more strongly bearded. These two varieties are sometimes ranked as distinct species. The seed is of a brownish hue, in one variety, known as imperial black barley, of a decided blackish brown color. It is more slender than wheat, with the same general shape, but is not as slender as rye. Both spring and winter varieties are in cultivation.

Formerly it was extensively cultivated in Kentucky and commanded a price of from 60 cents to \$1.00 per bushel. At present but little is grown here. One of our foremost seedsmen informs me that he sold seed for but one field in 1899.

*Hystrix hystrix* (Bottle-brush grass). A tall, broad-bladed, native grass growing in rocky places along Kentucky River. High Bridge, June 8, 1892; Brooklyn Bridge, June 22, 1894; Tyrone, July 14, 1892. Observed in the mountains of Kentucky.

*Ixophorus glaucus* (Pigeon grass, yellow foxtail). A common weed in cultivated ground. Produces late in summer a cylindrical, hairy spike, which when mature assumes a yellow color. Annual, and of no value for forage. Occurs throughout Kentucky. Lexington, August 12, 1890; West Point, July 27, 1892; Guthrie, August 4, 1892; Nortonville, August 7, 1892; Louisville, September 6, 1894 (received from Mr. Karl Yungbluth); Brooklyn Bridge, August 15, 1895; Clinton, 1898.

*Ixophorus italicus* (Italian millet, German millet, Hungarian grass). An introduced annual forage plant, very commonly grown in Kentucky for hay and for soiling. Its rapid growth and large yield makes it of value for the purpose. The seeds

are used to some extent for poultry. From a bushel to a bushel and a half should be sown to the acre.

*Ixophorus verticillatus* (Foxtail grass). A leafy stemmed weed, with panicles in the form of cylindrical, somewhat interrupted, green spikes. Common about Lexington in cultivated ground. Lexington, August 2, 1889; Lexington, September 26, 1889; Lexington, August 3, 1893.

*Leptochloa mucronata*. An annual species, sometimes found in cultivated ground. The stems at their summits bear numerous slender spikes, together forming a loose panicle-like cluster, which may be as much as 16 inches long and 8 inches in expanse. Lexington, September 3, 1890.

*Lolium italicum* (Italian rye-grass). This introduced species has been highly recommended for meadow, but has never done well in the plots of the Experiment Farm, the growth being light, and the plants lacking in vigor. Where we have succeeded in getting a good stand it disappeared in the course of a couple of seasons. Plants preserved as herbarium specimens measure 20 inches in height, some of the stem blades being  $5\frac{1}{2}$  inches long and  $1\frac{1}{4}$  inches wide. The large spikelets alternate along the terminal portion of the stem producing a slender spike 6 to  $7\frac{1}{2}$  inches in length.

Italian rye grass is little more than an annual, and probably is not as valuable here as it is in England. With the next, of which it is sometimes considered only a variety, it has been very highly praised by British farmers. By one of our seedsmen the seed is advertised for \$7 per hundred pounds. Fifty pounds serve for an acre of ground.

*Lolium perenne* (Perennial ray-grass, perennial rye-grass). This species resembles the Italian rye-grass closely, the important character separating the species being the absence of bristles on the chaff of this, the preceding species being provided with short ones. It has not proved a remarkable grass in our plot, and I am unable to recommend it from the experience we have had with it. The seeds sell for the same price

as the preceding, and are sown in the same quantity to the acre. In our plot it was in bloom and ready to cut in the latter part of May.

*Melica diffusa* (Tall melic-grass). A native grass credited to Kentucky by Britton and Brown in their "Illustrated Flora." It is not in the Station collection.

*Melica nutica* (Narrow melic-grass). This is also a native species, and has been recorded by Miss Sadie F. Price as occurring in Warren county.

*Muhlenbergia capillaris* (Long-awned hair-grass). A native grass, growing in sandy soil, credited to Kentucky by Dr. Asa Gray.

*Muhlenbergia diffusa* (Nimble will). A slender, low-growing grass, often seen about lawns and in woodland pastures, where it sometimes crowds out the more valuable blue-grass. It grows to a height of from one to two feet, according to the soil, producing numerous sharp-pointed blades, one inch or less in length. The panicle, which is developed in August and September, is slender and wisp-like, with small flowers, the scales of which bear slender bristles. It spreads to some extent by sending out roots at the joints of the stems.

While this grass is commonly regarded as a weed and is certainly objectionable in a good lawn or pasture of blue-grass, it has when young some value as forage, though the amount produced is small. It has been observed to be common in the woodland pasture of the old Henry Clay place. Brooklyn Bridge, June 22, 1892; Lexington, September 16, 1892; Clay's Ferry, August 22, 1893; Lexington, September 30, 1893; Louisville, September 6, 1894 (Karl Yungbluth); Lexington, September 22, 1894.

*Muhlenbergia mexicana* (Meadow muhlenbergia). This is a taller species of the genus, with more compact panicle and larger blades ( $2\frac{1}{2}$  to  $2\frac{3}{4}$  inches long in a specimen before me, sometimes as much as 6 inches). Of no value for forage. Lexington, September 6, 1890; mountains of eastern Kentucky (Kearney).

*Muhlenbergia sylvatica* (Wood muhlenbergia). A native perennial, spreading by underground root stocks. Height about 2 feet. Blades sometimes reaching a length of 6 inches, with a width of 3-16 inch. Clay's Ferry, August 22, 1893.

*Muhlenbergia tenuiflora* (Slender muhlenbergia). Similar to the preceding and like it spreading by means of scaly root-stocks. Panicles much larger and more slender. A woodland species. Nortonville, August 8, 1892; eastern Kentucky (Kearney).

*Oryzopsis melanocarpa* (Black-fruited mountain rice). A tall, long-leaved, native perennial, found in rocky woods. A specimen in the Station collection measures nearly four feet in height, the upper part of the stems with blades 10 inches in length, and bearing slender, large-flowered panicles about 7 inches long. Brooklyn Bridge, June 22, 1892.

*Panicularia acutiflora* (Sharp-scaled manna-grass). A tufted native perennial about 18 inches high, growing on wet ground. The panicle is very slender, the spikelets very large. Numerous slender blades arise from the base of the stems. Cave City, May 19, 1898.

*Panicularia elongata* (Long manna grass). A native species collected at Torrent, June 4, 1898.

*Panicularia fluitans* (Manna grass, floating meadow-grass). This species grows in wet ground along ponds and ditches, sometimes in shallow water, producing a coarse forage of some value. In European countries it is said to be cultivated to some extent for meadow, and the seeds are gathered for food. It may perhaps prove useful for wet land in this country. I have not seen the grass mentioned in our seedsmen's lists, but probably the seeds could be obtained from abroad by any of the prominent seedsmen. It grows to a height of three to five feet, and bears blades which may reach a foot in length, and have a width of  $\frac{1}{2}$  inch. The panicle, with a small number of long and narrow spikelets, is some-



times more than a foot long. It is credited to Kentucky by the botanists, Britton and Brown.

*Panicularia nervata* (Meadow spear-grass). A leafy-stemmed, native perennial grass, growing on wet land to a height of 4 feet, producing in June a large spreading panicle often as much as 9 inches in length and 5 inches from tip to tip of the spreading branches. Blades of preserved specimens are 15 inches long and  $\frac{1}{4}$  inch wide. It has all the outward appearance of a good forage plant, but is only seen growing spontaneously in the State. Whether or not it has been cultivated I am unable to say, but it is certainly worthy of trial on land that is too damp for the plants in common use. In nutritiousness it ranks with the best of our grasses, and is said to keep its value longer than most grasses when left standing, thus giving a greater range of time for cutting. Low ground, Lexington, June 9, 1890; Tyrone, June 9, 1892; Lexington, June 11, 1892; Crab Orchard, June 18, 1892; Lexington, May 16, 1894; College campus, Lexington, June 29, 1894.

*Panicularia pallida* (Pale manna-grass). A native perennial, growing in water at the edges of ponds. Credited to Kentucky by Dr. Asa Gray.

*Panicum agrostoides*. A native perennial growing along streams and ponds in damp soil. Stems sometimes 3 feet high, the panicles 7 inches long, with numerous rather small spikelets, the branches not spreading much. Blades long and broad. Possibly of value for cultivation on wet ground. Guthrie, August 4, 1892; Nortonville, August 7, 1892; observed also by Kearney in the mountains of eastern Kentucky.

*Panicum anceps* (Beaked panicum). A coarse, long-bladed grass of damp ground. Height 2 to 4 feet. Panicle straggling, 10 inches or more long, the lower branches widely separate from the upper, the spikelets curved, acute. With a scaly, creeping root-stock; stem flattened. Perennial and native to this country. Guthrie, August 4, 1892; Hopkinsville, Aug. 8, 1892; Greensburg, July 8, 1895; Dickey's Mills, July 14, 1896.

*Panicum barbulatum* (Barbed panicum). A native grass of wet ground. Aden Springs, June 24, 1892; Guthrie, August 4, 1892.

*Panicum capillare* (Old witch grass). A hairy, annual weed of cultivated fields, attracting attention because of its large and wide-spreading panicle, which often measures 18 inches in length and 16 inches from tip to tip of the very slender branches. Late flowering, with small spikelets at the extremities of the branches. Blades from  $\frac{1}{2}$  to  $\frac{5}{8}$  inch wide. 18 inches to 4 feet high. Of no value for forage. Lexington, October 2, 1889; Lexington, September 6, 1890; Lexington, September 24, 1894.

*Panicum clandestinum* (Hispid panic-grass). A native grass of moist soil in thickets and woodland. Sometimes 3 feet high, with stem blades  $1\frac{1}{2}$  inch wide, 8 inches long, clasping at the base. The panicle is small,  $4\frac{3}{4}$  long by  $2\frac{1}{4}$  inches in expanse, the spikelets few in number. Aden Springs, June 24, 1892; Lexington, June 5, 1894.

*Panicum commutatum*. Credited to Kentucky by Professor Beal.

*Panicum crus-galli* (Barn-yard grass, Japan barn-yard millet). A coarse annual with broad leaves and loose, bristly panicle, which may be 10 inches long and six from tip to tip of the longest branches. Common in rich moist soil, where it sometimes grows to a height of seven feet, though commonly not so tall. Blades often 15 inches in length and  $\frac{5}{8}$  or more in width. It has been grown from seed on the Experiment Farm, but did not show itself remarkable in any way. Planted April 25, it was 4 feet high when the panicles were developed, August 20. On first rate soil it produces a large amount of forage suitable, like millet, for use when green. It does not cure well.

Lexington, June 28, 1892; Lexington, August 2, 1892; Lexington City Reservoir, very common and rank of growth, August 27, 1896.

*Panicum dichotomum* (Forked panicum). A common native perennial, growing in woodland.

Tyrone, June 9, 1892; Pineville, June 15, 1892; Crab Orchard, June 18, 1893; Jackson, May 26, 1896.

*Panicum depauperatum* (Starved panicum). A slender native perennial, of no evident value.

Crab Orchard, June 18, 1892.

*Panicum elongatum* (Long panicum). Credited to Kentucky by Britton and Brown, also by Scribner.

