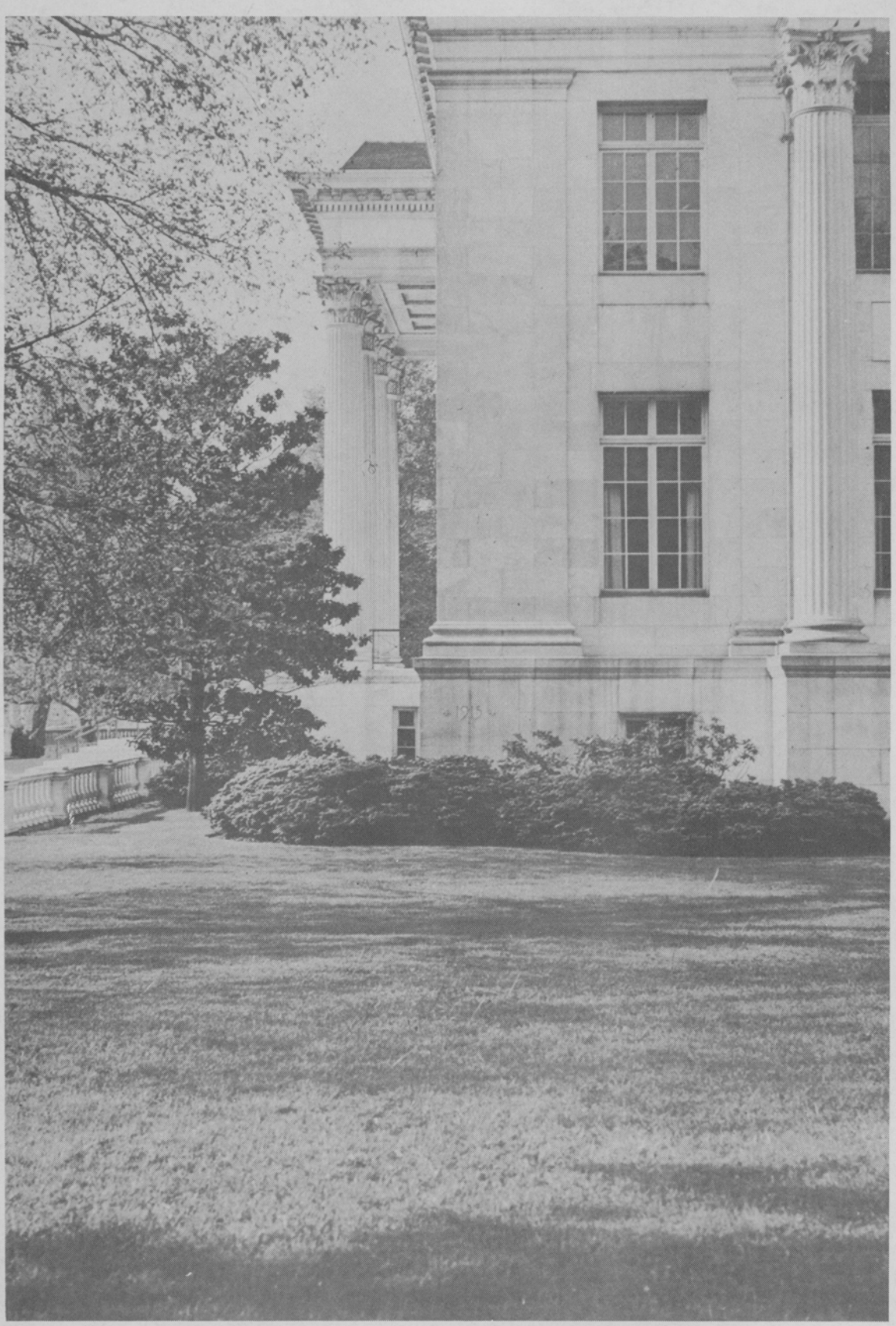
UNITED STATES
DEPARTMENT OF THE INTERIOR

CIVILIAN CONSERVATION CORPS
Project Training

LAWNS

P. T. SERIES NO. 14



North Lawn. American Red Cross Building. Washington.

UNITED STATES
DEPARTMENT OF THE INTERIOR
Civilian Conservation Corps
Washington

Prepared for and with the Cooperation of the Technical Services.
By
Guy B. Arthur,
Supervisor, Project Training.

LAWNS

Few subjects touch as many of the activities of the Department of the Interior as this one. Yet it requires courage to attempt a new book about it. So much has already been written that another book would seem unnecessary, —— until we see how broad the application must be for our departmental use, in point of temperature, rainfall, and use.

To keep this book within reasonable bounds its scope is defined as follows: Turf for used areas, maintained, mowed, and required to stand up under foot traffic.

To make the book what we planned it to be we have deliberately followed the leading of the camps in which seeding and sodding have been work projects, drawing freely upon many sources for dependable information. While the book must be authentic as a guide in making lawns, it is organized to turn up all possible benefit to those enrollees who are engaged in lawn building, for here is work which leads out into a number of occupations, none of which are overcrowded.

With much appreciation we gladly acknowledge help from the following:

Lawn Care, O. M. Scott & Sons Company, Marysville, Ohio.

A Pasture Handbook, Misc.Pub. 194, U. S. Department of Agriculture.

Manual of the Grasses of the United States, by A. S. Hitchcock, U. S. Department of Agriculture.

National Fertilizer Association.

Monthly Weather Review, U. S. Weather Bureau.

Technical Service Personnel in CCC Camps.

Important Cultivated Grasses, Farmers' Bulletin No. 1254, U. S. Department of Agriculture.

Conservation of Fertilizer Materials from Minor Sources, Misc. Pub. 136, U. S. Department of Agriculture.

Reviewed and approved by the Department of Agriculture for use in all its camps.

First edition, mimeographed, February 1940, Multilithed September 1940.

GRASS

Grass is the forgiveness of nature, — her constant benediction.

Fields trampled with battle, saturated with blood, torn with the ruts of cannon, grow green again with grass, and carnage is forgotten. Streets abandoned by traffic become grass grown like rural lanes, and are obliterated.

Forests decay, harvests perish, flowers vanish, but grass is immortal. Its tenacious fibres hold the earth in its place, and prevent its soluble components from washing into the wasting sea.

It invades the solitude of deserts, climbs the inaccessible slopes and forbidding pinnacles of mountains, modifies climates, and determines the history, character and destiny of Nations. Banished from the thoroughfare and the field, it bides its time to return, and when vigilance is relaxed, or the dynasty has perished, it silently resumes the throne from which it has been expelled, but which it never abdicates.

It yields no fruit in earth or air, and yet should its harvest fail for a single year, famine would depopulate the world.

—O—

From "Kansas Magazine", Topeka, Kansas, 1872.
By J. J. Ingalls.
Original in Library of Congress.

LAWNS

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PLAN OF THE BOOK

The most striking thing about grass is the extent of its service to mankind, but this is almost surpassed by the wealth of material which has been written on it. It would seem that anyone should be able to buy a book and make a perfect lawn. This might be possible, if the conditions under which lawns are made and maintained across the breadth of this country could be classified and controlled.

Having studied books, Government bulletins, and piles of job analyses, a method of handling the material has been devised which should meet the needs of the field. The job analyses, coming from many different places, where conditions peculiar to climate and soil have been met, are the best indicators and guides for the selection of material. Those camps which sent in especially interesting analyses were requested to write fuller descriptions of their work. Many of these are excellent, but few are exhaustive enough to cover the subject.

