LAWNS AND LAWN MAKING.
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INTRODUCTION.

There are few subjects relative to grasses of more general interest than that of lawns. Nothing is more beautiful than a well-kept lawn, whether it be of large or small extent. Even the small plots fronting city dwellings are points of attraction when covered with a soft, even turf. Lawns are the most fascinating and delightful features in landscape gardening, and there is nothing which more strongly bespeaks the character of the owner than the treatment and adornment of the lawns upon his place. How to establish lawns and the varieties of grasses best suited for the purpose are among the most frequent inquiries received by the Division of Agrostology. It is the general desire to have a lawn made quickly, to have the turf fine as well as permanent, and these results are often expected under impossible conditions. Fineness and permanency may be secured, but they are results which can not be obtained by hasty and unskilled preparation. A perfect lawn can not be made in a season, and the highest excellence sought comes only through intelligent care for a period of years. A green surface may be secured within a few months under favorable conditions, but a soft, velvety turf, which is both a delight to view and to walk on, comes only with years of patient care.

With the object of obtaining as full data as possible regarding the methods employed in the establishment and maintenance of lawns in various parts of the United States, a circular of inquiry was addressed to the superintendents of public parks and others known to be engaged in this work. Replies were received from points covering a range from Maine to Washington and southward to Florida, Texas, and southern California. The series of questions asked embraced the leading features of the work under discussion, and it is upon the replies received from these correspondents, together with the personal observation and experience of the writer, that this paper is based.

The topics presented in the circular were:

1. The preparation of the land for lawns.
2. The kind or kinds of fertilizers used in the preparation of the soil, and subsequently upon the lawns.
3. The variety used where there is much shade.
4. The variety or kind of seed used.

1 Thanks are here expressed to all who so kindly and fully responded to this circular.
2 Constrained by some to refer to fertilizers, which was really intended, and by others to the kind of grass used.
Preparation of the Land.

In what follows, proper grading and thorough drainage are presupposed. A well-drained soil is of the first importance and is absolutely necessary to success. Where the process of grading has involved much filling in, time should be allowed for the settling of the soil, and during this period a hoed crop may be cultivated on the land to advantage. If the land is very weedy, the cultivation of corn or potatoes for a season will assist in reducing the stock of weeds. It must be remembered that the lawn when once formed is to remain undisturbed; the sward is to be permanent, and hence the importance of most thorough preparation of the soil. In most cases, particularly in the Eastern and Northern States, a liberal application of fertilizers is necessary. If the land is native sod, this should be top-dressed in the fall with well rotted stable or barnyard manure, and the sod then turned by plowing. The decomposition of this sod will add to the soil that most valuable fertilizing element, humus. In the following spring a top-dressing of old, well-composted manure should be applied at the rate of 8 to 12 cords to the acre, according to the natural fertility of the soil, and the land cross plowed. The surface then should be made as fine as possible by repeated harrowings and thorough rolling before the seed is sown. The deeper the soil is stirred in plowing the better the results and the less care will be required in keeping the grass in good condition.

The nature of the subsoil has great influence upon the growth of the grass and the permanence and beauty of the lawn. Over a light and gravelly subsoil the grass is not infrequently destroyed by summer drought. The best soil for the formation of the lawn is a fine, sandy loam over clay subsoil. Where the effects of heat and drought are most severely felt, the soil must be most deeply and thoroughly worked in its preparation. It not infrequently happens in the case of dooryards and plots surrounding city and suburban residences that the soil is largely composed of the earth excavated in making the foundations. This earth is entirely unsuited for the growth of grass, and, where a lawn is desired, should be entirely removed or covered to a sufficient depth with fine earth rich in humus, to insure the healthy and permanent growth of the grass. This added soil should be at least 1 foot in depth, and a depth of 2 feet will repay the extra labor in the final results.

In the Western States and in the South it is not customary to stir the soil so deeply as recommended above. The practice, however,
can well be applied in most localities in the South, but in the West, where the soil conditions are essentially different from those in the East, the method pursued must be governed by the local requirements. A coarse, uneven soil will only yield coarse grasses and a finely worked soil and evenly worked surface will produce the finer sorts, which alone are desirable.

FERTILIZERS.

Reference has already been made to the use of well-rotted barnyard or stable manure in the preparation of the land for lawns. This is the best fertilizer to apply when it is to be plowed under, but only old and well-composted manure should be used. When such can not be obtained, commercial fertilizers may be substituted, and with these a liberal supply of lime and bone meal can be worked into the soil before seeding. Where it is necessary to apply fertilizers after the grass has started in order to maintain fertility, land plaster, bone meal, nitrate of soda, and hard-wood ashes are most commonly employed. A fall dressing of clear sheep manure, 3 to 5 tons per acre, followed by an early spring dressing of unleached hard-wood ashes (containing 8 per cent potash) at the rate of 3 to 5 tons per acre, according to the fertility of the soil, is advised by one correspondent.

A common practice is to top-dress lawns in the fall or early winter with a fine compost, adding in the spring a dressing of bone meal and hard-wood ashes; in the place of the fall dressing of compost, hard-wood ashes may be substituted. A too frequent use of hard-wood ashes, however, is to be avoided, as it will induce the growth of clover at the expense of the grasses. Bone meal, hard-wood ashes, and lime are the fertilizers most generally used to maintain the fertility of the lawn, whether shaded or exposed to the sun. When the soil has been properly prepared and enriched, there is little difficulty in securing a good growth of grass under trees if the branches are not too low.