*Panicum filiforme*. Credited to Kentucky by Kearney.

*Panicum latifolium* (Broad-leaved panicum). A native grass with slender stems and short broad blades, these in preserved specimens  $3\frac{1}{4}$  inches long by 1 inch wide. Panicle open, with a few rather large spikelets at the ends of thread-like branches. Height about 22 inches. Perennial.

Tyrone, June 9, 1892; Pineville, June 14, 1892; Cumberland Falls, July 12, 1892.

*Panicum laxiflorum*. Russell, Ky., June 9, 1898.

*Panicum microcarpon* (Small-fruited panicum). Cumberland Falls, July 12, 1892.

*Panicum miliaceum* (Millet). A coarse annual grown very extensively in eastern countries for its seeds, from which flour can be made. Not generally grown in this country. It is an excellent soiling plant for milk cows when grown in good ground; on sterile soils the yield is likely to be small. It must be cut when in bloom, as the stems soon afterward become hard and innutritious. Millet grown on the Experiment Farm measured about 22 inches in height, the broad blades 10 inches long and clasping at the base, the panicle loose but not spreading much, its branches bearing numerous large spikelets at the extremities, the whole with a length of about seven inches. The seeds are glossy and fully twice as

large as those of the more opaque and whitish German millet seeds. They weigh about 50 pounds to the bushel.

*Panicum pubescens*. A slight, native perennial of woodland. Blade, sheath and stem downy. Panicle open and rather small.

Pineville, June 15, 1892; Aden Springs, June 24, 1892; Clay's Ferry, August 22, 1893.

*Panicum proliferum* (Spreading panicum). A coarse, thick-stemmed, smooth annual growing in damp places in cultivated ground and along ponds and ditches. Sometimes four feet high, the loose panicles 18 inches or more long and expanding as much as 20 inches. Blades  $\frac{3}{4}$  inch wide and 18 inches or more long. Like barn-yard grass it is calculated to produce a large amount of forage, but as far as I know it has not been cultivated. Cattle are said to eat it freely.

Lexington, September 1, 1889; Lexington, September 12, 1889; Van Meters, August 14, 1893; Lexington, September 8, 1893; Lexington, September 11, 1894; Lexington, August 7, 1896; August 27, 1896.

*Panicum ramulosum*. Southeastern Kentucky.-- Kearney.

*Panicum sanguinale* (Crab-grass, finger-grass). This is a troublesome annual weed, occurring everywhere in cultivated ground, especially in stubble fields, and among late potatoes where these are not well tilled. In the latter part of July it ranges from about 12 to 18 inches in height, though in good soil growing considerably taller. The stems are very slender and bear at or near the upper extremity from 3 to 7 slender spikes from 3 to 4 inches long, and, when mature, of a purplish hue. The short blades and their sheaths are pubescent. The plants send out roots at the lower joints of the stems. It makes a very good hay, though rarely used for the purpose in this region. At the South it is with Bermuda-grass considered a valuable hay-plant, and we are told by Prof. Tracy, of Mississippi, yields as much as two tons to the acre. He says of it, "Although not often in the market, crab-grass

furnishes more forage for home use in the Gulf States than any other grass."

Lexington, July 24, 1889; Lexington, July 3, 1890; Louisville, September 6, 1894 (Karl Yungbluth).

*Panicum scribnerianum*. Credited to Kentucky by Miss Sadie F. Price.

*Panicum texanum* (Texas millet). This grass is a native of Texas whence seeds have been distributed to other states. In Texas on low and rather damp ground it grows to a height of four feet, and produces several cuttings during a season. It is grown also for hay in Louisiana, and is there regarded as a valuable forage plant. On our Experiment Farm, seeds from the United States Department of Agriculture were planted in 1896, and in the latter part of July the plants were fully grown, measuring about 18 inches in height and bearing large-flowered slender panicles 3-4 inches long. The plants show a disposition to branch and bear numerous rather short, broad blades, which taper rapidly from their bases. It did not impress me as a promising addition to the list of forage plants for this region. The grass was grown on rather poor soil, in which at the time there was but little moisture.

*Panicum virgatum* (Tall smooth panic-grass). A native perennial, found occasionally in moist sandy soil along streams. Height sometimes as much as 5 feet. Panicle exceptionally large, loose and long-branched, the large spikelets borne at the extremities chiefly, the flowers with slightly purplish chaff, and deep umber-brown stamens. Blades may be 14 inches long and  $\frac{1}{4}$  inch wide.

Clay's Ferry, August 22, 1893.

*Panicum viscidum*. This is included in Miss Price's list of Warren county plants. I have not collected it from the State.

*Paspalum floridanum*. Kentucky—Britton and Brown.

*Paspalum laeve* (Field paspalum). A common grass in wet ground in cultivated fields. Sometimes reaches 3 feet in

height, with blades 18 inches long and  $\frac{1}{4}$  inch wide. Stems bear from 3 to 7 slender spikes placed at intervals near the summit, the uppermost terminal in position. Spikelets large, oval, in two rows. Commonly regarded as a weed, but with some value as forage.

West Point, July 28, 1892; Guthrie, August 4, 1892.

*Paspalum longipedunculatum* (Long-stalked paspalum). This differs from the preceding in having but 1 to 2 spikes. It grows in sandy soil. Credited to the State by Britton and Brown; also by Kearney.

*Paspalum mucronatum* (Water paspalum). Kentucky—Miss Price.

*Paspalum setaceum* (Slender paspalum). Much like the preceding. Spikelets small, the spikes generally 1 or 2 in number. Annual. Native. Common.

Lexington, Sept. 23, 1890; Burnside, July 11, 1892; Hopkinsville, Aug. 8, 1892; Van Meters, Aug. 14, 1893; Louisville, Sept. 26, 1894 (Karl Yungbluth); Hawesville, Aug. 16, 1895.

*Phalaris arundinacea* (Reed canary-grass). A persistent perennial, the seeds of which are frequently brought into this country from Europe, but believed to be native to the United States. A plot started on the Experiment Farm in the spring of 1893 is still doing well, although it has never furnished as much fodder as have some other grasses. It grows in large tufts, which spread rapidly by underground shoots, and soon covers the ground thickly. The blades appear very quickly in spring, and remain green at all times thereafter until frosts come. The blades are coarse, rather harsh, and large, constituting the bulk of the forage, while the stems are likely to be few in number. Some notes made from time to time on the plot will explain more fully the character of the grass.

January 20, 1894. A rather scant growth.

June 19, 1894. A gretty good growth, consisting of broad tufts, presenting a bright thrifty appearance. A few heads, perhaps two dozen in all. Looks like good grazing. Stems

with panicles 37 inches tall. Panicles  $4\frac{1}{2}$  inches long, spike-like when old, the branches spreading when in flower; pale green when young, dark green to purple when older. Blades flat, 8–10 inches long,  $\frac{1}{2}$  to  $\frac{5}{8}$  inch wide, base yellow. Ligule white, conspicuous, rounded.

July 10, 1894. A good growth of wide blades in clumps 12–18 inches across. Some panicles now brown.

July 26, 1894. A very good growth of coarse, sharp-pointed blades in large tufts covering most of the plot; bright green; would make good grazing.

August 23, 1894. A fine growth of coarse blades covers most of the ground. Would make excellent grazing.

September 22, 1894. Good. A fine growth of coarse blades 10–12 inches high over whole plot.

November 6, 1894. Still in fairly good shape. Blades begin to show the effect of frost and some are brown. Would make good grazing.

December 4, 1894. Largely brown from frost.

March 6, 1895. Chiefly brown, but with small green blades appearing in the tufts.

March 30, 1895. Rapidly becoming green again. Coarse upright blades, five inches high.

April 29, 1895. A fine rank growth of coarse blades with a gray bloom. Eleven inches long and  $\frac{1}{2}$  inch wide. Would make good grazing or hay. No trace of stems.

May 20, 1895. Now in good condition. Several tufts at edge with panicles appearing, but most with no trace of flowers. Blades  $\frac{1}{2}$  to  $\frac{3}{4}$  inch wide.

June 29, 1895. Stems with panicles now 43 inches high. Panicles  $3\frac{1}{2}$  to  $6\frac{1}{2}$  inches long,  $\frac{3}{8}$  to  $\frac{1}{2}$  inch in diameter. Blades in dense tufts at base of stems; those on stems above middle, small and inconspicuous. Panicles now brown and seeds ripe. Blades at base of stems  $9\frac{1}{2}$  to  $11\frac{1}{4}$  inches long;  $\frac{5}{8}$  to  $\frac{3}{4}$  inch wide. Would make a fair amount of hay. Good for grazing.

May 24, 1899. Covers the ground completely. A fine growth, mostly blades.

Reed canary-grass is adapted to rather low wet ground.

From its manner of spreading by creeping root-stocks it can be made useful in binding the soil of embankments. The seed is advertised at \$65 per hundred pounds in a list of this season now before me. The well-known ribbon-grass of gardens is a variety of this species.

*Phalaris canariensis* (Canary-grass). This grass, a native of southern Europe, furnishes the elongate glossy seeds used to feed canary birds. It is sometimes grown in this country for the seeds. In Kentucky stray plants sometimes appear in gardens, where the seeds have been thrown in cleaning out bird cages. The spike-like panicle of a specimen collected at Lexington, June 5, 1891, by Professor A. R. Crandall and presented to the Station, is oval in shape, being about  $\frac{3}{4}$  inch long and  $\frac{1}{2}$  inch in diameter. The whole plant measures about 14 inches in height, but the grass often grows taller than this.

*Phleum pratense* (Timothy). On a good loam that holds water well timothy has no superior in this country for a single annual cutting of hay. On light porous soils that give up most of their moisture in midsummer it does not thrive. Nor does it in this region produce an aftermath of any great value, because of the large quantity of water required by the plant and the general deficiency of soil moisture in the latter part of summer. Though somewhat coarse, it is one of the most nutritious of our grasses when ripe, and as hay is greatly liked by horses especially. British farmers sometimes speak slightly of it: "It is not much liked by horses, cows, or sheep, and swine refuse it." Difference of quality due to climate or soil will probably explain why it is rated so differently in the two countries. Here it is commonly sown mixed with clover, a practice which can hardly be recommended because of the fact that the two plants are not at the best stage for cutting at the same time. The weight of seeds is variously given from 45 to 48 pounds to the measured bushel. About  $\frac{1}{2}$  bushel of seeds serves to sow an acre of ground.



*Poa alsodes* (Grove meadow-grass). A native grass collected at Natural Bridge, May 5, 1895.

*Poa annua* (Annual spear-grass). About lawns and pastures in early spring the annual spear-grass is to be seen in tufts and patches where it is conspicuous among blue-grass from its lighter color. In April and May its small panicle is developed. The seeds soon afterward drop, and the grass itself then disappears. The short blades are tender and sweet, and are cropped close to the ground wherever cattle can reach them. Stems with panicles not often exceeding 10 inches in height. Panicles 2 to 2¾ inches long, with an expanse of about 1½ inch. Blades from 1 to 3½ inches in length and with a width of about ⅛ inch.