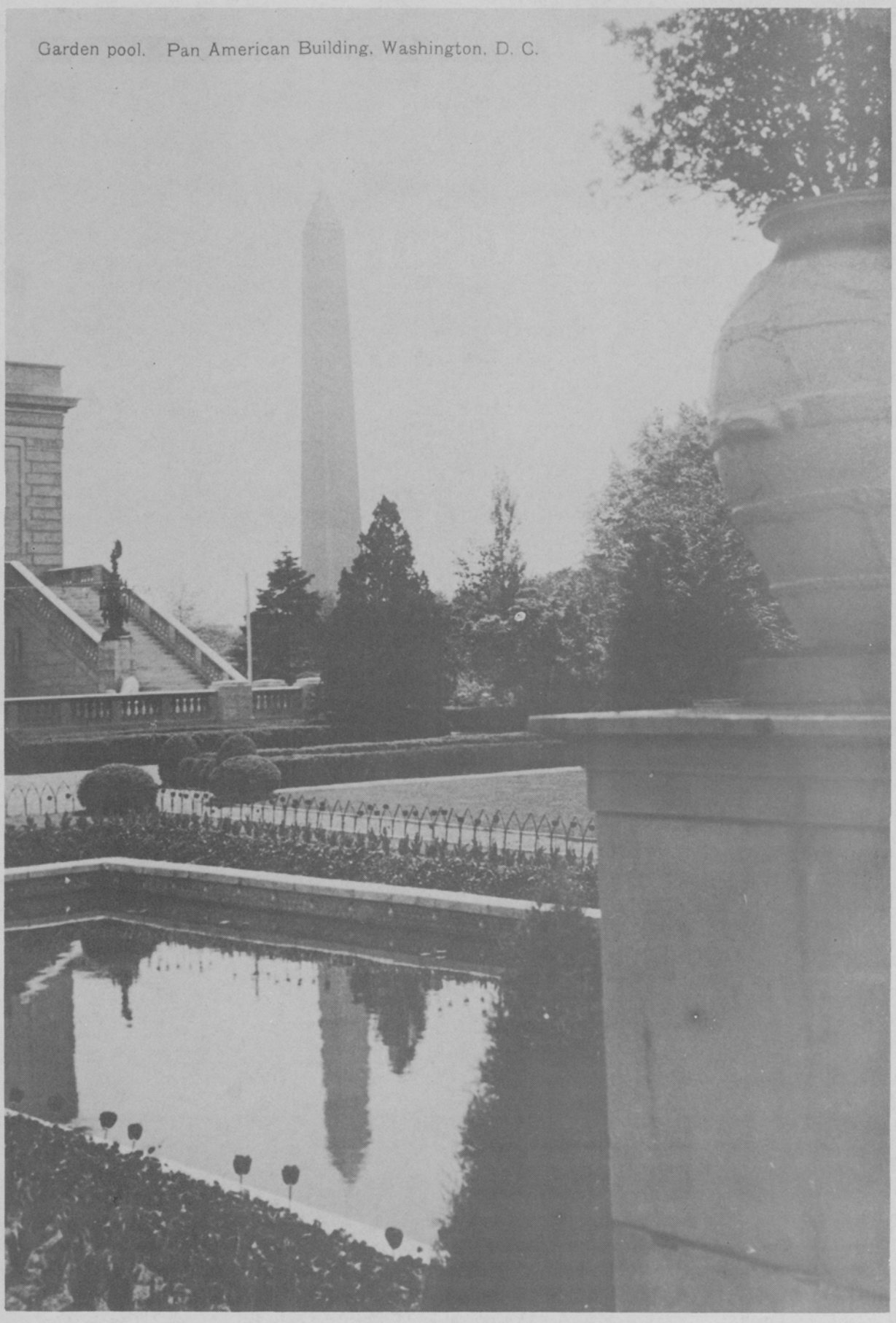
Therefore, from the material submitted by the camps we have picked out salient points, paragraphs, and sections, and built up these excerpts with material supporting the writers' views and experience from authoritative books, bulletins and contributions requested from such authorities as the National Fertilizer Association to give a full rounded treatment of each phase of the subject.

With thanks to all these writers in the camps, whose invaluable help is sincerely appreciated, we have tried to make the utmost of all their leads. It is highly desirable to mention the camps which have thus helped to make the book, and a list of these contributors appears following:

CAMPS WHICH HELPED TO WRITE THE BOOK

Illinois	SP-47, Salt Creek State Park	Alvin Olson, Sr. Foreman, Land.Arct.
Illinois	SP-58, Lincoln Log Cabin State Park	Theo. M. Kingsbury, Proj. Supt.
Indiana	SP-1, Spring Mill State Park	W. E. Holmes, Sr. Foreman.
Iowa	SP-4, Lake Wapello State Park	H. W. Freed, Sr. Foreman.
Iowa	SP-17, Backbone State Park	C. J. Fretheim, Sr. Foreman.
Michigan	SP-15, Pigeon River State Park	J. B. Schwerdt, Proj. Supt. W. M. Malone, Jr. Foreman.
Minnesota	SP-7, Sibley State Park	Keith J. Smith, Land. Foreman.
Minnesota	SP-12, Fort Ridgely State Park	Floyd Tilden, Proj. Supt. R. A. Skogland, Land. Arct.
Nebraska	CCC-ID, Winnebago Indian Agency	George H. Gregory, Prin. Foreman.
North Carolina	NP-5, Great Smoky Mountains N.P.	Edwin J. Rosser, Proj. Supt.

North Dakota	SP-5, Grand Forks State Park	M. N. Gronvold, Proj. Supt. J. D. Walp, Sr. Foreman.
North Dakota	SP-3, Fort Lincoln State Park	C. E. Arnold & J. E. Sprake, Proj. Supts.
Oklahoma	NP-1, Platt National Park	W. L. Scott, Jr., Proj. Supt. Donald E. Stauffer, Sr. Foreman.
Pennsylvania	SP-6, Raccoon Creek, R.P.D.	Orlando S. Pride, Proj. Supt. Chas. E. Mahaffey, Foreman.
South Carolina	SP-1, Cheraw State Park	Ed. Reid, Proj. Supt.
Tennessee	MP-3, Shiloh National Military Park	Otto Feldman, Jr. Foreman.
Virginia	SP-26, Chopawamsic R.D.P.	Frank H. Gay, Proj. Supt.
Wisconsin	SP-14, University of Wisconsin Arboretum	K. W. Kruger, Sr. Foreman. G. W. Longenecker, Park Authr.
Wisconsin	SP-11, Pattison State Park	H. E. Schreiber, Proj. Supt. G. E. Bliese, Jr. Foreman.



Garden pool. Pan American Building, Washington, D. C.

CHAPTER I

ANALYSIS OF CONDITIONS

Before starting a lawn we should stop, look, and listen. No book, not even this one, will make a lawn. "Of making books there is no end", is an ancient saying widely quoted, and many a lawn has come to an untimely end because it was built with a book instead of a thorough understanding of the conditions in which it has to live. Anyone, having decided to make a lawn, should be required to stop and think it over.

Look! No lawn can be made on paper. It cannot be made anywhere except on the ground laid out for it. In this neighborhood are all the conditions which will make it a success or a fizzle. Here are the soil, fertility, drainage, temperature, shade, water supply, air circulation, rainfall, slopes, gullies, rocks. Until the presence or absence of these, are understood, in their varying degrees, no one can determine what alterations must be made, what soil or fertilizer must be bought in, or what grasses will make a lawn.

Local costs must be looked into, for cost is a vital factor which is continually changing. All work is done more economically today than it used to be. Some years ago it was thought necessary to make a top soil seed bed twelve or even more inches thick, and fine lawns were made in this way, but we could not afford that today. When we find that grass roots seldom go below five inches in depth, and many varieties do not need more than two inches of soil, it is foolish now, and was then, to make the seed bed more than four inches deep, in general practice, and at a fraction of the old-time cost.

One of the biggest jobs of sodding done anywhere probably, and the largest ever done in the National Park Service, at Vicksburg National Military Park, was done on steep new slopes, on sterile soil, with Bermuda sod only two inches thick. Such performance affects preliminary estimates and final costs.

And Listen! This is not the first lawn to be made in this section very likely. Local people know a lot about the success and failure of crops and other lawns. They will unload plenty of information about seasonal rainfall and drought, freezing and heaving, slow or fast absorption of water and the behavior of run-off, the acidity of the soil or the amount and effect of lime present.

This information may show that it is unnecessary to bring in top soil at all, for some proven treatment of the soil on the site may serve just as well. Lawn grass calls for the same general growing conditions as food and pasture grasses, and farmers cannot import top soil to make a new seed bed for every planting of oats or buckwheat. If they can get a good stand of such crops they know what basic treatment or correction is necessary to make the local soil produce.

The seed catalogue may say that a certain grass is excellent for the prevailing conditions. Inquiry among local people may prove that this is true, to the teeming extent that it has become a weed, infesting not only lawns but cropped fields. There is no quicker way to become unpopular than to introduce more weeds, or species which

are hosts to plagues. Or, in quite the opposite development, the variety which seems most suitable or most expensive, may be already popular locally, so that seed, sod, or stolons can be obtained with no trouble and even without cost.

Once this information is assembled it can be analyzed and made to yield sound conclusions. The conclusions must be the product of open-minded analysis if they are to have any value. The choice of grasses to be used alone, and combinations of species, will follow naturally, along with the selection of humus and fertilizer. Plans can be drawn and specifications written for contract jobs. And the project can be carried through with confidence rooted in broad knowledge and straight reasoning.