SELECTION OF LAWN GRASSES.

The value and beauty of a lawn depends upon the color, texture, and turf-forming habit of the grass selected. A grass may be of good color but harsh in texture and incapable of producing a turf, or it may form a good sward and have a satisfactory texture, but be deficient, or even unsightly, in color.

TURF-FORMING GRASSES.

The quality of forming turf is of first importance in the selection of a lawn grass, for unless it possesses a good turf-forming habit it can have no value as a lawn grass, however excellent it be in color or texture. The turf-forming grasses are chiefly natives of the moist, temperate regions of the world. In the semiarid districts of the West and Southwest the grasses are for the most part "bunch grasses,"
growing in isolated bunches, forming no continuous turf such as is seen in the pastures and meadows of the East. In the Tropics, excepting upon the higher mountains, turf-forming grasses are almost unknown, the native species belonging chiefly to the class termed jungle grasses.

Only those grasses with creeping rootstocks or with a prostrate creeping habit of growth form a continuous turf, and hence are the only varieties furnishing lawn grasses. Orchard grass has no place upon the lawn, because it is a bunch grass, and however closely clipped and frequently rolled it maintains its characteristic tussock-like growth, as shown on Pl. VIII, fig. 2, which represents a small area of closely mown orchard grass, seen from above. The mass of leaves are grouped in tufts, or bunches, and parts of three of these tufts are shown in the illustration, which is an engraving from a photograph taken in the turf garden of the Connecticut Agricultural Experiment Station. In marked contrast with orchard grass, both in uniformity of surface and fineness of leafage, is Kentucky blue grass, shown for comparison on Pl. VIII, fig. 1.

Kentucky blue grass forms sod by its creeping rhizomes, which are all under ground. These send up at frequent intervals leafy shoots, which form the turf of the lawn. Under the most favorable circumstances these leafy shoots are rarely so numerous or fine as to make the soft springy turf so much desired in lawns. This latter quality is possessed in a marked degree by some of the finer varieties of the fescues and bent grasses. Bermuda grass, carefully managed, makes a fine elastic turf, pleasant to walk on, scarcely inferior to some of the finer varieties of creeping bent.

Turf grasses are the pasture grasses of the New England and Middle States. Nowhere will we find a better turf, of finer or more even texture or more pleasant to walk on, than in some of the pastures near the New England coast, which have been grazed by sheep for the past hundred years or more. Where these pastures have been grazed the closest and trampled the most there will be the closest and most even turf, composed generally of a single variety of grass. Such turf as we are considering (turf suitable for lawns) is produced either by the grazing of stock, particularly sheep, or by the frequent and intelligent use of the lawn mower and the roller. The value of sheep in turf formation is recognized by the managers of public parks and has been taken advantage of by some. This is notably the case in Central Park, New York, and Druid Hill Park, Baltimore. (See Pl. IX, figs. 1 and 2.)

COLOR.

A deep rich emerald green is the shade most desired in a lawn grass, as it is generally pleasing and certainly the most beautiful of all tints. No grass in the Northern and Middle States fills this require-
FIG. 1.—A TURF OF KENTUCKY BLUE GRASS (AS SEEN FROM ABOVE, DESIGNED TO SHOW TEXTURE).

FIG. 2.—A TURF OF ORCHARD GRASS (AS SEEN FROM ABOVE, DESIGNED TO SHOW CHARACTER OF TURF FORMED).
FIG. 1.—THE LAWN MOWERS, OR TURF MAKERS, OF CENTRAL PARK, NEW YORK.

FIG. 2.—THE LAWN MOWERS, OR TURF MAKERS, OF DRUID HILL PARK, BALTIMORE, MD.
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ment so well as Kentucky blue grass; the color of this grass when grown under favorable circumstances may be regarded as the standard upon which to base comparisons. Different varieties of Kentucky blue grass show slight variations in color, some being lighter than others, but upon the whole the deep rich shade of green may be relied upon. Some of the fescues possess an equally deep shade of green, but the best turf-forming varieties of this class usually have a grayish tint which is more or less objectionable. Creeping bent and Rhode Island bent are much alike in color, but they are considerably lighter than Kentucky blue grass, and should this be regarded a fault it is fully counterbalanced by their finer texture and superior turf-forming habit. Italian rye grass has a good color, and the fine-leafed variety of perennial rye grass is by no means an inferior lawn grass. The color of these rye grasses is not very different from that of Kentucky blue grass, but there is a marked difference in the appearance of the herbage; the surface of the leaves of perennial rye has a shining or polished appearance not apparent in Kentucky blue grass. The color of Bermuda grass during the summer season is highly pleasing, but it turns brown upon the approach of cold weather, making it an undesirable lawn grass excepting in the warmer parts of the South, unless it be for residences occupied only during the summer months. It is a common grass in the vicinity of Washington, D.C., where it is locally known as wire grass, and frequently appears as a weed upon blue-grass lawns. Its presence in such lawns is not usually detected until under the first frosts the Bermuda turns to a light brown, when it becomes conspicuous by disfiguring the appearance of the turf. The color of St. Augustine grass is inferior to that of Bermuda, but that of Louisiana grass, sometimes used as a lawn grass in the far South, is quite equal to it in point of color.