Lexington, May 26, 1890; Wilmore, April 12, 1895; Guthrie, May 15, 1898.

*Poa autumnalis* (Flexuous spear-grass). Credited to Kentucky by Dr. Gray.

*Poa brevifolia* (Short-leaved spear-grass). A native grass. Midland, April 29, 1893; Filson, May 8, 1893; Dix River, April 13, 1895; Natural Bridge, May 5, 1895.

*Poa chapmaniana* (Chapman's spear-grass). Cave City, May 19, 1898.

*Poa compressa* (Canada blue-grass). This is a short, wiry, perennial, found growing spontaneously in Kentucky, generally in rather poor soil. It is very persistent where it gets a start, spreading like ordinary blue-grass by underground shoots and completely occupies land to the exclusion of most other plants. A plot sown on the Experiment Farm in 1893 has had complete possession of the ground at all times since the grass appeared above ground. It does not produce much forage, and that produced is rather dry, the blades being short and narrow, and the stems hard. It is not worth considering for hay, and for pasture is scarcely worthy of trial except in thin soils where common blue-grass does not maintain itself. For

binding embankments it has a value. The notes following relate to our plot.

May 13, 1893. A short growth, 5-6 inches high; bluish green.

June 12, 1893. A rather short erect grass with close panicles, flattened stems, and short blades. In flower, and at its best. Tallest stems about 1 foot 8 inches high. Average about 1 foot 6 inches. Panicles 3-4 inches long, green, with some purple at edges of chaff. Blades at base largely dry and brown; short; about 2 inches long. Looks tender and succulent. No tendency to form tufts.

June 18, 1894. A very good and uniform growth averaging 18 inches high. Stems wiry, upright. Living blades short and all arising from stems. Not much grazing or hay about it. Panicles 2-4 inches long, the branches standing out rigidly from the axis. Blades  $2\frac{3}{4}$  inches long,  $1\frac{1}{8}$  inch wide, folded, the back forming a ridge.

September 22, 1894. This has stood the drought well and is now sending up a good growth of characteristic, erect bluish blades.

November 6, 1894. This has grown but little since damp cool weather set in, in which respect it differs from most of the other grasses of the plots. Not suited to fall grazing.

March 6, 1895. Brown, but alive everywhere, with a trace of green when looked at closely.

March 30, 1895. Good. A uniform growth of green blades coming up rapidly.

April 29, 1895. No stems yet.

May 22, 1895. Good. Growing rapidly, but no panicles yet. Much darker, bluer green than Kentucky blue-grass.

June 29, 1895. A uniform growth 18 inches high. Late. Just maturing. Panicles still green in the main, though seeds have developed. Drill lines completely obliterated as in Kentucky blue-grass. Might do well for pasture in some soils. Short for hay.

July 28, 1896. Holds its own well. No weeds among it. Ten inches high to top of panicles. Very even growth, but not a heavy yield owing to scant blades and wiry culms.

June 20, 1897. Looks well. Just beginning to flower.

August 23, 1899. This is an old plot, but the grass looks well. Keeps free from weeds and is as thrifty as ever it was. Wiry.

The following localities at which this grass has been collected indicate that it is generally distributed in the State :

Lexington, June 5, 1892 ; Tyrone, June 9, 1892 ; Junction City, June 19, 1892 ; Lexington, June 23, 1894 ; Lexington, July 9, 1896 ; Russell, June 9, 1898 ; Rockhaven, June 3, 1899 ; Newport, June 15, 1899.

*Poa nemoralis* (Wood meadow-grass). This species has been recommended as suitable for shaded ground, but the seed bought of an eastern dealer and tried at the Experiment Farm proved to be very largely ordinary blue-grass seed, a circumstance that has restricted our observations upon it. The few plants of wood meadow-grass secured from this seed persisted only for a couple of seasons. It is probably better suited to more northern localities, but a fairer trial may lead to a change of opinion on this point. It resembles blue-grass in a general way, but grows rather taller in the same soils, and bears a more open and graceful panicle. It is in bloom here from the first to the middle of June, according to the advancement of the season, when the stems with panicles average about 20 inches in height, the panicles ranging from about 4 to 6½ inches.

*Poa pratensis* (Blue-grass, Kentucky blue-grass, green grass, smooth meadow-grass).

Ever smelt Kentucky grass,  
Or heard about its blueness?  
Seems as if the whole blamed world  
Was bursting out with newness.  
Skies and folks alike all smiles,  
Gracious! you are lucky  
If you spend a day in June  
Down in old Kentucky.—Alfred Monson.

This little plant has contributed more to the reputation of Kentucky than any other one product. In what is known as Blue-grass Kentucky the wealth and consequent leisure for ed-

education and other means of self improvement of a large part of the population is derived from stock raising, a vocation rendered easy and profitable by the abundant pasture which blue-grass affords throughout much of the year. Kentucky would not be Kentucky without it. But it is not peculiar to Kentucky, for it occurs throughout much of the Northern hemisphere, constitutes the bulk of the pasture of the middle and northwestern states and is everywhere at the North used as a lawn grass. In the southern tier of states it does not thrive, and is not to be recommended for that part of the United States. The chief difficulty in growing it there appears to come from the destructive effect of the summer sun. It suffers from that source in Kentucky at times, and occasionally during protracted droughts becomes quite brown in August. The fall rains quickly restore it again. During most winters it furnishes some grazing, and it is only when the weather becomes very severe that the blades become entirely brown. While blue-grass occurs everywhere in the State from the Big Sandy to the Mississippi River, it does not grow well in any but limestone soils, and in a large part of western Kentucky constituting perhaps fully half of the State it cannot be depended on for forage. I have seen it growing at Clinton, Hickman county, but it does not there spread and take possession of fields, lawns and roadsides as it does in the region about Lexington.

Blue-grass is a variable plant. In open pasture where the turf is long-established it is often of a pure green color, with narrow, slightly folded blades, the tips of which are somewhat turned up and prow-shaped. The stems bearing panicles are apt to be rather short in such situations, not often exceeding two feet in height. When less crowded the blades become darker in color, wider, and the stems taller. Where the soil is specially good and moist, the blades assume a bluish cast from a gray bloom which coats them, are longer (12 to 18 inches), wider ( $\frac{1}{4}$  inch not infrequently), and droop so as to form a thick and characteristic mat over the surface of the ground. From the midst of a rosebush in my yard I obtained May 23, 1897, a plant that measured 40 inches to the top of

its panicle, the latter being six inches long, with a greatest expanse of six inches. The panicles begin to appear on scattered plants about May 1, and from about May 23 to May 29 they are everywhere in bloom and at their best. They are brown, the seeds ripe and dropping, during most seasons, by the 25th of June.

Blue-grass is not regarded as a profitable meadow-grass. The hay made from it is good enough, but the slightness of its stems and upper stem-blades, together with the small number of stems produced, makes the yield small. As a pasture-grass for this section it leaves little to be desired. It is nutritious, persistent, hardy, forms a dense turf, and thrives under the cropping and trampling of stock.

*Poa sylvestris* (Sylvan spear-grass). Hillsides in woods. Tyrone, May 18, 1891.

*Poa trivialis* (Roughish meadow-grass). An introduced grass, adapted to bottom lands, and thriving best where the heat is not very severe in summer. It resembles ordinary blue-grass, but lacks the creeping habit, and has rough leaf-sheaths. Specimens grown in the plots of the Experiment Farm measure about 28 inches in height, the rather slender panicle constituting seven inches of this and expanding about 1½ inch. It is in flower in the latter part of May. I have several times had seed planted, but have never succeeded in getting a good stand. Our land is rather dry, however, and possibly it would do better where the condition of the soil was more in its favor. In European countries it ranks among the best of forage plants.

*Secale cereale* (Rye). This is one of the cereals, and is very commonly cultivated in Kentucky for soiling. It is sown for this purpose early in the fall, and the succeeding spring furnishes an excellent pasture for milk cows and sheep. The long, grayish green spike-like panicles are fully developed some seasons by the middle of May. The seeds are rather dark in color, and are more slender than those of either wheat or barley. The fact that it will grow in poor soils, in dry situations, where such grains as wheat and corn do not do well, will always by

itself make rye a valuable member of the cereal group of forage plants. In addition to this quality its straw is long and exceptionally tough, rendering it useful for various domestic purposes, for which the shorter and more brittle straws of wheat and oats are not suited.

The grain makes excellent bread, scarcely inferior to that made from wheat. But the young grain is peculiarly subject to the attacks of a parasitic fungus, which sometimes causes many of the seeds to push out from among the chaff in the form of a black spur, thus constituting the so-called spurred rye, otherwise known as ergotized rye. When ergot is prevalent among the grain it is likely to cause sickness and even death among those who may use flour made from it. Of course these enlarged grains can to a great extent be removed at the mill, but it is perhaps safest to avoid grain that is badly infested. The same fungus attacks wheat, blue grass, orchard grass, and other members of the family, but is only occasionally prevalent on them.

*Sieglingia seslerioides* (Tall red-top). This is a showy, native perennial grass, likely to be encountered along railroads or in neglected ground anywhere in Kentucky. Quite often only a clump or two is present in a place, but when allowed to have its way it may spread and eventually occupy an acre or more of ground. On the State College campus at Lexington it has been introduced by some chance, and each year presents a fine appearance on the slope below the Station building. The stems reach a height of from three to four and a half feet, and bear panicles often ten inches long and six inches in expanse. The blades are frequently sixteen inches in length. The stems are rather hard and wiry, and the branches of the panicle are coated with a peculiar greasy material. It is in flower during the latter part of August and early September. The grass has sometimes been sent to the Station by correspondents who wished to know its value for forage. Occasionally it is complained of as a weed. When fully grown it is rather woody and tough for forage, but I have seen the statement in print that it is valued as a forage plant at the South, though it is said to disappear under continued grazing.

Lexington, Sept. 6, 1893; Lexington, Oct. 20, 1894; Brooklyn Bridge, Aug. 15, 1895; Cynthiana, Aug. 7, 1897 (From Supt. J. A. Thorn, of Battle Grove Cemetery.)

*Sporobolus asper* (Prairie-grass). A native perennial recorded from Kentucky by Miss Sadie F. Price. Not recognized as having any agricultural value.

*Sporobolus vaginæflorus*. Credited to Kentucky by Britton and Brown; also by Kearney.

*Stipa avenacea* (Black oat-grass). A native perennial of dry soils. Reaches a height of three feet, and bears a few-flowered panicle producing at length seeds which are enclosed in a blackish brown scale bearing a long twisted and bent bristle. The blades are narrow and few in number. It has been collected only at Pineville, June 15, 1892.

*Tripsacum dactyloides* (Gama grass). A coarse grass of damp soils in swamps and along streams. It is a native, and perennial. It reaches a height of seven or eight feet, and produces broad blades somewhat resembling that of corn. The spikes occur singly or in pairs either in the axils of the leaves or at the summit of the stem. They are sometimes 10 inches or more in length, the lower third bearing pistillate, and the upper two-thirds only staminate flowers. It is represented in the Station herbarium by specimens collected by Professor C. W. Mathews, at Cumberland Falls, July 14, 1892.