CHAPTER II

PREPARATION

The preparation of the ground for a lawn is the same for any kind of planting, whether by seeding, sodding, strip sodding, or stolons, or combinations of these methods. This preparation does not begin with the raking of the ground just before seeding, as is so often written, but with the first cut made in the area. The site must first be molded by grading, shaped in pleasing lines with safe slopes and gentle contours, and brought to grade. This is called the rough grading.

All filled dirt must be tamped or rolled in layers. If possible the entire surface should then be disked or scarified on contour lines so that any rains which fall soon after will consolidate cuts and fills. All of the better soil will of course be saved to surface the newly molded area.

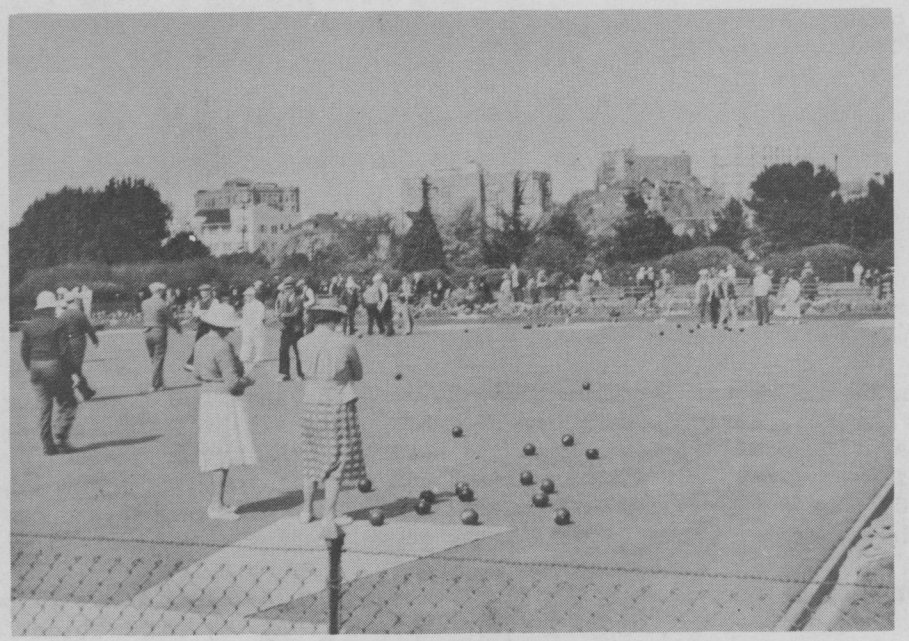
Any walks, roads or foundations which are to go into the lawn area should be put in at this juncture, and all trees and shrubs should be planted, so that the remaining steps in making the lawn may proceed without interference. This building and planting should be done immediately after rough grading.

Drainage. We are tempted to say that drainage is the most important single element in building a lawn, and this comes near to being true if all of the service of water, and the behavior of soil toward water, is taken into account. Soils are tight, loose, fine, coarse, cohesive, tough, sticky, sandy, and so on, and all of these indicate not only a type of origin and structure, but also their capacity for shedding water, for holding water, and for giving up water.

Clays get muddy and rutted in a road because they are so finely divided that they will not allow the water to drain away between their particles. Dirt roads support loads in proportion to their ability to drain excess water off the top or down through their structures. Sandy soils remain hard and usable in wet weather because water does not stand in them. It drains away. This information is important in building lawns.

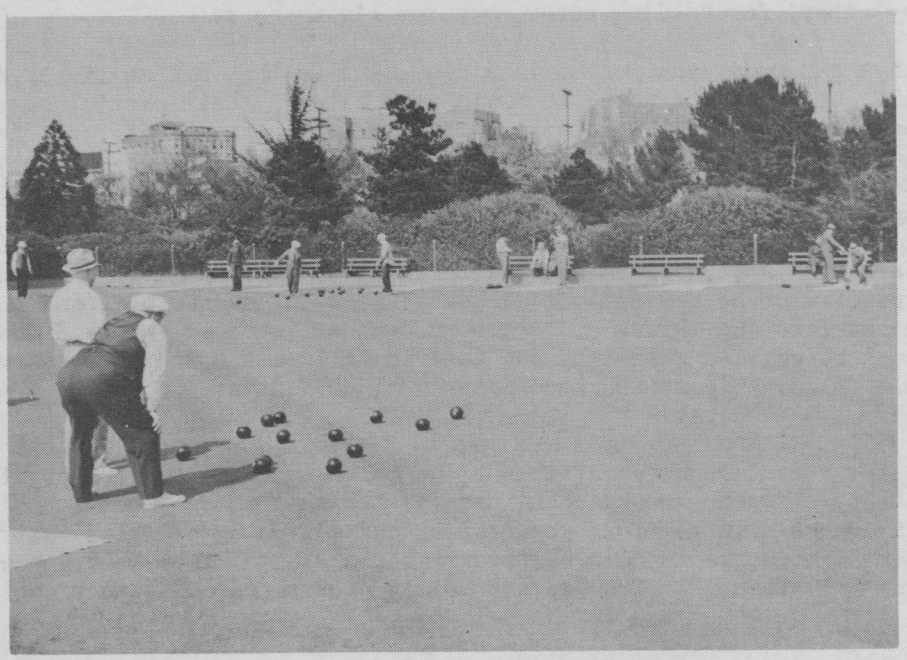
There are three ways in which water must be provided for in a lawn. First, excess water must be drained off without damage to the surface, and this is done both over the surface and through underground channels such as sewers. Second, enough water must be carried down into the soil to build a sub-surface reservoir for dry weather. Third, this sub-surface water must be fed back up to the grass roots as required.

If the second requirement is met the third one is likely to be, for both depend upon a state of openness and sponginess in the soil which permits the free movement of water downward in vertical absorption, and upward by capillary attraction. Clays and other tight soils impound whatever water does soak into them, thus tending to become sour and stagnant. They do not permit of free circulation of water and air.



Bowling Greens
Merritt Park, Oakland, California.

The art of curving the bowls is one of the oldest. Nothing taxes the lawn builder's art as severely as leveling these greens, and keeping them covered with healthy turf.



Soils must breathe as truly as they must drain. As air is drawn into the soil all growing and decaying processes are stimulated, humus is built up, moisture moves back and forth with ease, and there is less danger of water pockets. A soil which is full of air, and breathes freely, will not freeze so easily, and it will not heave because there are no water pockets to expand.

It is just as necessary to tighten light soils as to loosen others. This is done by mixing dry clays into the top six inches to give it more body to retard the flow of water, and prevent too great a loss by surface evaporation. Such additions should never be made with soil alone, but with soil and humus together.

More often it is necessary to lighten a tough or tight soil. There are two ways of doing this, preferably used together. Humus alone will do much for a tight soil, but the benefit lasts only while the humus remains in active condition. Vegetable matter digests slowly in a tight soil for lack of air and active moisture.

Another aid is the right use of lime. Lime is usually thought of only as a fertilizer --- which it is not, or as an adjunct to fertilizers, but one of its more important uses is in changing the structure of a soil. When unslaked, or lump, lime is mixed into a tight clay soil it gathers the very fine particles of clay together into larger units, forming open channels between them so water can get away. As a result the soil absorbs water more rapidly and helps it to percolate deeper. The deeper structure forms a sponge which will take up an enormous quantity of water when it rains, and give it off through capillary action as needed in drier seasons.