TEXTURE.

Reference has already been made to the degree of fineness of several varieties of grasses, but the narrowness of the leaf blade does not always determine the texture. Some of the varieties of fescues have exceedingly narrow or thread-like leaves (Pl. X, fig. 1), but the turf formed by them may be harsh and unpleasant to the touch. Other grasses again may have comparatively broad leaves, which are soft and flexible, and the turf they produce may possess a desirable texture. Bermuda grass under the lawn mower yields a turf of excellent quality, the short, leafy stems become densely crowded, forming a soft, cushion-like sward (Pl. XI, fig. 2). St. Augustine grass is much inferior to Bermuda in this respect, and Korean lawn grass, which may be cultivated in Southern latitudes, has coarse, somewhat rigid leaves, and is decidedly harsh. Buffalo grass (Pl. XI, fig. 1) makes a fine, soft, and pleasing turf, so far as its texture is concerned, and when procurable may be substituted for Bermuda, as it
will thrive in drier situations or in more arid climates. The texture of Kentucky blue grass (Pl. VIII, fig. 1) is only fairly good, and while we have selected Kentucky blue grass to represent the standard of color, the standard of texture must be represented by the fine and soft bent grasses (Pl. XII, figs. 1 and 2). They make a turf soft as velvet. A uniform turf of creeping bent (Pl. XII, fig. 1), carefully managed, carries with it the idea of richness represented by costly garments or rich tapestries and carpets.

These illustrations of turf formed by cultures of single varieties of grass should be compared with that composed chiefly of Kentucky blue grass and white clover (see Pl. X, fig. 2). The uniform and even character of the former is exhibited in striking contrast with the latter, which is uneven, irregular, and far less pleasing to the eye.

VARIETIES.

The principal lawn grasses of this country are Kentucky blue grass, creeping bent, and Rhode Island bent, the first a species of *Poa (Poa pratensis)*, the latter belonging to the genus *Agrostis (Agrostis stolonifera and A. canina)*. White or Dutch clover is often sown with Kentucky blue grass, and this mixture is not objectionable, because the shade of green in the clover is nearly the same as that of the grass. There are several of the fine-leafed fescues, the names of which are not well known, which are also valuable lawn grasses in the regions where Kentucky blue grass may be grown. It can not be too strongly emphasized that the best lawns—those presenting the best turf and greatest uniformity in color and texture—consist of pure cultures of single varieties.

Other grasses occasionally recommended for lawns, especially in “lawn-grass mixtures,” are Canadian blue grass, crested dog’s-tail, creeping fescue, rough-stalked meadow grass, meadow foxtail, velvet grass, and sweet vernal grass. It is only necessary to say here regarding mixed seeds for lawns that under certain conditions, as in woodland parks, which will be grazed rather than subject to the lawn mower and roller, or upon terrace slopes and road embankments, mixtures may be used.

Canadian blue grass is a native, and when properly handled makes a beautiful, deep, rich bluish-green sward. It is especially valuable for holding terraces, even better suited for this purpose than Kentucky blue grass.

Crested dog’s-tail grass is a soft, rather fine-leafed grass, which has been sparingly cultivated in this country. By some it is regarded an excellent lawn grass, but it has no qualities superior to the lawn grasses recommended above, excepting perhaps for shaded places, and in most respects is inferior to them. It may be used in mixtures for woodland parks.
FIG. 1.—A TURF OF FINE-LEAFED FESCUE GRASS (AS SEEN FROM ABOVE, DESIGNED TO SHOW TEXTURE).

FIG. 2.—A TURF OF MIXED GRASSES AND WHITE CLOVER (AS SEEN FROM ABOVE, DESIGNED TO SHOW TEXTURE).
Fig. 1.—A Turf of Buffalo Grass (as seen from above, designed to show Texture).

Fig. 2.—A Turf of Bermuda Grass (as seen from above, designed to show Texture).
FIG. 1.—A TURF OF A FINE-LEAFED BENT GRASS (AS SEEN FROM ABOVE, DESIGNED TO SHOW TEXTURE).

FIG. 2.—A TURF OF A COARSE-LEAFED BENT GRASS (AS SEEN FROM ABOVE, DESIGNED TO SHOW TEXTURE).
Creeping fescue makes a fair turf and may be used upon sandy soils, although its use is not recommended. Nowhere can be found blue-grass lawns of finer appearance, either in color, purity, or texture, than in some of the yards in Provincetown, Mass., where the soil is sandy in the highest degree.

Rough-stalked meadow grass is adapted to low-lying, damp, and more or less shady situations.

Meadow foxtail grass has been recommended for addition to mixtures of lawn-grass seed for Northern and Middle States. It makes a fairly good turf when sown alone and properly treated, but its use is not recommended excepting in damp, shaded situations.

Velvet grass, or velvet lawn grass, as it is sometimes called, can only be classed as a weed when growing upon lawns. Its presence in the lawn only serves to disfigure it.

Sweet vernal grass adds no feature of value to the lawn, and should never enter into any lawn mixtures, even where the use of mixtures may still be persisted in.