*Trisetum pratense* (Yellow oat-grass). This oat-grass has been grown on the Experiment Farm from seed obtained of a seedsman in New York City. It has not done well, in no case giving a first rate stand, and such plants as were secured did not (on rather poor soil) bear the marks of a first rate forage plant either for hay or pasture. In European countries it is sown in mixtures for permanent pasture, and ranks high among the grasses used for that purpose. Our plants reached a height of two feet by the middle of June and bore somewhat compact panicles,  $1\frac{1}{4}$  by  $4\frac{1}{2}$  inches, of a yellowish color and satiny lustre. Judging from accounts given of it by European writers

it is probably worthy of trial in this State on uplands. Sheep are said to be especially fond of it. I find the seed advertised at \$85 per hundred pounds. About 25 pounds are sown to the acre. It is a perennial.

*Triticum vulgare* (Wheat). Kentucky farmers raise from about seven to thirteen million bushels of this cereal annually. The bulk of the crop is produced by counties in the central northern section of the State, yet several of those adjacent to the Mississippi River rank among the best wheat-growing counties of Kentucky. According to our State Commissioner of Agriculture, in 1898, with a total yield for the State of 13,481,829 bushels, the following eighteen counties produced more than 200,000 bushels :

Christian .....	687,923
Union .....	583,022
Hickman .....	522,656
Daviess .....	479,868
Logan .....	468,758
Woodford .....	382,985
Henderson .....	372,823
Shelby .....	350,430
Fulton .....	288,496
Warren .....	284,056
Breckinridge .....	246,829
Mercer .....	243,090
Scott .....	242,537
Nelson .....	240,207
Fayette .....	237,796
Larue .....	237,765
Hardin .....	223,436
Boyle .....	204,556

The yield per acre not infrequently reaches thirty bushels in the better class of soils, but generally is somewhat below this, and perhaps the average for the State, taking one season with another, will not exceed fifteen bushels per acre. Only fall wheat is grown, and generally the preference is for some smooth red wheat of medium hardness.

Quite often stock is allowed to graze young wheat during fall and winter, especially when the weather is so mild as to cause the plants to grow too rapidly. Aside from this ro



green forage is derived from the crop. The chief enemies of wheat in the field are the Hessian fly, the grain aphid, the wheat bulb-worm, smut and red rust. The stored wheat is frequently attacked by the grain weevil, while the ground product in mills is often damaged by several small moths, sometimes also called weevils.

*Uniola latifolia* (Broad-leaved spike grass). A tall and showy native perennial, common along streams in rich soil. Noticeable because of its loose panicle of very large flattened spikelets, the latter sometimes an inch in length. Blades numerous, 6-7 inches long and  $\frac{3}{4}$  inch wide. Grows to a height of three or four feet.

Burnside, July 12, 1892; Frankfort, July 30, 1892; Clay's Ferry, Aug. 22, 1892; Clay's Ferry, July 27, 1893; Brooklyn Bridge, Aug. 15, 1895.

*Uniola laxa* (Slender spike grass). A native grass credited to Kentucky by Britton and Brown.

*Zea mays* (Corn, maize, Indian corn). This is the king of grasses. It is more generally grown in Kentucky than wheat, and of the two appears to be much better adapted to the southern and eastern counties. Such counties as Pike, Lawrence and Whitley are among the best corn counties in the State, each of them producing more than 500,000 bushels in 1898. During the same year five counties, Christian, Henderson, Ohio, Union, and Warren, produced more than a million bushels each. These latter counties constitute part of a group chiefly underlain by rocks of the carboniferous period. Another important corn-producing section is constituted by about a dozen counties in the center of the blue-grass region, the underlying rocks being here of lower silurian origin. The State produced 55,443,918 bushels in 1898. The yearly product ranges from 35 to 69 million bushels, the latter figure being somewhat surpassed in 1889. Most of the varieties grown in the United States are to be seen in our fields, dent, flint, sweet and pop-corns, but of the field corns a white dent is generally preferred, and appears to give the most satisfactory results.

Stockmen frequently sow corn for green forage, usually planting in drills, for which purpose it competes for favor with sorghum; the latter stands drought rather better, but I think has no other advantage. The dry fodder is also used for stock after the corn is husked, but in this form loses in quality, and a good deal of it is wasted. When stripped from the stalk early in the fall and cured as hay the blades make a nourishing winter food. The silo could be profitably used, in western Kentucky, especially, for the preservation of fodder from corn fields, but as yet few of these structures are to be seen in the State.

The most troublesome enemies of the crop are the corn worm, the corn root worm of Kentucky (*Diabrotica 12 punctata*), the corn root aphid, and corn smut. The chinch-bug is destructive locally at times.

*Zizania aquatica* (Wild rice). A tall coarse native grass, found growing shallow water, where its large seeds ( $\frac{3}{4}$  inch long) constitute an important food for wild water fowl. It sometimes reaches a height of 8 or 9 feet. The staminate flowers of its panicle are below the pistillate, contrary to the usual arrangement where the male and female flowers are distinct. The stems and blades when cut at the proper season make good hay. I find the seeds quoted at \$15 per hundred pounds. The grass is credited to Kentucky by Drs. Short and Peter in their list of Kentucky plants.

## 2. Analyses of Some Kentucky Grasses.

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BY A. M. PETER, CHEMIST.

In the following tables are given the analyses of some of the grasses described in the first part of this Bulletin, the samples having been obtained and analyzed from time to time mostly from the experimental grass plots, during several years past. The analyses were made by Messrs. H. E. Curtis, J. C. W. Frazer and the writer. The methods employed were those of the Association of Official Agricultural Chemists. Some of these analyses have already been published in the Annual Reports of this Station, but are included here because they have never before appeared in a bulletin. Other analyses of Kentucky grasses have been published in Bulletin No. 5 (now out of print).

The samples for analysis were taken, in most instances, by cutting the grass an inch or two above the ground, as it would be cut for hay. The grass was brought at once to the laboratory and weighed, then dried in a warm room, weighed again, ground to powder and analyzed, and the results calculated both upon the fresh grass, as cut, and the material when perfectly free from moisture. The results are printed in the table of analyses under the corresponding headings. In some cases the fresh grass was not obtained but only the hay made from it, as will be evident from the low percentage of moisture shown in the fresh material. The small numbers refer to the notes following the table, in which additional information in regard to some of the samples is given.

In the ordinary analysis of a feeding stuff it is customary to determine the percentage of moisture, ash, protein, fiber, nitrogen-free extract and fat. In addition to these we have determined in most of our analyses the percentages of phosphoric acid, nitrogen and potash, as these are important in

judging the value of a feed stuff as a manure-maker, or the value of a grass for enriching the soil. A large part of these constituents of fertilizers passes into the manure, when the material is fed to stock, and the richer the food is in these the more valuable the manure is likely to be.

It may not be out of place here to give a brief statement explanatory of the nature of the substances into which a feed stuff is usually separated by analysis.

*Water* is contained in all feed stuffs and its amount varies greatly, being usually largest in the young plant, becoming less as the plant becomes more woody. In dried materials like hay it may be about 10 per cent., but is quite different in different materials, and varies in the same material with the moisture of the air in which it is kept.

*Ash* is the mineral matter which is left when the feed stuff is burned. It usually consists mainly of carbonates and phosphates of lime and potash. The ash of grasses usually contains also a large proportion of silica. Besides the mineral substances which are actually contained in the vegetable matter itself, the ash usually contains sand or soil that has adhered to the plant in the form of dust. Animals derive the phosphates of their bones from the ash constituents of their food, but the phosphates and potash are only partly used up in this way, the rest going to enrich the manure.

*Protein* is the name for a class of substances containing nitrogen. This is one of the most important constituents of feeding stuffs, as it is the one which furnishes the material for making flesh, blood, muscles, &c. Protein is often divided in analysis into *albuminoids*, or substances similar to albumen or white of egg, considered very valuable as food, and *amids*, which are considered less valuable. In very young, tender grasses the proportion of amids is apt to be large.

*Fiber* is the woody part of plants and is the least digestible constituent of feed stuffs. A part of it, however, is usually capable of being digested and serves a similar purpose in the food to the nitrogen-free extract.

*Nitrogen-free Extract* is the starchy part of the feed-stuff, including, besides starch, the sugars, gums, &c., and is an

important part of a food. As grasses become ripe the proportion of nitrogen-free extract largely increases.

*Fat* is that part of the feed stuff that is soluble in ether and includes, besides true fat or oil, the wax and green coloring matter of plants. The fat of food may be stored up in the body as fat, or burned to keep up the heat and energy of the animal.

In the following tables the first column contains the number of the sample; the second the common name of the grass and a reference to the page in the first part of this Bulletin where its description is to be found. After this follows the analysis, calculated upon the grass in its green state, as cut, or the hay as it was in the laboratory without artificial drying; and next, the analysis calculated upon the same material after it has been entirely freed from moisture by drying with the aid of heat. Inasmuch as the percentage of water is so various, the latter set of figures is the best to use in comparing the analyses. Next is a column showing the time of cutting, and lastly the number of the sample is repeated.

Some general ideas of the relative value of different grasses as food may be had from a comparison of their analyses, but a correct estimate can only be had when the proportion of each constituent that is digestible—that is, the co-efficient of digestibility—is known.

STATION NUMBER.	NAME OF GRASS.	In the Fresh or Air-dry Material ; per cent.					
		Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
394	Red-top hay (p. 60).....	10.96	5.16	4.34	24.27	53.74	1.53
3593	Red-top (p. 60).....	56.64	2.93	3.77	11.71	23.94	1.01
3594	".....	66.41	2.85	2.69	10.69	16.73	.63
5709	".....	59.74	2.43	2.72	12.39	21.85	.87
3580	Creeping red-top; dry hay (p. 63).....	6.51	5.68	6.44	30.41	48.87	2.09
3592	Creeping red-top; dry hay.....	58.13	2.90	4.63	11.17	22.30	.87
3581	Johnson-grass (p. 64).....	61.22	2.01	2.01	13.60	20.64	.52
3599	".....	51.48	2.78	2.64	17.96	24.41	.73
3631	".....	51.10	3.32	2.65	16.16	25.93	.84
5716	".....	70.84	1.71	1.27	10.53	15.19	.46
5717	Fleshy roots of same (p. 64).....	88.92	1.01	.47	3.19	6.26	.15
3621	Kafir corn (p. 65).....	75.64	1.73	1.89	8.19	12.12	.43
3610	Sweet vernal-grass (p. 66).....	67.26	1.81	2.62	9.82	17.62	.87
5705	".....	63.15	1.93	2.57	11.49	19.78	1.08
3583	Tall oats-grass (p. 67).....	63.64	1.97	2.94	11.41	19.09	.95
3609	".....	73.38	1.64	2.58	8.88	12.83	.69
5706	".....	70.69	1.54	2.27	10.49	14.40	.59
3587	Smooth brome-grass (p. 70).....	50.26	3.56	3.46	15.33	26.32	1.07
3611	".....	40.60	2.94	3.59	17.28	34.32	1.27
3612	Hairy brome-grass (p. 70).....	51.38	3.32	4.18	13.64	26.21	1.27
3586	Rescue grass (p. 72).....	53.84	2.63	3.85	12.40	26.59	.69
2022	".....	61.91	2.86	3.33	11.00	20.09	.81
3576	Orchard grass; dry hay (p. 73).....	8.36	8.69	7.06	33.35	41.41	2.13
3588	".....	52.86	3.24	3.85	15.62	22.98	1.45
5703	".....	69.15	2.01	2.35	10.83	14.93	.73
234	".....	71.91	2.12	2.49	8.41	14.43	.64
3613	Wavy hair-grass (p. 77).....	49.37	3.30	3.68	15.02	27.30	1.33
3626	Yard-grass (p. 78).....	77.07	2.52	2.90	6.84	10.27	.40
3619	Teff (p. 79).....	69.52	2.39	2.04	9.91	15.56	.58
3598	Stink-grass (p. 80).....	73.97	1.86	3.31	8.58	11.88	.40
3615	Teosinte (p. 81).....	79.84	1.29	.87	6.18	11.55	.27
3633	".....	81.47	1.36	2.02	4.75	10.12	.28
5711	English blue-grass (p. 82).....	65.33	2.51	2.98	11.73	16.68	.77
223	".....	76.57	2.69	3.63	4.88	10.94	1.29
232	".....	74.36	2.23	2.50	7.36	12.78	.77
239	".....	69.62	2.30	2.52	8.78	16.06	.72
376	Hay of same.....	10.78	6.99	7.50	25.53	47.34	1.86
378	".....	10.62	6.27	6.31	30.34	45.03	1.43
382	".....	7.97	10.03	7.62	26.07	46.50	1.81
126	Seed ".....	8.87	5.67	12.75	19.75	51.48	1.48