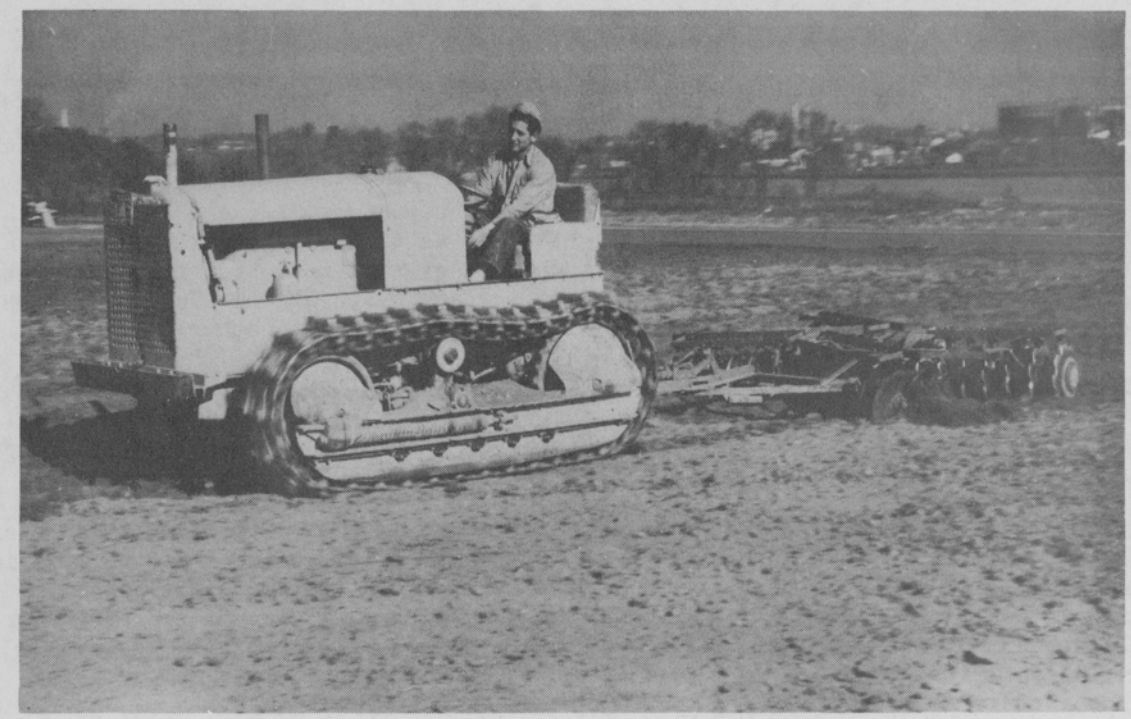
It is important to emphasize that only lump lime, the raw oxide fresh from the kiln, will do this. Hydrated lime will not.

Lump lime, or "hot" lime as it is sometimes called, will burn the skin when it is sweaty and irritate the eyes. Therefore, it should be cast "down wind" so that the dust blows away from people and animals applying it. In case lime dust gets into the eyes, and causes severe irritation, the best help is to tilt the head backward and have someone put a drop of sweet oil in each eye. This will carry the dust out and soothe the tissues.

The best method of lightening a heavy soil is with a combination of lime and vegetable matter. A little rich manure to mix with the vegetable matter is so much the better, for it will start bacterial decay. Lime should be used sparingly, but there is no limit to the amount of vegetable matter except the capacity of the soil to cover it. Since it is the humus in soil which carries plant food, it is desirable to build up as much as possible as a reserve. In cropped land more vegetable matter can be plowed under each season, but a lawn must live on what is incorporated in the beginning.

The area drained itself somehow before it was molded into a lawn, and the water followed certain well defined channels which may or may not be entirely eradicated. Unless the fill in an old channel or gully has been thoroughly compacted and bonded with the subsoil the runoff will seek to follow the old line, and may infiltrate steadily until it washes the filled dirt out of the channel. The persistence of the old drainage lines calls for a new system fitted to the altered area, to carry the water off without damage.

This new drainage system must recognize both surface runoff and sub-surface drainage, and provide underground structures to supplement and protect the surface system. This in turn calls for a close examination of the soil, both on the surface and for some distance down, to see what rate of percolation into the soil may be



Seeding on Columbia Island, Washington, D. C.

Above: The plowed ground is disced thoroughly.

Below: A home-made board leveler breaks the clods and fills the holes.

expected at different seasons and in different kinds of weather. Aids should be devised to keep rainwater right where it falls, so as to build up the under-surface reserve, and to slow down the runoff so it will not cause scouring and gullying.

Only sheet water should be allowed to flow over the surface of a lawn. Any concentration of rainfall which cannot be prevented, or which may be induced by design, should be carried off from suitable pockets or intakes into tile sewer lines underground, and these should be carried below frost so they will function when the surface of the lawn is frozen. Thawing begins on roads, walks, and in gutters, and if this runoff is not carried away by the drainage system it will accumulate somewhere to cause trouble, often to freeze again.

Fine Grading. With the drainage system installed the area should be brought to grade at all points, doing such scarifying, tamping and filling as may be necessary to produce a smooth surface, and one that will keep its shape when it expands under rain.

In many writings about lawns it is assumed that the soil in place is not—seemingly cannot be—fit for a seed bed, and that great quantities of so-called top soil must be hauled from a distance and spread out as the double extra special quint-essence of fertility. And this may be done on an area adjoining a field which produces a record crop of wheat or succulent vegetables.

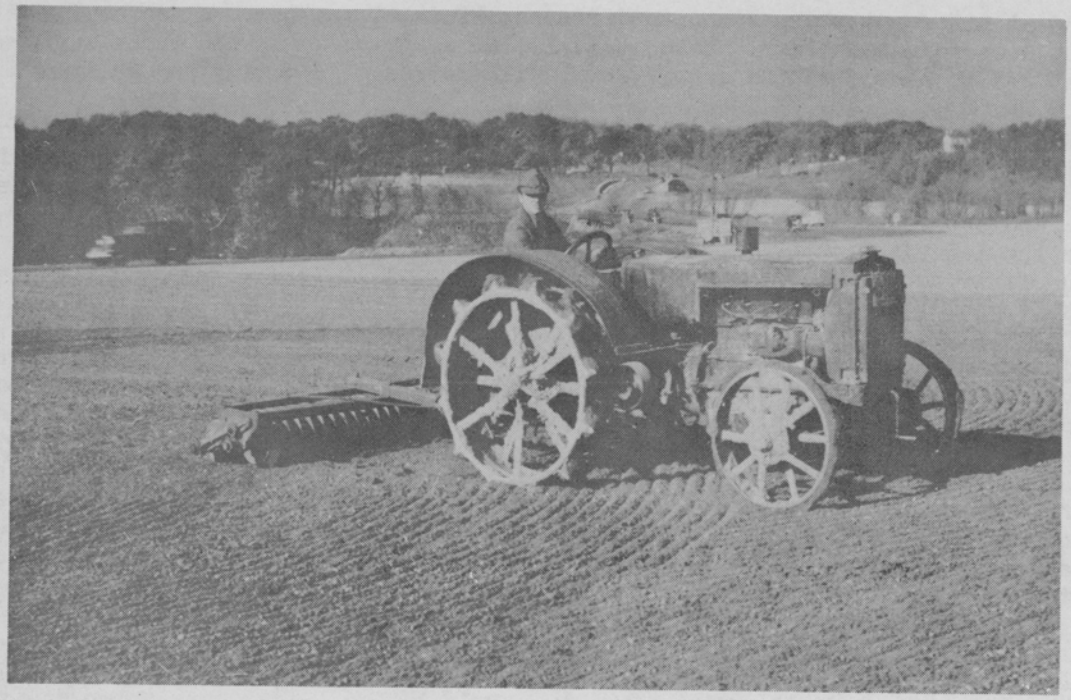
Let us note that this top soil is often the most expensive single item in the project, and may exceed all other costs.

Along with this we should note that a dark color is no guarantee of fertility. The presence of enough humus in some soils to give a dark color would be almost positive proof of undigested vegetation and high acidity, —— so high that few things would grow in it. While the value of lime as a lawn fertilizer has been much overrated, it is still true that our most verdant pasture areas are on limestone soils, frequently where limestone outcrops are a distinctive feature, and these soils are anything but black.

And as a further comment on imported top soil, farmers have made a practice of digging up this soil, not from their fertile fields where it has been producing crops, but from river bottoms. In such places soil has not been tempered by cropping, nor seasoned by cultivation and aeration, and it has accumulated all the weed seeds and disease organisms which thrive in such heavily shaded and excessively watered places.

There is no doubt that "top soil" is pretty much a superstition in the making of lawns. Where an area is being molded into a lawn, the better soil on top will naturally be saved for surfacing the area after it has been graded into shape. The subsoil, in which the molding is done, may have been so far under the top soil that it is sterile; —— the raw product of grinding down rocks. But when the original covering is put back on this sub-soil it will have its original fertility, and this fertility may be higher than that of top soil which might be purchased outside and applied with rites and ceremonies simply because it came from a distance and looks black.

Preference should be given to the soil already in place unless its present fertility is too low to be built up with fertilizers, humus, and manures in time for fall planting. It is advisable in any planting to use material which has been acclimated and seasoned in place, for it is at least a known factor, whereas imported material is an unknown quantity——in all ways. Economy will encourage the use of the native soil, and the labor required to put this soil in shape will usually be no more than that needed to establish imported top soil.



Seeding on Columbia Island, Washington, D. C.

Above: Fine discing makes a mellow seed bed. This operation was added to make deeper furrows for late fall sowing, since the seed might not germinate before spring.

Below: A home-made seeder. The seed box is agitated by a knocker arm bearing upon the spokes of the wheel. Uniform seeding requires a steady gait. Seeding is done first in one direction, and then in another to get full covering.