The use of white, or Dutch, clover in connection with Kentucky blue grass is common. When these two are combined they may be mixed at the rate of 6 to 8 pounds of white clover to 25 or 30 pounds of Kentucky blue grass.

**LAWN GRASSES FOR THE SOUTH.**

In the far South and Southwest, where Kentucky blue grass and the bent grasses can not be successfully grown, other turf-forming grasses must be sought. There are several of these grasses which will withstand warm temperate or subtropical climates. The best known of these is Bermuda grass. This grass makes a very beautiful, deep green, fine turf under the lawn mower, and thrives in the heat of midsummer. In the latitude of the District of Columbia, when treated as other turf-forming species, it has exhibited its good qualities to perfection. Excepting in the far South, however, it is not a desirable lawn grass, as it quickly turns brown upon the approach of cold weather and is rather late in becoming green in the spring.

There is a variety of Bermuda grass occurring in some parts of Florida, where it has attracted attention under the name of St. Lucie grass. It is regarded as a more desirable grass for lawns than the ordinary form, because it does not root so deeply and is less liable to become a pest by spreading into cultivated fields.

Another grass largely used in the South Atlantic and Gulf Coast regions for lawns is St. Augustine grass, or, as it is locally known, Charleston lawn grass (the Buffalo grass of Australia). This grass will grow in more moist situations than Bermuda, and is the species chiefly used in some of the Southern cities, as, for example, Charleston, S. C. Although similar in habit of growth to Bermuda, it has much coarser stems, the leaves are broader and more rigid and of
less pleasing color, being much lighter in tint, and it requires more care in its management.

Both Bermuda and St. Augustine grass are used for lawns in Jacksonville, Fla., the former being selected for the higher, drier places and the latter for locations where the soil is somewhat moist. Texas blue grass may prove to be a valuable lawn grass for the South. Its color is excellent, texture fairly good, and it is at its best during the winter months.

**SELECTION OF SEED.**

The greatest care should be taken to procure seeds of the very best quality of the variety desired. The highest priced seed is the cheapest in the end. A cheap grade may always be looked upon with suspicion, and is usually dear at any price, and the sowing of seed of any grade upon a poorly prepared seed bed is wasteful.

It has long been a common practice to use a variety of seeds or so-called "lawn mixtures" in seeding down lawns. Those advocating these mixtures argue that there is no one grass which will suit the ordinary lawn maker, as he wants a lawn quickly, he wants a lawn fine, and he wants it to be permanent, results which it is claimed can only be obtained by mixtures. Further, it is asserted that the variety in the mixture best suited to the soil and climatic conditions will eventually run out the others, and the lawn will finally become composed of a single species. This course will manifestly cause a delay in securing a satisfactory turf, and when there are several varieties of grasses combined the liability of introducing weed seeds is greatly increased.

One of the chief features of beauty in a lawn, as already stated, is uniformity of color, and this can not be obtained by a mixture of varieties of grasses; the color will always be mottled and irregular. Under the most favorable conditions it is difficult to procure absolute uniformity in color, for there is likely to be variation in the shade of tint between individuals of the same species.

Uniformity of texture is impossible where two or more varieties of grasses are sown; no two species possess exactly the same degree of fineness, and even individual plants or strains of the same species are apt to vary in this particular.

The mixing of creeping bent with Kentucky blue grass is like mixing the good with the bad, and such a combination has a real disadvantage, which is particularly manifest in the later autumn months when the distinctive coloring of these two grasses is especially pronounced. The lawn composed of these two species is then almost unsightly because of its decided mottled appearance; the dark green of the blue grass stands out in striking contrast with the paler color of the creeping bent. For the same reason, white clover should never be sown with the bent grasses.
AMOUNT OF SEED USED PER ACRE.

The amount of seed to be used will depend somewhat upon the character of the soil, but more particularly upon the quality and kind of the seed used. The seed, of course, should be sown much more thickly than for hay production, and allowance has to be made for the thoroughness with which the seed has been cleaned from chaff. Rhode Island bent and creeping bent are both likely to contain a large amount of chaff and imperfect seeds, and the quantity of seed sown should be sufficient to make allowance for this. Under the new methods of cleaning seeds of Kentucky blue grass, the chaff is almost entirely removed, but in the case of this grass there is often a lack of vitality, or germinative power, and it is always best to use a liberal quantity in seeding down the lawn.

Mr. William Doogue, superintendent of public grounds, Boston, sows 4 bushels of Kentucky blue grass and redtop mixed in equal parts, to which about 6 pounds of white clover have been added, to the acre, or 1 peck to 300 square yards. Owing to the great variation in the weight per bushel of grass seeds of the same kind (due to the presence of more or less chaff), it is best to base the amount upon weight rather than measure, and from 50 to 60 pounds of seed of fine quality is not too much to use upon an acre of ground, or $\frac{1}{2}$ pounds to 100 square yards, poor land requiring more seed than fertile land. Some advise as much as 100 pounds of seed to the acre.

TIME OF SEEDING.

In the State of Washington the time for seeding is given as from September until April; in Florida during the wet season, from June until September. It may be stated here, however, that in the latter State seed is rarely used, as the lawn grasses are St. Augustine and Bermuda, which are usually propagated by cuttings. In North Carolina, March is specified as the time for sowing lawn grass seed. In New England the seed may be sown from the middle of April to the middle of May or from the middle of August to the middle of September.