In the Water-free Material ; per cent.								DATE OF CUTTING.	STATION NUMBER.
Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.	Phosphoric Acid.	Nitrogen.	Potash.		
5.80	4.87	27.26	60.35	1.72	.....	.....	.....	In full bloom, 1887.....	394
6.76	8.69	27.01	55.22	2.32	0.59	1.39	2.27	June 28, 1894.....	3593
8.47	8.00	31.82	49.84	1.87	0.55	1.28	1.69	" 29, ".....	3594
6.05	6.77	30.78	54.25	2.15	0.59	1.08	1.81	" " 1897.....	5709
6.08	6.89	32.52	52.27	2.24	0.50	1.17	2.09	July 17, 1893.....	3580
6.93	11.05	26.67	53.28	2.07	0.62	1.77	2.31	June 23, 1894.....	3592
5.17	5.19	35.05	53.26	1.33	0.55	0.83	0.85	July 19, 1893.....	3581
5.73	5.44	37.02	50.30	1.50	0.65	0.87	0.63	" 26, 1894.....	3599
6.80	5.41	33.05	53.02	1.72	0.69	0.87	0.39	Sept. 8, 1896.....	3631
5.87	4.36	36.11	52.09	1.57	0.47	0.70	1.25	July 31, 1897.....	5716
9.09	4.23	28.78	56.58	1.32	1.17	0.68	4.73	" " ".....	5717
7.10	7.76	33.62	49.77	1.75	0.94	1.24	2.30	" 29, 1896.....	3621
5.52	8.01	30.01	53.80	2.66	0.59	1.28	1.93	May 24, 1895.....	3610
5.23	6.98	31.17	53.70	2.92	0.65	1.11	1.85	June 5, 1895, <sup>2</sup> .....	5705
5.42	8.08	31.39	52.51	2.60	0.59	1.29	2.18	" 19, 1894.....	3583
6.18	9.70	33.36	48.16	2.60	0.67	1.55	2.82	May 24, 1895.....	3609
5.24	7.80	35.78	49.16	2.02	0.60	1.25	2.31	June 5, 1897, <sup>3</sup> .....	5706
7.15	6.97	30.83	52.90	2.15	0.52	1.11	2.38	" 20, 1894, <sup>4</sup> .....	3587
4.95	6.05	29.09	57.77	2.14	0.47	0.97	1.40	July 6, 1895.....	3611
6.82	8.57	28.06	53.92	2.61	0.51	1.37	2.35	" " ".....	3612
5.69	8.33	26.87	57.62	1.40	0.65	1.33	1.32	June 23, 1894, <sup>5</sup> .....	3586
7.52 <sup>7</sup>	8.74 <sup>8</sup>	28.88	52.72	2.14	.....	.....	.....	July 27, 1892, <sup>6</sup> .....	2022
9.48	7.70	36.39	45.20	2.32	0.63	1.23	3.14	June 14, 1893.....	3576
6.87	8.18	33.13	43.73	3.09	0.63	1.30	2.25	" 23, 1894, <sup>5</sup> .....	3588
6.52	7.62	35.12	48.39	2.35	0.59	1.22	2.05	" 5, 1897, <sup>3</sup> .....	5703
7.55	8.86	29.94	51.40	2.27	.....	.....	.....	" 3, 1887, <sup>9</sup> .....	234
6.52	7.28	29.67	53.90	2.63	0.50	1.16	1.85	July 6, 1895.....	3613
11.00	12.64	29.82	44.78	1.76	1.04	2.01	3.71	" 30, 1896.....	3626
7.84	6.68	32.49	51.08	1.91	0.68	1.07	1.96	" 6, 1896.....	3619
7.13	12.71	32.96	45.66	1.54	0.82	2.03	2.60	" 3, 1894.....	3598
6.39	4.32	30.65	57.29	1.35	0.50	0.69	1.22	Aug. 31, 1893.....	3615
7.32	10.89	25.62	54.67	1.51	0.86	1.74	1.48	Sept. 22, 1896.....	3633
7.23	8.58	33.84	48.12	2.23	0.63	1.38	2.41	July 1, 1897.....	5711
11.48	15.50	20.81	46.71	5.50	.....	.....	.....	May 12, 1887, <sup>10</sup> .....	223
8.68	9.76	28.72	49.82	3.02	.....	.....	.....	June 3, " 11.....	232
7.56	8.39	28.89	52.79	2.37	.....	.....	.....	" 13, " 12.....	239
7.84	8.41	28.62	53.05	2.08	.....	.....	.....	When heading, <sup>13</sup> .....	376
7.01	7.06	33.95	50.38	1.60	.....	.....	.....	" in bloom, <sup>13</sup> .....	378
10.91	8.28	28.33	50.51	1.97	.....	.....	.....	" seed fully formed, <sup>13</sup> .....	382
6.22	13.99	21.67	56.50	1.62	.....	.....	.....	" fully ripe, <sup>14</sup> .....	126

STATION NUMBER.	NAME OF GRASS.	In the Fresh or Air-dry Material ; per cent.					
		Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
3605	Sheep's fescue (p. 84) .....	65.22	2.04	3.09	12.02	16.91	.72
3603	" " .....	66.63	2.24	3.99	11.27	16.13	.64
3606	" " .....	66.00	1.75	3.88	9.60	18.05	.72
5713	Meadow fescue, English blue-grass (p. 85)	56.02	2.95	5.75	14.52	19.69	1.07
3582	Red fescue (p. 87) .....	68.23	2.14	3.65	10.57	14.60	.81
3604	" " .....	63.16	1.78	3.61	12.56	18.02	.87
2021	Hungarian-grass (p. 89) ..	63.72	2.73	2.23	12.53	18.13	.66
3596	Pigeon-grass (p. 89) .....	82.49	2.05	2.04	5.53	7.47	.42
3600	Rice cut-grass (p. 88).....	64.40	3.92	4.24	10.20	16.59	.65
3597	Meadow spear-grass (p. 93).....	68.59	2.35	1.72	9.59	17.31	.44
3601	Barnyard-grass (p. 94).....	82.93	1.86	2.62	4.74	7.49	.36
3624	" " .....	87.40	1.68	1.66	4.13	4.95	.18
3625	Spreading panicum (p. 96).....	80.99	1.66	2.88	5.53	8.50	.44
3622	Crab-grass ; dry hay (p. 96.).....	8.21	8.57	5.75	29.19	46.19	2.09
3623	Texas millet (p. 97).....	72.85	5.06	2.55	8.25	10.93	.36
3602	Slender paspalum ; dry hay (p. 98).....	8.81	7.38	9.19	28.78	44.77	1.07
3614	Reed canary-grass (p. 98) .	59.34	4.06	3.97	9.61	21.55	1.47
5710	" " " .....	59.43	3.17	3.41	11.99	21.15	.85
3579	Timothy (p. 100).....	47.80	2.27	3.24	16.04	29.65	1.00
3595	" " .....	59.90	2.06	2.79	12.43	21.92	.90
233	" " .....	79.41	1.40	2.13	6.28	10.30	.48
238	" " .....	69.33	2.34	2.70	9.57	15.40	.66
377	Hay of same .....	9.77	4.69	4.75	28.20	51.11	1.48
397	" " " .....	11.13	4.14	4.56	27.10	51.27	1.80
398	" " " .....	13.52	4.82	4.34	27.61	48.30	1.41
371	" " " .....	9.56	4.10	4.75	29.22	49.62	2.75
3589	Canada blue-grass (p. 101).....	55.64	2.22	2.79	12.55	25.78	1.02
5712	" " " .....	50.47	2.27	2.86	14.47	28.58	1.35
5736	" " " .....	66.00	1.72	2.19	11.17	18.02	.90
3590	Kentucky blue-grass (p. 103).....	49.36	3.87	5.16	15.45	24.87	1.29
3591	" " " .....	56.64	5.13	4.38	12.27	20.64	.94
226	" " " .....	70.54	2.08	3.79	6.89	15.17	1.53
229	" " " .....	66.05	2.29	3.12	8.65	18.85	1.04
236	" " " .....	54.58	2.76	4.10	11.41	25.82	1.33
375	Blue-grass hay .....	9.39	7.74	10.43	19.60	50.42	2.47
225	Blue-grass fertilized .....	73.89	1.85	4.62	5.96	12.63	1.05
228	" " " .....	70.09	2.03	3.69	7.48	15.50	1.21
237	" " " .....	63.25	2.14	3.60	9.25	20.60	1.16
3630	Tall red-top (p. 105) .....	64.75	2.11	2.69	12.73	17.10	.62