Special Preparation. Up to this point the preparation has been the same for all different kinds of planting, but here it begins to differ, as follows:

Sodding. If the whole area is to be solid-sodded the surface should be scarified and any additional humus disked in.

Strip Sodding. If it is to be strip-sodded more work will be required, depending upon the nature of the soil, the time of sodding, and whether the intervening spaces are to be treated in any way or not. All of these will be discussed in the section of Chapter III entitled, "Sodding."

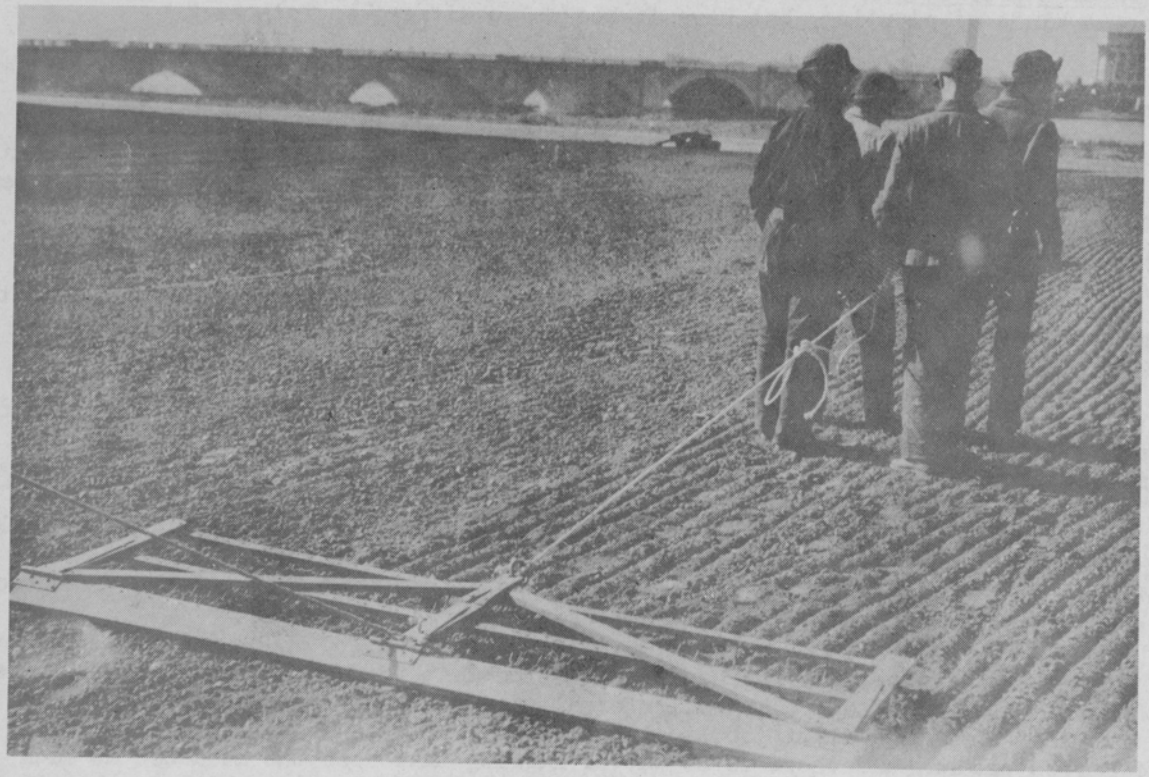
Stolons. The treatment should be the same as for seeding. The planting is often a combination of stolons with seeding or sodding, but the ground preparation is the same.

Seeding. For this method of planting the whole surface must be made into a finely pulverized seed bed three or four inches deep, free from weed stolons or seeds, and fertilized if necessary.

If top soil, fertilizer, manures, or compost, are being used, they will be broken down and incorporated with the soil in this seed bed. The kinds, combinations, and quantities of these materials are a matter separate from the making of this seed bed, and are discussed in Chapter VI entitled, "Fertilizers and Humus."

The method of preparing the seed bed must be left to the men actually in charge of the job. A big job naturally calls for all the labor saving machinery the funds will provide, while a smaller job located where there is an abundance of acceptable labor may be spaded, and there is no way of digging that does the seed bed as much good as this personally conducted turnover. The only requirement which can be set up in a book is that the seed bed must be worked and pulverized until it is rich in plant food and that this plant food must be readily available to the roots of the grass seedlings.

Ready for Planting. At this point the visible evidence of a lawn in-the-making is an area molded to grade, scarified, harrowed, spaded, raked, or otherwise reduced to a crumbly texture, with any added humus or fertilizer thoroughly hashed in, and leveled off for planting. If any lines of leveling or grading remain they follow contour lines accurately, in order to conserve water as it falls and prevent the formation of even the tiniest wash channels. All roads, sidewalks, buildings, major plantings of trees and shrubs, which are to be in the area are in place, and all that remains is to plant the lawn and bring it under maintenance.



Seeding on Columbia Island, Washington, D. C.

Above: Enrollees pulling another home-made tool, a drag filled with cut iron nails, for getting the seed well under cover.

Below: Final operation. Rolling at brisk speed with rubber tired tractor. In warm weather a lighter roller would be used.

CHAPTER III

PLANTING

The occurrence, height, and luxuriousness of vegetation are roughly parallel with the amount of moisture and warmth available for growing. Thus, trees grow highest in warm regions where there is the most rain, snow and fog. As the amount of moisture decreases, the height of trees decreases, and all vegetation grows steadily lower and more scattered until in the desert it consists of a few sparsely placed shrubs and clumps of grass. Nature fits into each region the plants best suited to live there. The choice within any temperature zone is governed largely by the amount of precipitation.

Because the amount of moisture and temperature are so important in choosing species and growing a lawn, it seems fitting to include a tabulation, Chapter IV, of the amount of precipitation and the temperature in cities representative of zones. It is not sufficient to know what the total amount of precipitation may be for the entire year, for the choice of a time for planting is fully as important as anything else. Take two combinations: (a) the lawn might be planted at the end of a rainy spell, and the grass would get enough moisture to make a good start, after which a dry spell would set in and the grass would wither before it established a strong root system: or, (b) the lawn might be planted in a dry season and then have to live through a cool rainy period with little sun, and fail for lack of heat.

TIME TO PLANT

It may be imperative to plant a lawn at some other time than in the cool days of autumn, but all bookwriters, seedsmen and practical lawn builders agree that fall is the time to do it. Professor Lawrence S. Dickinson, author of The Lawn, faces the issue courageously, saying, "It surely is a great temptation, when one moves into a newly built house on May 1, to immediately plant a lawn! Yield not! Grow cover crops and plant in the fall."

While this sage advice refers particularly to seeding, it applies equally to all other methods of planting. Here is an area which has been disturbed, torn up and stirred around, scraped off, filled in, limed, manured, fertilized, and then sandpapered to a smooth surface. It needs a rest. It should be allowed to settle down gracefully under favorable and mellowing conditions. And in late autumn, when the days are warm and the nights cool, when the dew is plenteous and gentle rains fall lightly, the new surface will accommodate itself to planting with the least difficulty, assimilate extra fertilizing ingredients most readily, and give the greatest impulse to the seed or sod.

HOW TO PLANT

There are four ways to plant a lawn: A, by seeding; B, with stolons; C, by solid sodding; and D, by strip sodding. These are often combined to save time or money, or for other purposes.

SEEDING

The preparation of the seed bed is practically the same for any kind of planting, but extra care will always be taken for seeding. The readjustment of the area is far more drastic for seeding than for other methods of planting, since not only the conformation of the lawn has been modified, with resultant changes in the distribution of the native soil and in the drainage, but the fertility of the surface soil has been modified in one way or another.

Therefore, for seeding it is far better to prepare the seed bed in the spring and carry it over to the fall with cover crops. These cover crops should be strong species likely to resist the heat and drought of the hot months, developing a strong sod to prevent erosion of the soil, and help the soil to assimilate the ingredients which have been added, while it is settling gracefully into its new shape and conditions.

Preferably these cover crops should be legumes, — soil builders, sown thickly over the area. Each authority advocates his favorite species, but lawn builders are referred to Chapter V entitled, "Kinds of Grass," and invited to choose their "makings" and roll their own.

Seed for the permanent lawn may be sown with the cover crop, and thus make a start under the shelter of the temporary cover, developing a root system and making a little top growth, ready to profit to the full in milder weather. With this method the cover crop may be mowed down close when the weather becomes cooler, and thus encourage the permenent grass to become sturdy. Or—some prefer to keep the cover crop through the winter for additional protection, and mow it down in the spring.