If the seed is sown in the spring, it should be as early as possible, or as soon as the land is in condition to receive it, in order that the young plants may become sufficiently well established to withstand the often dry and hot summer months. This applies, of course, to regions where Kentucky blue grass or the bent grasses are used for lawns. Another advantage of very early spring planting is that it enables the grass to get ahead of the annual weeds, which are not usually troublesome before midsummer. If seeding is done in the fall, it is necessary to sow the seed sufficiently early to enable the grass to become well rooted before severe winter weather sets in. Young seedlings are likely to be killed by winter freezing or thrown
out of the ground and destroyed by frosts. Fall planting has this advantage, that the grass, if it passes through the winter successfully, is in condition to crowd out weeds the following season, and at the same time be sufficiently well rooted to resist summer droughts.

MANNER OF SEEDING.

The seed must be sown or scattered evenly over the surface if a patchy and unsightly growth is to be avoided. It is best to select a time when there is little or no wind, and, if possible, immediately previous to an expected rain. Care must be taken not to cover the seed too deeply. A very light raking or brushing may be allowed, and is even advantageous, but generally rolling will be sufficient. The rolling is necessary to make the surface soil firm, to press the seeds into close contact with the earth, and to render the surface smooth and even. The germination of the seed largely depends upon the depth to which it is covered. An eighth of an inch of earth is ample covering for most grass seeds, while Kentucky blue grass is said to germinate best when exposed to the light, and consequently not covered at all.

TRANSPLANTING TURF.

When there is a ready and abundant water supply turf may be transplanted at any time, and the same may be said in regard to seeding; good lawns may be made whenever the soil is in good condition.

Where pure cultures can be obtained, which is very rare, unless they have been previously prepared, the turf of Kentucky blue grass or bent grass may be used in making a lawn. This turf, if in ample quantity, may be carefully cut and transplanted to the lawn, covering the surface of the latter completely, being well pressed down upon the previously prepared earth. Where the supply of pure turf is limited, but still can be obtained, it may be cut into small pieces 2 or 3 inches square, and these set out at intervals of 6 to 8 inches, being pressed into the soil about one-half inch below the uncovered surface, which will eventually settle a little, and if the soil has been properly prepared the growth of the grass will soon cover the ground and make a satisfactory sward much more quickly than can be obtained by seeding (see Pl. XIII, fig. 1). This method has the advantage, too, of insuring the production of exactly the kind of turf desired, a result not always obtained by sowing seed. A lawn of limited extent planted in this way at Washington, D. C., early in September was fairly well covered with grass by December 1.

Where there are steep slopes to be covered, as in the formation of terraces, it may be impossible to establish a turf by seeding, owing
Fig. 1.—Transplanting Turf at the Turf Garden, South Manchester, Conn.

Fig. 2.—Lawn in Public Gardens, Boston, Mass.
Fig. 1.—A Lawn at Newport, R. I.

Fig. 2.—A Bit of Landscape with Shaded Lawn, Fairmount Park, Philadelphia, Pa.
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to the liability of the seed bed being washed down by rains. In such
cases it becomes necessary to use sods or turf, which should be cut in
long strips and laid at right angles to the slope. When the incline is
very steep the sods must be fixed or held in place by wooden pins 10 or
12 inches long, driven in at more or less frequent intervals, according
to the necessities of the case.

The using of turf of mixed grasses, such as is usually obtained when
an order is given for turfing a lawn, is not to be recommended. Such
turf can never be made to present a satisfactory appearance, and will
always be a source of annoyance and trouble. It is only when turf of
good quality can be procured that it should be used at all, even along
walks and around flower beds. Here the use of poor turf would be
no better than seeding.

MOWING THE LAWN.

The number of times the lawn should be cut will depend very much
upon the character of the season or the amount of irrigation. In the
turf garden of the Connecticut Experiment Station the grass is cut
eighty times or more during the season. Ordinarily, in parks at least,
the lawn is mown every week or ten days, although in some sections
where the soil is good and there is a continuous growth of grass the
lawn mower is kept constantly going. The oftener the lawn is mown
and the more frequently it is rolled the better and finer the turf.
The grass should not be allowed to attain such a growth that when
cut there will be any decided change in color. The lawn should be
kept close cut, and this can only be done by frequent mowings. Dur-
ing the dry summer months it is best not to cut so close as in the
spring or fall; this applies to parks and lawns of large extent. Too
close cutting in midsummer is apt to expose the roots to the burning
influence of the summer sun. Mowing should begin as soon as growth
starts in the spring, and ought to be discontinued in the regions
where the winters are severe by the first of September or October.

OBSTACLES TO BE OVERCOME.

The principal obstacles to be overcome in the establishment of a
perfect lawn are poor soil, bad drainage, dry weather, inadequate
water supply, and weeds. Poor soil and drainage are overcome by
thorough preparation and enrichment of the land, as already pointed
out. When this has been properly done the other obstacles mentioned
are of small moment even if dry weather prevails. On a well-drained
and well-pulverized soil the grass is in a position to withstand drought.
In other words, the ill effect of inadequate irrigation may be largely
overcome by this initial preparation of the soil.