In the Water-free Material ; per cent.								DATE OF CUTTING.	STATION NUMBER.
Ash.	Protein,	Fiber.	Nitrogen-free Extract.	Fat.	Phosphoric Acid.	Nitrogen.	Potash.		
5.88	8.88	34.57	48.60	2.07	0.52	1.42	1.65	May 22, 1895	3605
6.70	9.27	33.78	48.32	1.93	0.64	1.48	1.88	" 20, "	3603
5.15	11.42	28.23	53.04	2.11	0.59	1.83	1.69	" 22, "	3606
6.70	13.06	33.01	44.79	2.44	0.73	2.09	1.93	July 1, 1897	5713
6.73	11.47	33.27	45.98	2.54	0.63	1.83	1.96	May 12, 1894	3582
4.82	9.80	34.11	48.92	2.35	0.52	1.57	1.90	" 22, 1895	3604
7.53 <sup>7</sup>	6.14 <sup>15</sup>	34.55	49.96	1.82	.....	.....	.....	July 18, 1892	2021
11.74	11.67	31.58	42.62	2.39	0.71	1.87	5.92	June 29, 1894	3596
11.00	11.92	28.65	46.60	1.83	0.75	1.91	1.52	August 8, "	3600
7.34	5.48	30.53	55.22	1.43	0.36	0.88	1.84	June 29, " 16	3597
10.88	15.34	27.78	43.94	2.08	0.83	2.47	4.59	August 8, "	3601
13.36	13.17	32.79	39.25	1.43	1.07	2.11	5.17	August 22, 1896	3624
8.76	15.13	29.11	44.70	2.30	0.78	2.42	3.86	Sept. 2, "	3625
9.34	6.26	31.80	40.32	2.28	0.90	1.00	3.09	July 29, "	3622
18.64	9.39	30.42	40.21	1.34	0.94	1.50	1.44	" 31, " 3	3623
8.09	10.09	31.56	49.09	1.17	0.53	1.61	2.64	Sept. 26, 1894, 17	3602
9.98	9.76	23.63	53.02	3.61	0.65	1.56	2.43	July 8, 1895	3614
7.82	8.40	29.57	52.12	2.11	0.58	1.34	2.08	" 1, 1897	5710
4.35	6.21	30.72	56.81	1.91	0.53	0.99	1.52	" 17, 1893, 18	3579
5.14	6.95	31.00	54.65	2.26	0.50	1.11	1.97	June 23, 1894, 19	3595
6.79	10.33	30.49	50.07	2.32	.....	.....	.....	" 3, 1887, 20	233
7.62	8.80	31.12	50.30	2.16	.....	.....	.....	" 13, " 21	238
5.19	5.26	31.26	56.65	1.64	.....	.....	.....	Crop of 1886, 22	377
4.66	5.13	30.49	57.69	2.93	.....	.....	.....	In full bloom, 23	397
5.57	5.02	31.93	55.85	1.63	.....	.....	.....	" " " 24	398
4.53	5.25	32.33	54.85	3.04	.....	.....	.....	Most of bloom had fallen, 25	371
5.01	6.30	28.28	58.10	2.31	0.54	1.08	2.01	June 23, 1894, 4	3589
4.59	5.77	29.21	57.70	2.73	0.52	0.92	1.59	July 1, 1897	5712
5.06	6.44	32.84	53.01	2.65	0.56	1.02	2.10	June 17, 1899	5736
7.65	10.20	30.54	49.07	2.54	0.64	1.63	2.19	June 23, 1894	3590
11.83	10.09	28.29	47.63	2.16	0.55	1.62	2.01	" 29, "	3591
7.07	12.85	23.34	51.50	5.20	.....	.....	.....	May 13, 1887, 27	226
6.78	9.18	25.49	55.51	3.06	.....	.....	.....	" 27, " 27	229
6.08	9.02	25.13	56.85	2.92	.....	.....	.....	June 9, " 28	236
8.54	11.51	21.63	55.65	2.67	.....	.....	.....	May 29, 1886, 3	375
7.07	17.70	22.83	48.37	4.03	.....	.....	.....	" 13, 1887, 29	225
6.80	12.32	25.01	51.83	4.04	.....	.....	.....	" 27, " 29	228
5.83	9.80	25.16	56.05	3.16	.....	.....	.....	June 9, " 29	237
6.00	7.63	36.12	48.49	1.75	0.69	1.22	2.02	Aug. 22, 1896	3630

We give below the co-efficients of digestibility of a few grasses and hays as determined by feeding experiments made at American Stations. The figures are taken from a table compiled by W. H. Jordan, published in the Experiment Station Record, Vol. 6, p. 7 (1894-5). The numbers show how many out of 100 parts of each constituent were found to be digestible. Thus opposite "Timothy," in the column headed "Protein," we find the number 48. This means that forty-eight hundredths of the protein contained in the timothy experimented upon was found to be digestible; or, if a sample of timothy is found to contain 3.24 per cent. of protein, we may calculate that the per cent. of digestible protein contained in it is  $3.24 \times .48$ , or 1.56 per cent. The digestibility as well as the composition of grass varies considerably at different stages of growth and in different seasons.

AVERAGE DIGESTION CO-EFFICIENTS OF SOME GRASSES.

GRASS OR HAY.	Number of Single Trials.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Red-top hay .....	3	60	29	61	61	62	50
Johnson-grass hay.....	1	54	56	45	58	54	39
Orchard-grass hay.....	3	56	...	59	60	55	54
Hungarian-grass .....	4	63	41	62	68	66	52
Hungarian-grass hay .....	2	65	47	60	68	67	64
Timothy .....	3	63	32	48	56	66	53
Timothy hay.....	22	58	37	49	53	63	57
Same, cut in full bloom..	5	61	44	57	59	64	56
Same, cut late.....	5	54	32	45	48	61	51

**NOTES TO THE ANALYSES.**

- <sup>1</sup> From A. P. Farnsley, Louisville. Grown on rich land; yielded 1½ ton per acre. Stored in barn. (1st Ann. Rep., p. 18.)
- <sup>2</sup> Seeds had formed, but were not ripe.
- <sup>3</sup> In flower.
- <sup>4</sup> Had just finished flowering
- <sup>5</sup> Heads brown; lower leaves still green
- <sup>6</sup> Seeds nearly ripe; plants still green.
- <sup>7</sup> Carbonic acid has been deducted. (5th Ann. Rep., pp. 10 and 11.)
- <sup>8</sup> Albuminoids, 7.32 per cent.
- <sup>9</sup> In full bloom. (1st Ann. Rep., p. 18.)
- <sup>10</sup> About 8 inches high. (1st Ann. Rep., p. 15.)
- <sup>11</sup> About 9 inches high; just coming into flower (loc. cit.).
- <sup>12</sup> About 9 inches high seed in milky stage (loc. cit.).
- <sup>13</sup> Raised by the late Dr. R. J. Spurr on his farm near Greendale, Fayette County (loc. cit.).
- <sup>14</sup> From I. Reese, Fern Leaf, Mason County (loc. cit.).
- <sup>15</sup> Albuminoids, 4.91 per cent.
- <sup>16</sup> Wet ground near pond.
- <sup>17</sup> From Louisville.
- <sup>18</sup> About half the heads brown.
- <sup>19</sup> Nearly done flowering.
- <sup>20</sup> Just headed out completely but not yet in bloom; 2½-3½ feet high. (1st Ann. Rep., p. 16)
- <sup>21</sup> In full bloom; 3-4 feet high (loc. cit.).
- <sup>22</sup> From Dr. Spurr; crop of 1886; ripe and in good condition (loc. cit.).
- <sup>23</sup> From A. P. Farnsley, Louisville; crop of 1886; cured and stored in barn (loc. cit.).
- <sup>24</sup> Same crop as 397; sample taken from stack January 1, 1887 (loc. cit.).
- <sup>25</sup> From W. A. Reese, Eminence (loc. cit.).
- <sup>26</sup> Headed out but not in flower. (1st Ann. Rep., p. 14.)
- <sup>27</sup> About 16 inches high; just done flowering (loc. cit.).
- <sup>28</sup> Seed nearly ripe but stems still green (loc. cit.).
- <sup>29</sup> Fertilized with sulphate of ammonia at the rate of 300 lbs. to the acre.

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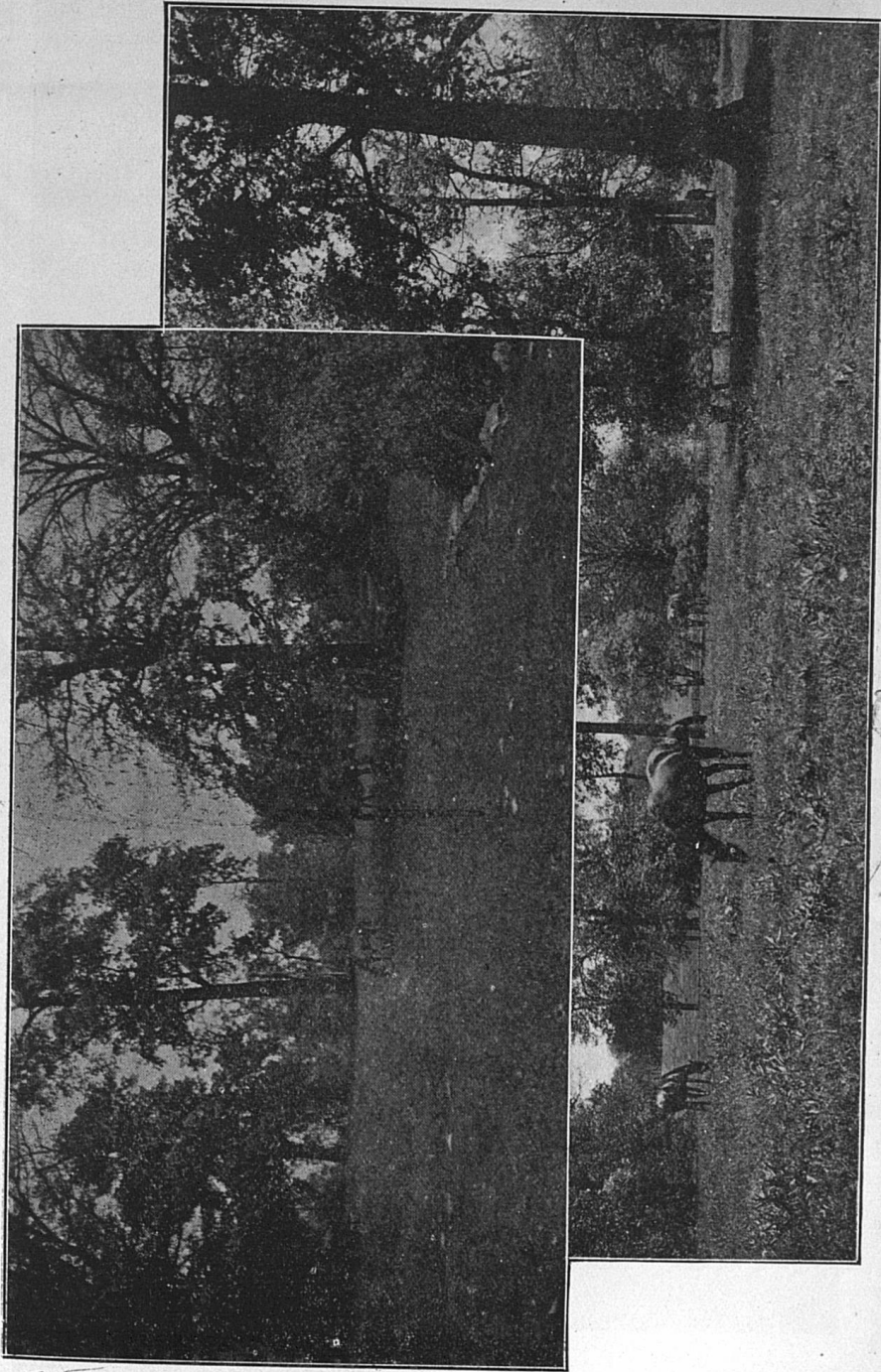


FIG. 1.—Woodland pastures in April. Horeb pike, 6 miles north of Lexington. Photographed by H. G.