In the spring the seeding must be checked up carefully. The builder may have planned to supplement the earlier planting with other species in the spring. Or this spring inspection may discover that all of the ingredients in the mix did not come through equally well, or there may be bare places. All of these are good reasons for additional planting. It may be done by raking in, or by spiking in, depending upon conditions. It should be done early, as soon as the snow leaves, or even on the last snow.

The seed should be cast by hand, beginning at one corner and working back and forth across the area, using one-half of the total amount of seed. The other half of the seed should be used in a similar sowing at right angles to the first. Usually a mixture will be cast together, but some seed, like rye, is heavier than others. Broadcasting rye with timothy would result in a heavy spread of rye at a distance from the sower, and leave the timothy at his feet. Separate sowings of the two kinds may be better.

If there should be any breeze, work down the wind for the best distribution of seed. If special seeding must be done in shady spots, terraces, rocky or wet places, be sure to carry the regular mixture beyond the border into the less favored area, and scatter the special seed mixture well over into the normal area. Both areas will then make their selection, and the seed better suited will predominate in each spot.

Seed must be brought into intimate contact with soil particles to germinate quickly and uniformly. This will be speeded by raking the seed in lightly, or by rolling, but preferably by both. After rolling it is good practice to cover the whole area with a light mulch of hay or straw free from seeds. This protects from too much sun, conserves heat, and cushions the fall of rain to prevent erosion. Any sprinkling should be done on this mulch.

Cutting Sod by Hand

Cheraw State Park, South Carolina. SP–1.

The Tools They Use

Brush hook
Long handled No. 2 square point shovel
Heavy tamp

When slopes are seeded, scouring of the surface can be prevented by covering the ground with strips of burlap, cheap muslin or cheesecloth made for the purpose, pegged in place. The grass will come up through the cloth which is then gently rolled off. Where there is likely to be erosion until the grass is well established the cloth is allowed to stay in place until it is well rotted, when it will come up without damage.

Seed is mixed by weight, and 3 to 3½ pounds of seed should be sown on each 1,000 square feet of surface. However, it is well to go back to the study of local conditions and practices to find out how much to plant, and lean heavily on any experience which can be found nearby. Thick sowing is advisable, but more than 5 pounds to 1,000 square feet is too heavy for healthy sod.

To compare the cost of seeding in a carefully prepared seed bed with the cost of sodding on bare, sterile soil, is unfair. In time the accumulated cost of the lawn sodded on bare sub-soil may exceed that of the seeded area. But usually the comparative cost of seeding is not high.

PLANTING WITH STOLONS

A number of camps have reported good success with stolons, not only in the South where that method is so common, but in several places in the northern tier of States.

A stolon is merely a slip off of a parent plant, a piece of the creeping stem which habitually roots wherever the joint strikes the earth. Only grasses which take roots at the joints, or nodes, can be propagated in this way. Practically every basic grass in the South spreads with stems or rootstocks, and several of the creeping bents in the North. Stolons and their preparation for planting are discussed under Sod Nursery in this chapter. They can be purchased from growers. In either case they come as chopped-up pieces of stalks and roots, with some soil adhering.

The seed bed should be prepared precisely as for seeding, but in the final raking it is well to leave rake marks, for the ridges and hollows form a better surface for planting stolons than a smooth one.

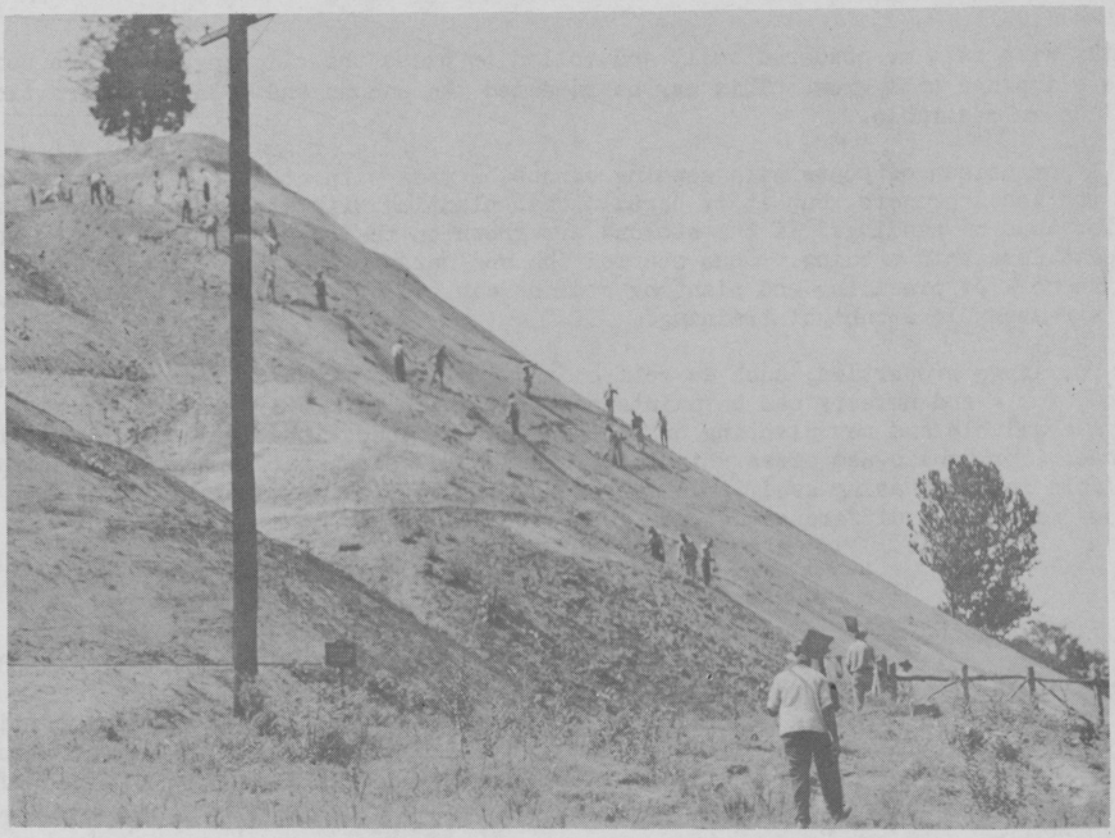
Stolons are planted in several ways. They are sometimes set carefully in holes made with a dibble. You can buy a dibble if you are that kind of a lawn builder. But no store dibble is as good as 3 feet of broom handle nicely sharpened, with a little bracket on one side to set your nigh foot on to sink it into the ground. The stolon is set in the hole, and then the dibble is sunk again alongside and crowded toward the stolon, to press the dirt around it.

Another way is to make shallow furrows across the area, say 12 inches apart. The stolons are dropped into these furrows at about a foot apart. Then the furrows are tamped or rolled to press the dirt firmly over the slips.

But the best way for larger areas is to scatter the stolons evenly over the surface, and immediately cover them lightly with silt or sandy soil to hold moisture and to bring the stolon into intimate contact with the soil on all sides. Then the area should be tamped, but preferably rolled lightly, to press the stolons into the soil. Especially good practice is to spread an inch of topsoil evenly over the stolons and scrape it lightly to a smooth, loose surface.

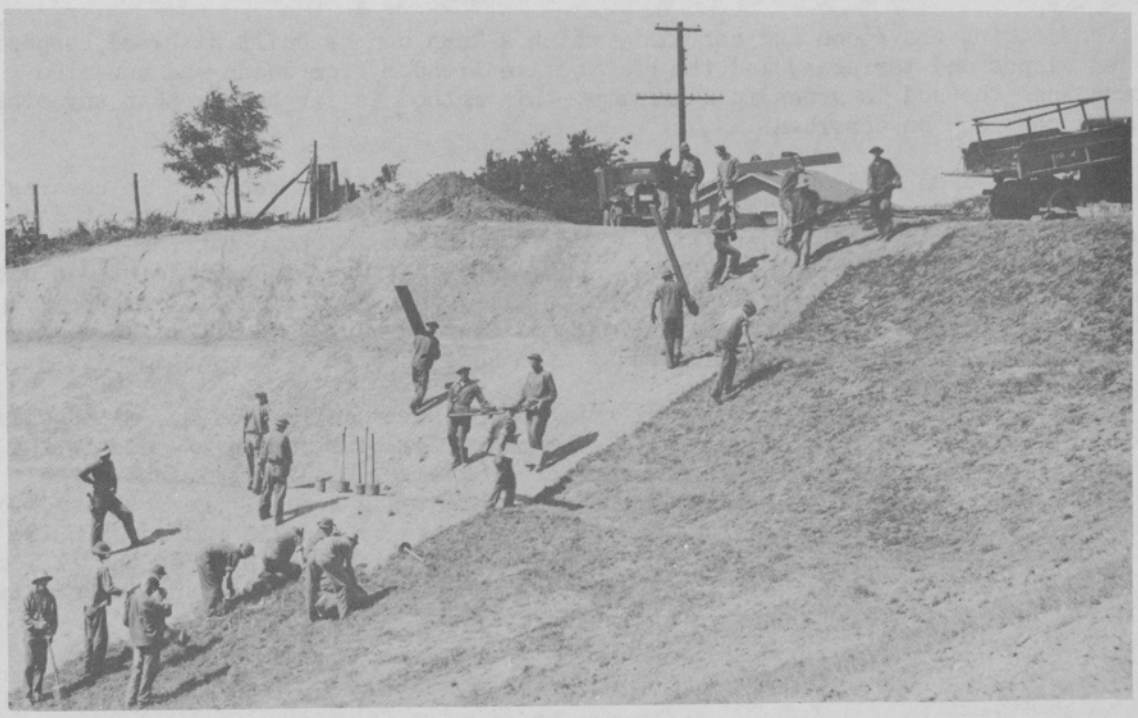
Daily watering in warm weather is desirable, and it may even be helpful to cover the area with a little hay or straw to protect the planting from hot sun and to cushion the fall of rain.