Until the turf is well formed constant attention is necessary to pre-
vent the invasion of weeds. They should be removed upon their first
appearance, and in no case allowed to gain a foothold, for when once established their removal becomes very laborious. Annual weeds, like foxtail and crab grass, may be removed readily, but perennials, such as dandelions and plantains, are more difficult of eradication, and where weeds of this character have been allowed to become at all abundant, the simplest remedy, generally speaking, is to plow the land and start afresh. Crab grass is becoming a very serious pest in lawns in the Central States. This grass seeds freely and grows best during the hottest midsummer months when Kentucky blue grass and the bent grasses are vegetating but little. The seeds appear to be scattered everywhere; they germinate quickly, and where there is the least bit of room available upon the lawn, crab grass seizes upon it, and soon, by its persistence and vigor of growth, will cover considerable areas by crowding out other grasses. Crab grass is likely to be overlooked when it first appears, but later in the season, at the beginning of cool weather, it turns brown and reveals itself by disfiguring the lawn with more or less extended patches of dead vegetation. There is hardly anything more unsightly in the lawn than this dead growth of crab grass. In the early spring the areas which crab grass occupied the previous season are usually filled by the little annual spear grass or by chickweed or other quick-growing weeds of various kinds. When the lawn is infested with crab grass, it should be removed by pulling or raking, fertilizers added, the ground reseeded and rolled. In the vicinity of Washington, D. C., Bermuda grass often becomes a pest upon blue-grass lawns, and like crab grass, its presence is not usually detected until the cool weather of autumn, at which time its leaves and stems turn brown; it is then readily distinguished from crab grass by its much lighter color. When the lawn has once become infested with Bermuda grass, there is little else to be done but to encourage its growth or to plow up the land and reseed, being careful at the same time to remove all Bermuda grass stems and roots; crab grass is an annual and is removed with less difficulty.

A species of *Paspalum* is often a troublesome weed upon lawns, particularly from Pennsylvania southward. It is not uncommon to see this grass usurp all the space in small dooryards or grassplots. It is a rather hard and wiry-stemmed grass, with comparatively broad leaves, and is totally unfit for making turf. It is, however, more easily removed than Bermuda grass. Another common weedy grass found in lawns and dooryards is goose grass (*Eleusine indica*). It is a coarse annual, and in its persistent growth is scarcely less annoying than crab grass. Lawns infested by it should be treated in the same way as recommended for crab grass. There are many grasses which are likely to spring up in the lawn if opportunity is given them, and it is quite rare to find a lawn entirely free from weeds.
ROAD BUILDING BY U. S. DEPARTMENT OF AGRICULTURE AT GENEVA, N. Y., SHOWING CRUSHING PLANT.
A PERFECT LAWN.

It will be understood from what has been said, that the selection of the variety in making a lawn must depend upon circumstances and the taste of those for whom the lawn is made. The varieties suited to temperate climates, not subject to excessive drought or where water may be employed, are Kentucky blue grass, Rhode Island bent, and creeping bent. For shaded streets and parks, hard fescue and various-leafed fescue, especially the latter, may be used to advantage; and in northern latitudes, woodland meadow grass is a desirable variety for shaded situations. In the warmer portions of the South, Bermuda and the variety known as St. Lucie grass stand first; and when the soil is somewhat moist or very sandy, St. Augustine grass may be substituted. Curly mesquite is recommended for trial in the warmer regions of the Southwest, too dry for the successful cultivation of Bermuda. The three grasses last named are most readily propagated by transplanting the rooted stems. Under favorable conditions these grasses will spread rapidly and soon cover the soil with a turf varying in fineness according to the species. Among the finest lawns in this country are some of those at Newport, R. I. The best of these are composed almost entirely of either creeping bent or Rhode Island bent. There is ample moisture, and no labor is spared in keeping the surface in perfect order by frequent cuttings and rolling and by removal of all weeds. Nothing can be more beautiful than these broad, unbroken stretches of velvet-like sward. (See Pl. XIV, fig. 1.)

A perfect lawn consists of the growth of a single variety of grass with a smooth, even surface, uniform color, and an elastic turf which has become, through constant care, so fine and so close in texture as to exclude weeds, which, appearing, should be at once removed. Briefly, such a lawn may be secured by thorough preparation of the soil and the application of suitable fertilizers; by seeding with pure seed of the highest quality; by proper attention to irrigation and the maintenance of fertility; by the prompt removal of weeds, and, finally, by the frequent and intelligent use of the roller and lawn mower.

REPLIES TO CIRCULAR LETTERS OF INQUIRY.

In the beginning of this paper reference is made to the replies received in answer to a circular letter issued by the Department relative to the subject of lawns. It can not fail to be of interest to quote here some of these replies, and it is to be regretted that only a few can be presented. These, however, represent widely distant and diverse sections of the country. The numbers preceding the paragraphs in the replies correspond to the questions in the circular mentioned on pages 355 and 356.
(1) That the conversion of land into suitable soil for a permanent, satisfactory lawn depends wholly upon the condition of the land to be utilized. If the land consists of a natural deep alluvial soil, with a clayey subsoil basis, the work of conversion should be a comparatively easy task. Early in September the land should receive a deep subsoil plowing, turning down the sward in every case to enable it to decompose and become fibrous and alluvial. As early as practicable in the spring the whole surface should receive a coating of five-year-old composted cow manure, at the rate of 10 to 12 cords to the acre. It should then be cross plowed.