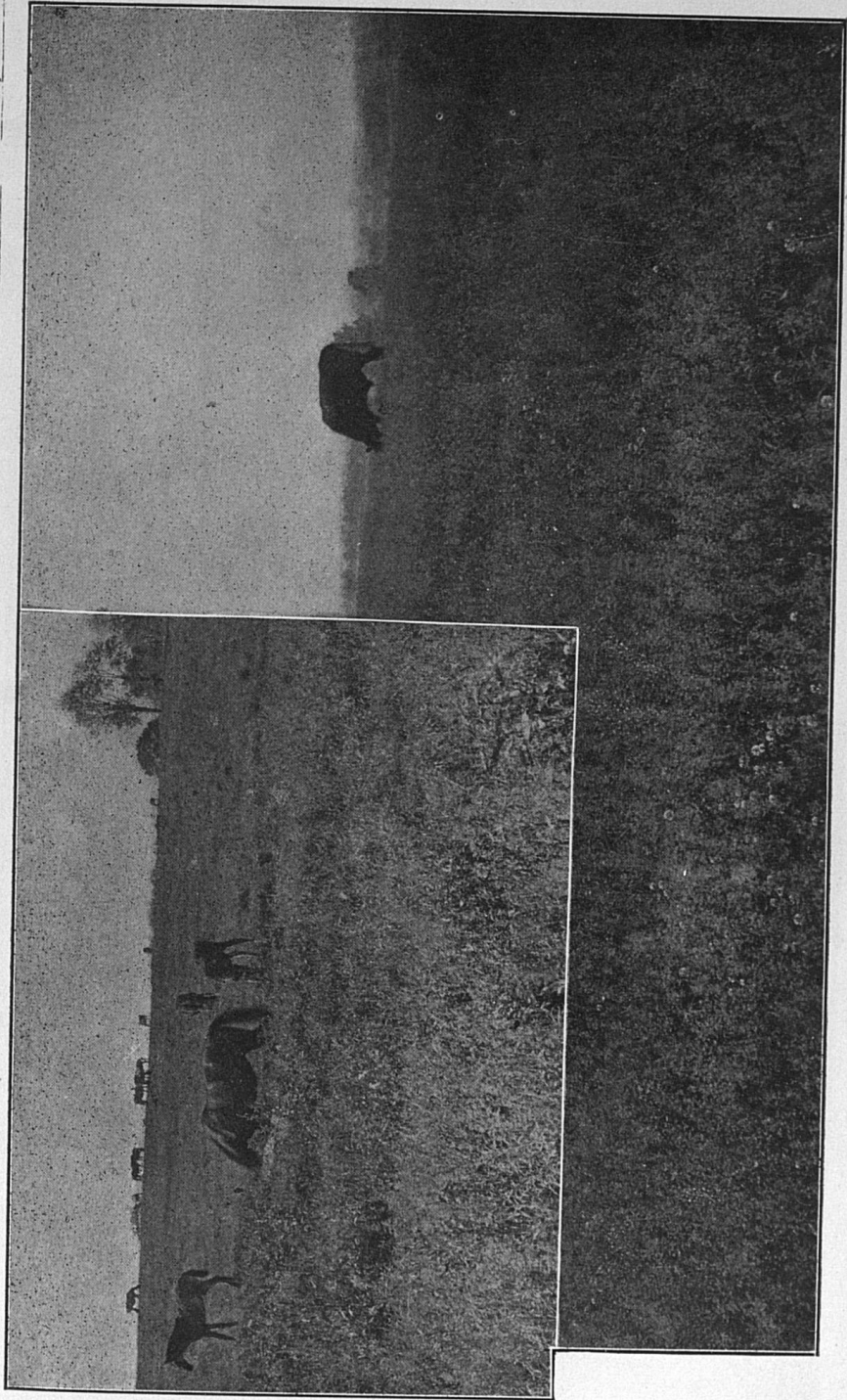


FIG. 2.—Open pasture in May; upper, Newtown pike, about 4 miles north of Lexington; lower, Nicholasville pike, about 3 miles south of Lexington. Photographed by H. G.



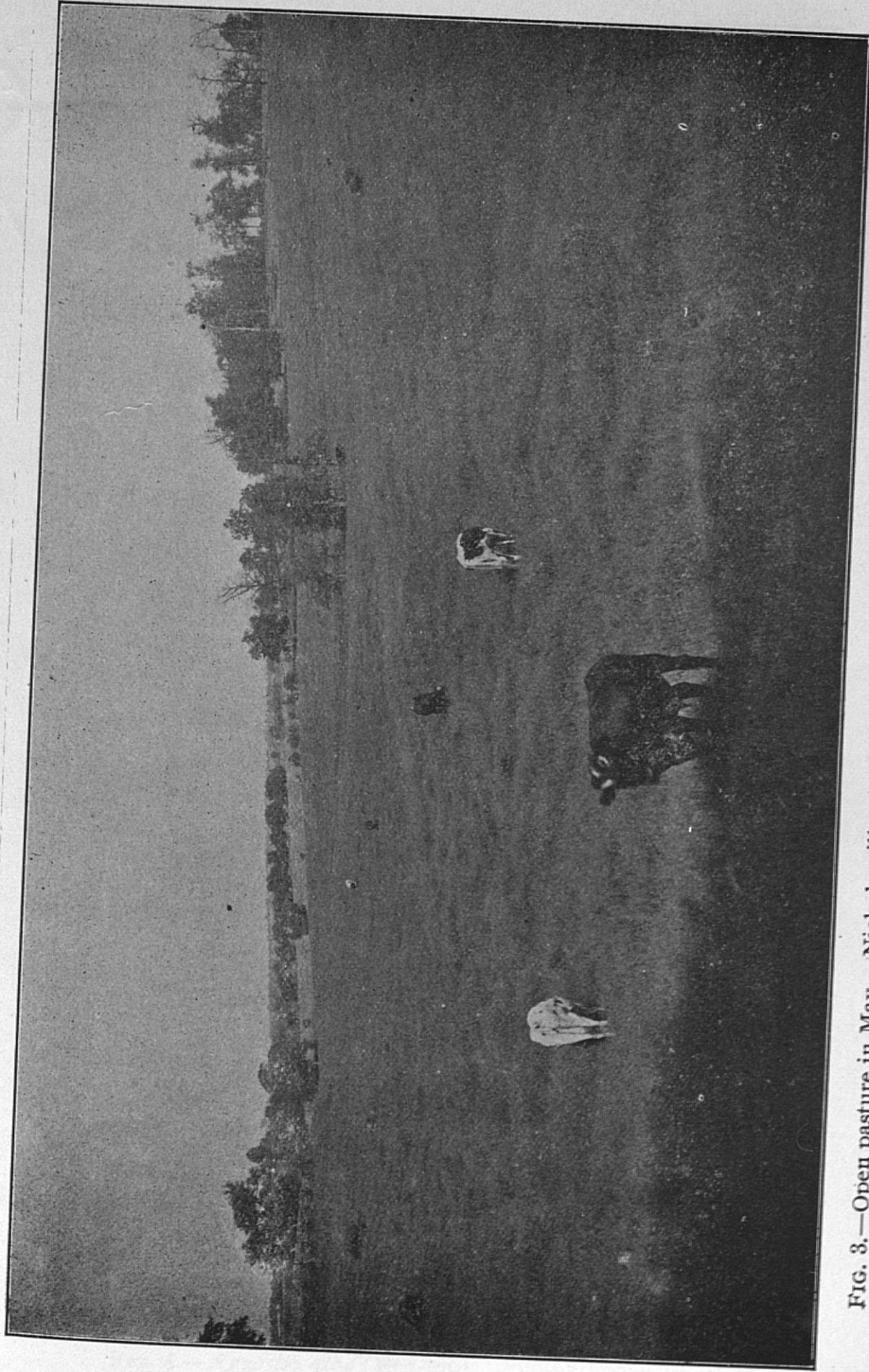


FIG. 3.—Open pasture in May. Nicholasville pike, about 4 miles south of Lexington. Photographed by H. G.



FIG. 4.—*Agrostis alba* (Red-top). Photographed by H. G.



FIG. 5.—*Andropogon halpensis* (Johnson-grass).  
Photographed by H. G.

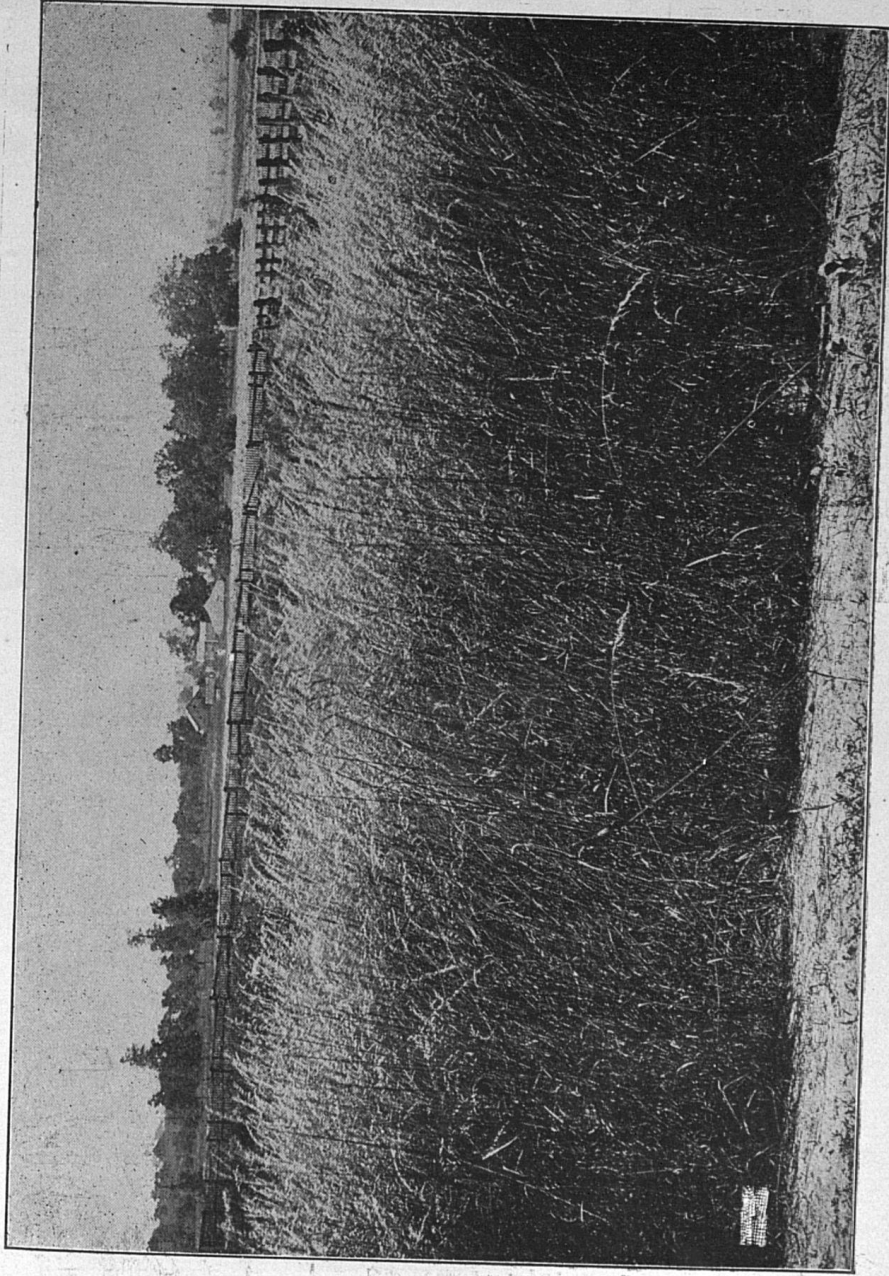


FIG. 6.—Plot of *Arrhenatherum elatius* (Tall oats-grass). Kentucky Experiment Station Farm, June 23, 1894.  
Photographed by H. G.