When a uniform stand of new shoots covers the area the mulch should be raked off, and the lawn mowed. The lawn may look thin at this time, but if it is again covered



Sodding Slopes at Vicksburg National Military Park
Vicksburg, Mississippi.

154 Acres of solid sodding on slopes like these.
The biggest acreage ever sodded by the National Park Service.



lightly with silt or powdered soil, and rolled to press the clippings into the soil these clippings will grow. This may be repeated the second and even the third time if it deems desirable.

A comparison of costs with seeding cannot be made without quotations on stolons from the local growers, but it it certain that planting with stolons produces a lawn earlier than by seeding. If the stolons are grown on the site this method of planting may cost less than seeding. Once started the sod nursery costs practically nothing, and the work of preparing and planting stolons can be done by any labor available, with a reasonable amount of training.

For large properties, such as golf courses, planting with stolons is an excellent method, for a sod nursery can be maintained from which an ample supply of stolons is always available and new planting or patching can be done with little equipment or expense. For public-use areas which must stand hard wear, where money is not always available for purchasing seed, this method of getting a quick catch of grass with stolons may be the difference between good maintenance and none at all.

SOLID SODDING

Solid sodding means covering the area completely with sod. At first thought some may say that it is unnecessary to prepare the soil as carefully for solid sodding as for seeding, but those who know will make few concessions on this score. If sod were cut a foot or eighteen inches thick, as it was many years ago, and thus carried with it a sufficient depth of soil to last a lifetime, it might be planted on a concrete pavement. But today we skin off a scant inch and a half of sod, shearing off all of the deep roots, and then expect this to grow on a newly graded surface of sterile soil.

Sod which is little more than the upper surface of the nursery or field will burn out in hot weather unless there is a finely pulverized bed of good soil for the roots to penetrate for moisture and food. Therefore, the bed must be prepared carefully, as carefully as for seed. If this is done, and the first cost of the sod is not too high, the total cost of the lawn need not be excessive.

Considering the speed and certainty which a lawn can be built with sod, especially on slopes and terraces, and the comparative freedom from weeds and unwanted species when the sod is grown in a nursery, this method is far better than any other if extra cost can be absorbed.

Little need be said about the actual process. The sod is received in squares or rolls, and is laid uniformly over the area as quickly as possible, tamping it down firmly as it is laid, and then rolling after it is all down, to bring the roots into intimate contact with particles of soil. Care must be taken to break joints in both directions, so as to avoid any water washes. All joints should be filled with a light, silty, or sandy soil before rolling, and if necessary this should be tamped into the joints with the end of a board to make sure that it is compacted.

It is generally necessary to plant steep slopes with solid sodding, so especial attention should be paid to successful operations. The outstanding example is the project at Vicksburg National Military Park at Vicksburg, Mississippi, where the erosion of steep slopes in the light loess soil threatened some of the most important points in the historic area. Altogether 199 acres have been solid sodded. On 154 acres the work was to stop erosion on slopes, some of which were steeper than 1:1 or 45 degrees. This is the largest solid sodding project yet reported, and is certainly the largest project ever undertaken in the park system.

Experience at Vicksburg calls for solid sodding on any slope steeper than 1 foot rise in 6 feet run, and also favors solid sodding, instead of strip sodding, in loess soil, which is discussed in the next part of this section, because finger washes start so quickly and deepen so rapidly.

This experience recommends a study of local conditions to determine what to do with any slope. Some of the points to be covered in the study are stated very briefly here:

1. The nature of the soil, not only its origin and type, but also its fineness and cohesion. Soil which sticks together, like clay, would receive much different treatment than a soil which falls apart, like sandy silt or loess soil, for one would resist erosion much better than the other.

2. The seasons in which sodding can be done. No one can make grass take hold on a steep slope under the hot sun of the deep South. If started in the rainy winter months it should pull through the next summer, but the best season is the fall.

3. Amount and rate of precipitation. It is important that while this factor is encountered in every discussion of making lawns, rain is much more destructive on slopes. Not only the average rainfall must be considered, but the maximum precipitation in short periods must be studied before going ahead with any important slope sodding.

4. The steepness of the slope is of course the key factor. The handling of the other factors is gauged to the steepness of the slope, and this handling will be sharply modified and constricted as the steepness increases.

5. Is the job on a cut, or a fill? Both may be sterile soil. One will be more likely to erode and settle than the other. The cut might be strip sodded. Perhaps the fill must be solid sodded.

6. The drainage load on the sodded area may come from outside that area, and the catchment area or drainage slope may throw a heavy load on the sodding. It may be possible to break up this flow by building hollows into the slopes to spread the sheet of water more evenly over the area.

7. Last, how much will the sodded slope be used? How much unavoidable tramping over it by visitors? All use of a slope tends to displace the sod, and should not be permitted at all until it is certain that the sod has rooted into the subsoil underneath.

The sod used at Vicksburg was Bermuda grass cut about 2 inches thick, and laid on a base that had been thoroughly scarified and wet down. The sodding was done during the winter; it stopped when the weather began to get warm in the spring. A good deal of the sod was grown in a sod nursery, but some was purchased from farmers at from $5 to $12.50 an acre, from carefully inspected pastures. All joints were carefully broken, and each piece of sod was pegged down with thin sticks split off of a pine block about a foot long. The area was watered whenever the sod appeared to be wilting.

It was found at Vicksburg that extreme care had to be taken to prevent any concentration of water on the slopes. Opinion goes so far as to hold that any rock, tree, shrub, unevenness in sod, or other obstruction, is a menace, for water must detour around each such projection to concentrate in finger channels which quickly enlarge as they rejoin below the projection. The impact there as they collide produces a cutting action, usually a little waterfall, and this may displace soil so rapidly as to move a square of sod downhill. If this happens other sods will go and the whole job below that point may be destroyed.

No little thing has assumed such importance in conservation as these seemingly trifling, "little" washes, and some authorities hold that the only intelligent conservation of soil begins at the very head of each tiny rivulet.

STRIP SODDING

There are a number of good reasons for strip sodding, such as speed, comparative cheapness, and so on. Strip sodding is often one part of some combination of planting methods.

Common uses are for edging next to walks to take the heavy wear which seeding could not stand, along the sides of buildings and under eaves, on breaks in drainage slopes, around flag poles, ponds, benches, and other obstructions where people walk, and as edging for flower beds. All of these uses are effective.

Strip sodding suffers from a prevalent fallacy, that an area can be strip sodded on any kind of soil and left to cover fully and quickly by the spread of grass from the strips of sod. The fallacy is that this can be done on any area, on any kind of soil, with no preparation of the seed bed. The first illustration on page 34 is used to show how foolish the assumption is. The strip sodding shown here was placed four years before this picture was made, and no progress has been made in covering the spaces between the strips. The other picture shows a similar effort of unknown age.

Sterile soil, or soil in which there is no vegetable matter at all, — soil which is the raw product of grinding down rocks, exposed in a grading operation, will hardly grow anything. It is lifeless and without fertility. Soil, as recognized in agriculture, may bring to plants certain mineral salts which have corrective or stimulating values, but it serves chiefly as a carrier for vegetable matter which has been digested until it is a brown substance called humus. Recent experiments show that soil is not necessary, and that moss, excelsior, or even water will carry the needed plant food.

Then it is a waste of time and money to plant grass where there is no plant food available. To set strips of soil between the trenches and expect it to spread out over sterile soil between the trenches will not work magic.