(2) The manure, however, should be applied intelligently, and not promiscuously, according to the fertility of the soil. A shallow soil, resting upon a silicious or sandy bottom, is totally unsuitable, while a light soil, resting upon a friable or clayey bottom, generally insures a satisfactory lawn. If the land is covered with a vegetable deposit which has accumulated an accretion of matter for years, from falling leaves, etc., it is all the more preferable. Hard, dry soils or stiff clays, where great detrition frequently takes place, are undesirable. Wet lowland should be well underdrained and sweetened. Lowland which has been previously cultivated may be chosen when it has a good depth, is easily drained, and is capable of being improved by the application of suitable manures. Worn-out land is an unprofitable and uncertain quantity to experiment with. For fall dressing, clear sheep manure, 3 to 5 tons per acre, is the best. For early spring dressing, Canada hard-wood ashes, 8 per cent potash, from 3 to 5 tons per acre, according to the fertility of the soil.

(3) A liberal allowance of Canada hard-wood ashes where there is much shade.

(4) Kentucky blue grass and redtop, equal parts, 4 bushels per acre, of pure, clean seed, with about 0 pounds of Dutch white clover added.

(5) One peck of seed will sow 2,722 square feet; 1 bushel will sow 10,890 square feet; 4 bushels will sow 43,560 square feet. Kentucky blue grass mixed with white Dutch clover is preferable, although I have had excellent success with redtop and white clover.

(6) The time of seeding in the spring is from the middle of April to the middle of May; for fall seeding, it is from the middle of August to the middle of September.

(7) The number of "cuttings" depends wholly upon climatic influences. From the first of May to the middle of October we average weekly "cuttings."

(8) If the foregoing directions are adhered to there will be no obstacles to overcome.

The questions propounded in your circular lead me to presume the employment of intelligent and skilled labor in the execution of the minor details of harrowing, leveling, grading, seeding, rolling, and, finally, the general contour of the landscape, etc., which should be in perfect harmony with the mansion and surrounding embellishments.

From Mr. C. D. Beadle, Biltmore, N. C.:

(1) The preparation of the ground being the most important step in making a lawn in western North Carolina, we endeavor to thoroughly plow and subsoil the area to be seeded and to finely pulverize a few inches of the surface, making the

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1See report of superintendent of Greenwood Cemetery, New York, upon this subject.
mechanical condition as nearly perfect as possible. During the progress of the operations above outlined liberal quantities of fertilizers are thoroughly incorporated.

(2) Lime, well-rotted manure, bone meal.

(3) We make no change.

(4) Kentucky blue grass (*Poa pratensis*) and a little white clover (*Trifolium repens*). If very quick results are desired the introduction of the redtop (*Agrostis vulgaris*) will greatly hasten the effect, but this species is inclined to be very short lived at Biltmore.

(5) Three or 4 bushels per acre.

(6) March.

(7) As often as a cutting will improve the appearance, taking the precaution, however, to leave the grass a little long during the late fall as a protection in winter.

(8) Proper drainage and fertility of the soil, and especially to get the surface all alike as to its fertility.

(9) Kentucky blue grass (*Poa pratensis*) decidedly, with us.

From Mr. A. F. Harley, city engineer, Jacksonville, Fla.:

(1) We find it most economical to keep the land perfectly clean, that is, to remove all growth that may be made during the first season from that portion of the land we expect to plant in grass.

(2) We fertilize the land during this period with stable manure and ashes from our crematory.

(3) In low and wet land would advise planting the St. Augustine grass and in lighter soils the Bermuda grass.

(4) We hardly ever use seed, preferring in every instance to plant the grass in rows.

(5) See reply to No. 4 above.

(6) During the wet season, from June until September.

(7) Our lawn mowers are in constant use.

(8) The land to be clean, that is, capable of producing no other variety than that planted.

(9) For general use, I would recommend Bermuda grass.

From Mr. J. F. Foster, general superintendent and engineer, South Park commissioners, Chicago, Ill.:

(1) About 8 to 10 inches of the best vegetable mold that can be obtained in this locality at a reasonable cost is spread upon the surface graded for lawns, and if not of the best quality, rich manure from the stock yards is spaded into it. It is well pulverized, rolled, and seeded.

(2) The only fertilizer that we have used is manure from the stock yards, which has been piled up five or six years, and is very rich. This is spread upon the lawns to a depth of perhaps one-half inch every two years.

(4) Fancy-chaff redtop, Kentucky blue grass, white clover, and fancy redtop, in proportions of 39, 81, 12, and 42, respectively, based on weight.

(5) About 4 bushels to the acre.

(6) During the month of April.

(7) The number of cuttings during a season varies greatly, a good growing season probably twelve times.

(8) Weeds, poor earth, and want of water.

(9) Kentucky blue grass.
From Mr. A. J. Graham, superintendent department of parks, Denver, Colo.:

1. In our country we have the original prairie composed of buffalo grass, sage brush, cactus, sunflowers, etc. We break that in fall or early winter and sow rye, if broken early; if late, sow spring rye or oats. That keeps down weeds and pulverizes the soil. If in a hurry for a lawn, plow in the rye or oats in August, and prepare for a lawn, which mainly consists in grading and pulverizing the soil.