FIG. 7.—*Bromus inermis* (Smooth brome-grass).  
Photographed by H. G.



FIG. 8.—*Bromus unioloides* (Rescue-grass).  
Photographed by H. G.



FIG. 9.—*Poa annua* (Annual spear-grass).

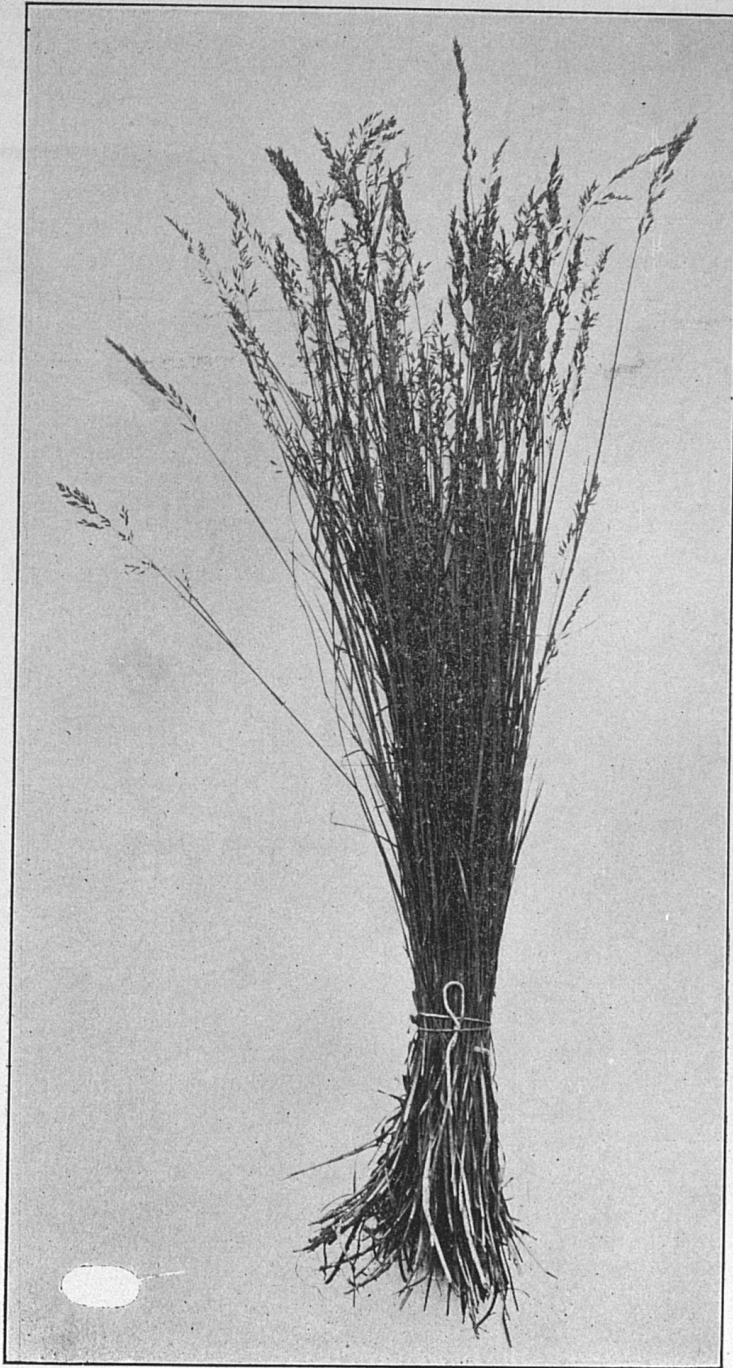


FIG. 10.—*Poa compressa* (Canada blue-grass).  
Photographed by H. G.





FIG. 11.—*Poa pratensis* (Kentucky blue-grass). Panicle with stamens exposed. Natural size. Photographed by H. G.

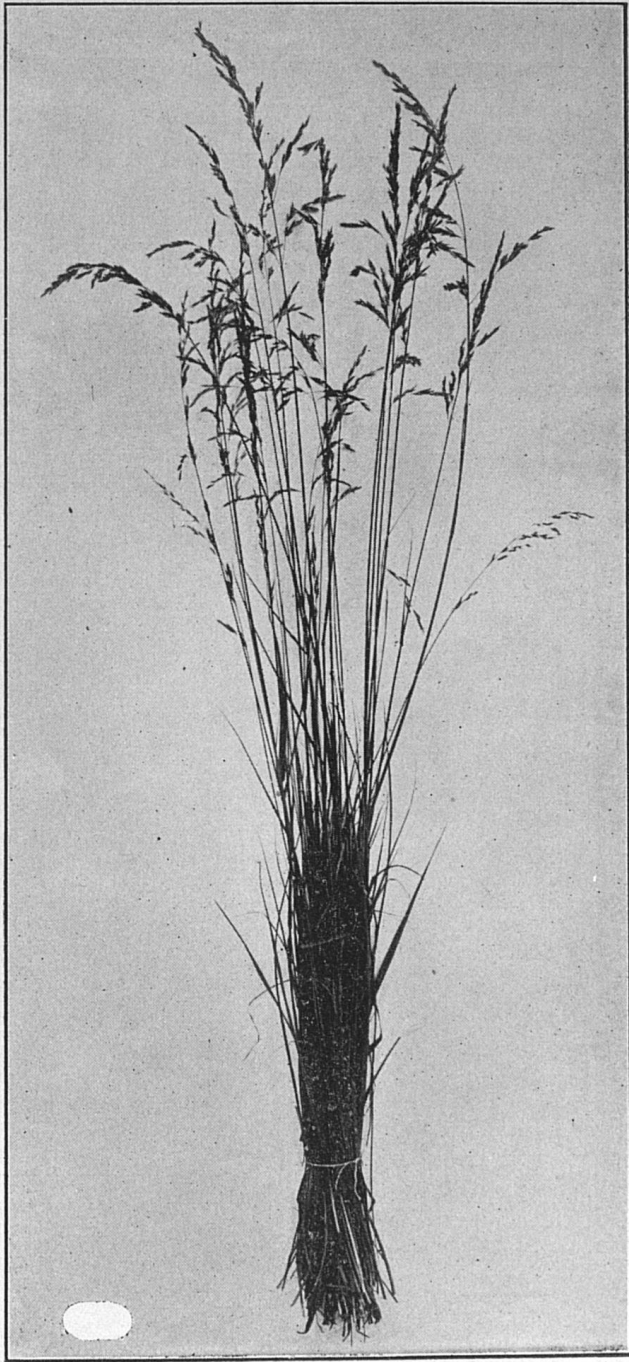


FIG. 12.—*Festuca elatior* (English blue-grass).  
Photographed by H. G.

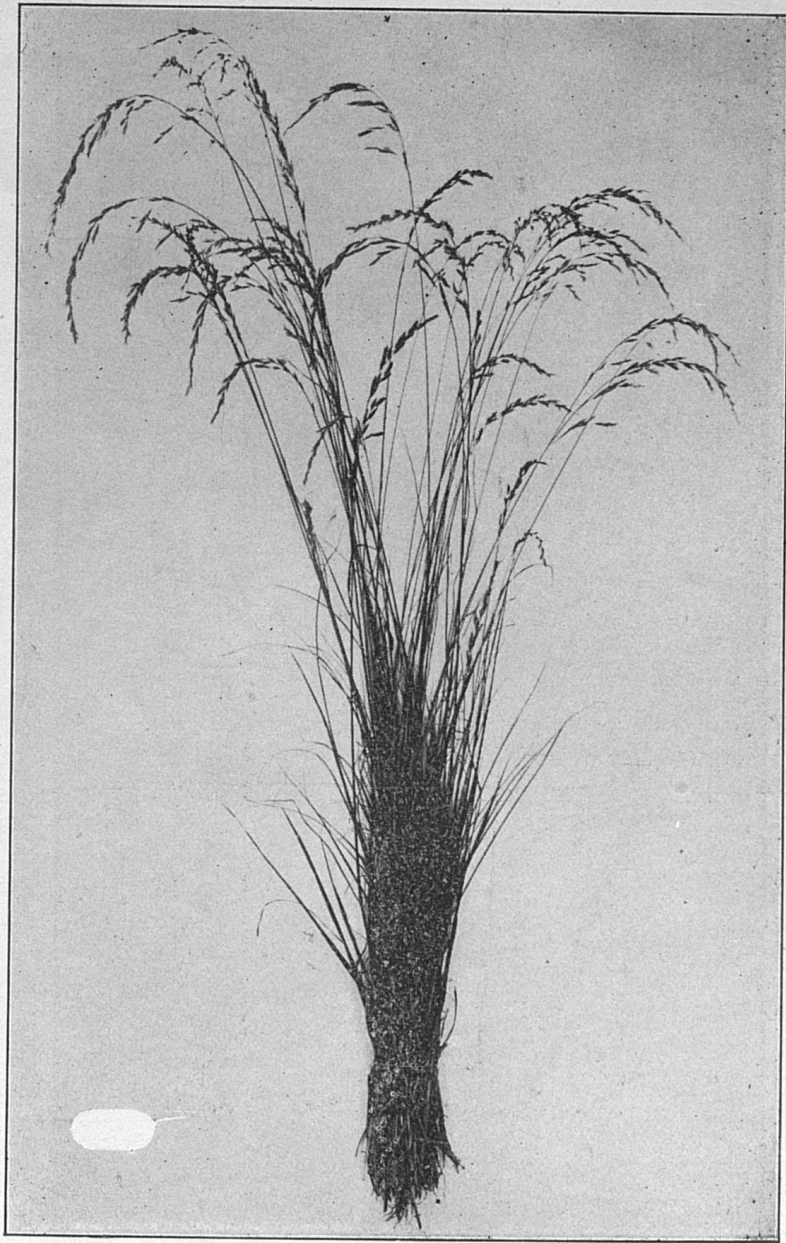


FIG. 13.—*Festuca pratensis* (English blue-grass).  
Photographed by H. G.



FIG. 14.—*Ixophorus glaucus* (Yellow foxtail).  
Photographed by H. G.