2. I find it more beneficial in this climate to top-dress with well-decomposed manure rather than plow it in, as it stimulates the young grass, and at the same time retains the moisture, which is a great item in our dry climate, where we have to produce lawns entirely by irrigation. Our soil here is rich enough to produce fine lawns without the aid of manures, but top-dressing of barnyard manure or ground bone gives it a fine velvety appearance.

3. We use Kentucky blue grass with a mixture of white clover.

4. We sow on or about the 20th of August. A great many are sown in the spring, but one is then apt to be bothered with weeds. No weeds in the fall.

5. We cut every week from the first of May to the middle of September. Our grass grows very fast, owing to keeping it wet, which we have to do.

6. The chief obstacles are ground squirrels, gophers, and ants, but they finally disappear, owing to the moisture—they all like dry surroundings.

7. If I should use one kind of grass, I would say Kentucky blue grass.

From Mr. F. N. Little, superintendent department of public parks, Seattle, Wash.:

1. Thorough cultivation, with proper precautions for drainage, even admixture of the fertilizers that may be used, and thorough rolling both before and after seeding.

2. On light sandy soil, which is the prevailing soil here, we have to depend largely on barnyard manure for putting humus into the soil. Where the soil is good loam we use the commercial fertilizers with good results, the absence of weed seeds being a valuable economic feature. After the lawn is established, we top-dress alternate years with ground bone and blood and bone.

3. Dactylis glomerata.

4. For ordinary purposes a mixture of Poa pratensis, Festuca pratensis, Anthoxanthum odoratum, and Trifolium repens, the latter being used as a protection to the other seeds in late sowing. For dry soils without sprinkling we are experimenting with the various fescues in conjunction with Trifolium repens; but we have no definite results to report.

5. From 50 to 60 pounds per acre.

6. From September until April.

7. Average forty cuttings per annum.

8. Uneven character of soils and extirpation of obnoxious weeds.


From Mr. George E. Kesler, secretary and engineer board of park commissioners, Kansas City, Mo.:

1. Plowing, harrowing, and the rolling of surfaces is the usual method of preparation, plowing rarely more than 8 inches deep.

2. Fertilizers are rarely used in preparation of the soil, and beyond moderate use of stable litter, bone meal and wood ashes are separately used to slight extent.
(3) Blue grass (Poa pratensis) is decidedly the best in shade.
(4) Blue-grass seed is used almost exclusively; occasionally an admixture of white clover.
(5) From 4 to 5 bushels per acre.
(6) The best time, for seeding in this climate, is late summer.
(7) As the number of cuttings in the season depend so much upon variable conditions, it is impossible to answer this clearly.
(8) Chief obstacles to formation of a perfect lawn are weeds and wild grasses; among these the worst is the foxtail.
(9) Blue grass used alone is decidedly the best of all.

From Mr. William Page, general superintendent park department, St. Louis, Mo.:

(1) Our lands consist mostly of yellow clay, the top of which we give a heavy dressing of old rotten cow dung.
(2) For fertilizers we use bone meal and old rotten manure.
(3) We avoid having lawns with too many trees; otherwise use the same fertilizers.
(4) We mostly use Kentucky blue-grass seed.
(5) We use 21 pounds to 1 acre.
(6) We do our seeding mostly in February and March.
(7) Grass is cut on the lawns every ten or twelve days, according to dry or wet weather.
(8) The chief obstacles to getting perfect lawns are: Poor, musty seed, gophers and moles, low wet grounds, using new manure full of cut worms and containing too much seed of weeds.
(9) Blue grass has proved to be the best for sole general use.

From Mr. Henry L. Haynes, chairman park commission, Austin, Tex.:

(1) The preparation of the land consists in thoroughly breaking up with a turning plow to a depth of about 6 inches and thorough harrowing.
(2) Our soil having every element necessary, fertilizers are not used.
(3) Answered in No. 2.
(4) Bermuda is our standard lawn and park grass, and is established by sodding and by rootlets, especially the latter, when planting largely.
(5) Answered in No. 4.
(7) From two to four cuttings, except where used for lawn or park, when the lawn mower should be used almost constantly, causing a dense growth and a smooth and carpet-like surface.
(8) Drought is the only obstacle whatever, as Bermuda grass thrives here on very poor soil when watered during our long dry spells.

From Mr. J. F. Mendenhall, secretary commissioner of parks, Los Angeles, Cal.:

In reply to your queries, there is nothing in the establishment or maintenance of lawns in the parks or private homes of this city different from the plan pursued in the Central States. Blue grass is always used, generally alone, but sometimes with white clover. The latter never dies (if watered), and will kill out almost anything else. It is absolutely necessary to water lawns in this country during the dry season, and this is usually done once or twice a week. We have what is
called Bermuda grass, which is about to take all our lawns, and is not desirable, but will grow anywhere, killing out the blue grass. Seed comes through the water ditches.

(1) Same as in Eastern States.
(2) Old manure, bone dust, etc., same as used on best Eastern lawns.
(3) Australian rye; blue grass.
(4) Blue grass (Kentucky fancy).
(5) One pound fancy blue grass to 100 square feet.
(6) Early fall or spring; any time will do, except hottest weather; must be sprinkled every few days.
(7) About 25 on good lawns.
(8) Nothing special.
(9) Blue grass.