A seed bed well prepared is fully as important for strip sodding as for seeding, for unless the nodes of the creeping grass find lodgement in fertile soil they cannot grow. This seed bed should be rich, well pulverized, watered to keep it moist, and kept free from weeds.

Another error is sometimes made in planting strip sod on a slope is shown in the drawing on page 32. Assuming that there is some top soil or vegetable matter above, some of it can be expected to wash down and lodge above the strip of sod, and that the trailing stems will work gradually up the slope to form a complete cover. This is taking place where the sod is set into the slope to grade. Sometimes the sod is not set into the slope in this way, but is allowed to stand above grade, with the mistaken notion that in this way it will catch and hold more of the rich soil which is washed down. What this method does is to form a series of waterfalls, and the water pouring over them cuts away the soil below until it makes a series of benches, or an undulating slope.

For strip sodding on any slope care should be taken to collect and weigh the factors which are listed for study under the discussion of solid sodding at Vicksburg on page 16. Solid sodding will stand more washing, naturally, than strip sodding, and therefore strip sodding can seldom be attempted where there is danger of forming finger washes. In fact those in charge of the work at Vicksburg say that no strip sodding will be successful where water can collect to form finger washes.

Seeded Slope Covered with Burlap.

This covering will be taken up as soon as the grass sprouts. But if it were staked down it could remain until the grass was ready for mowing in the fall,—or even through the winter.

The cost of strip sodding is purely a local matter. None of the factors which make it up can be known outside of the area in which it will be done.

COMBINATIONS OF METHODS

There are many combinations of these methods of planting a lawn, which depend upon combinations of local conditions affecting cost, use, climate, labor, soil, slopes, and so on. Some of these can be mentioned as suggestions, but with no thought of exhausting the possibilities.

There is the common practice of sodding along walks and around buildings and used areas, and seeding the enclosed parts. The sod takes the wear where wear cannot be avoided.

Another way is solid sodding around edges and filling in the center with stolons, which is practiced with good effect.

Planting partly with seed and partly with stolons seems to serve at least one good purpose. This is to make a basic planting with bent or Bermuda stolons, and then introduce some other variety with seed. This serves to keep a lawn in condition more uniformly through the entire year, each species becoming prominent in the season most favorable to it.

Solid sodding is often combined with strip sodding, and the strict definitions of the two methods are lost in their merging.

One of the most interesting combinations is practiced a good deal by different camps. This is to strip sod around and across areas, and then fill in the centers by casting chopped-up waste from the sod nursery. This waste is much the same as stolons. It is not chopped up as carefully, and it carries a great deal of soil with it. Where a good seed bed cannot be prepared over the entire area, this method of spreading the nursery waste introduces stolons with sufficient soil to enable them to make a start. The results have been very satisfactory.

SOD NURSERY

A sod nursery would seem to be essential in any area where new planting must be done from time to time, and where maintenance is practiced. Whatever else may be said for sodding it is the safest way to get a lawn free from objectional species. Of course it is also the quickest way to get a lawn started, since a growing lawn is transplanted to the new location.

Starting a nursery is the same as starting a lawn, with the advantage that the nursery site may be especially chosen for ease in operating. Different grasses may be sown in separate plots, and a mixture can be made on a lawn by planting alternate squares of sod of different species.

The operations in the nursery are the same as on a lawn except for lifting and transporting sod. Arrangements are sometimes made for forcing the sod with watering systems. A compost pit is a necessity to replace the soil that is carried away with sod.

Different kinds of grass should be planted in separate plots to meet different conditions, such as shady places, rocky places, terraces, wet areas, infertile soils, drought, abused areas, and closely clipped places such as golf greens.

Sod should be cut a certain standard width for ease and uniformity in handling. It should also be cut into a uniform depth, in order that a lawn shall be level. This

cutting can be done in several ways, but the best one is with a sod cutter. One type consists of a sled with a steel channel-shaped blade dropped straight down from one side runner, crossing under the sled at the required depth, and turned up on the other side to the other runner. Another type, which is illustrated on page 28, is like a plow, and was made at Camp SP-5, Larimore, North Dakota. The cutter is set in place in the sod bed and drawn along by hand or with power. It cuts both sides of a strip of sod and shears it off the sub-soil underneath. After pulling the cutter the full length of the sod bed, the strip is cut into pieces of convenient length and rolled up.

In hot weather these rolls must be hauled immediately to the site of the lawn. But they can be stored at the nursery during cool months, if they are covered with soil. The covering serves as a mulch. Any quantity of sod can be stored during cool weather if well covered, thus cleaning out the beds for a new crop. The grass will lie dormant through the winter months. These piles may freeze without damage. In far northern States where camps have stored sod in this way, frost has been found in the piles late in May.

It is the upkeep of nursery beds which taxes the ingenuity of most operators. Some have tried to take up alternate strips of sod, expecting the bared strips to rebuild themselves. Others have filled in the bared strips with new soil and seeded them. The practice of cutting alternate strips has no advantage if the stripped space has to be seeded. The whole bed might as well be harvested, replenished with soil, and seeded over again.

It is this constant replacing of soil that makes a sod nursery expensive, and unless simple means are found for facilitating the repeated use of an area the cost may easily be prohibitive. A piece of rich bottom land may be found where the soil is deep enough to permit extensive and sustained operating. In such a place care must be taken to keep the beds graded while taking out sod, without extra cost. Alternate stripping is dangerous in this respect, for it is apt to leave the surface of the beds undulating, high and low; so uneven that the sod will not be of uniform thickness.

For other areas the best help is with composts. The methods of making compost are discussed in Chapter VI entitled, "Humus and Fertilizers." Any soil nearby can be mixed with compost, or the compost may be disked in, to make a satisfactory seed bed, and this can be done over and over. Care should be taken to insure that this added soil is a tough, pliable sort, so that sod will not tear apart in handling.

A scheme to aid in rolling up the sod is to place about an inch of sand over the old soil, and then fill in two inches of new soil on top. In theory this makes it unnecessary to cut under the sod at all, and when the sides are cut the strip may be rolled up. In practice we encounter the fact that sand draws moisture from below by capillary action, and becomes a reservoir. If it operated only to supply the surface soil with this moisture it would be admirable, but grass roots strike down to get the water, and go on through to the soil below. The effect is to make long roots, and a weak sod for transplanting. To make a strong sod for transplanting surface rooting should be encouraged, and by contrast with the sand layer that would call for growing on an impervious surface.

This leads to another condition to be faced in maintaining a sod nursery. Some plants are naturally deep rooted. Others are shallow rooted. It seems that most of the deep rooted grasses reproduce themselves more readily than the shallow rooted types. For one example of this difference the deep roots of Bermuda will begin to grow to form new tops an hour after the sod has been stripped off the area. A shallow rooted sod may leave an area stagnant, to grow up in weeds.

The preparation of stolons is merely taking up sod in the ordinary way, shaking the dirt off the roots, and chopping the whole plant into small pieces. These pieces are then sacked in burlap, and kept thoroughly moist while traveling to the site and while waiting to be used. Usually about 10 square feet of lawn can be planted from one square foot of good sod.

For the method of spreading nursery waste in areas already enclosed by solid sodding or strip sodding, all scraps are saved when taking up sod in the beds, and these, with any discarded sods or odd pieces, are shredded or chopped up by hatchets or other tools, and the whole mass, with soil adhering, is spread over the planting area. Care should be taken to keep the soil with the roots, even if the mass has to be wet down, and at times it may be desirable to mix in additional soil in order to spread the grass cuttings over a larger area. Heavy soils are best for this process because they will not wash off the stolons as readily as silts or other light soils.

CHAPTER IV

TEMPERATURE AND PRECIPITATION TABLES

Growing depends upon temperature and precipitation so completely that any plan for planting must take these factors into account. In a local situation, handled locally, not much thought may be given to these factors, since every person takes it for granted that he can get along with the weather pretty well. More accurate knowledge will be helpful even to them. For planning work at a distance statistical information will help to determine the most favorable conditions and seasons.

We feel justified in compiling from statistics of the U. S. Weather Bureau several figures for each of 8 to 197 stations over periods from 20 to 50 years of continuous reporting. Since the Weather Bureau merely reports weather as it finds it, there are no apologies for local highs and lows which may not have come to official attention, any more than we can be held to account for the "big wind" or the "ice storm" of some story. The figures used here are dependable for all ordinary conditions.

Under temperature we have included for each of the four seasons: Annual Mean Temperature, Average, High and Low. The annual mean temperature is copied, the average is calculated, and the high and low are merely picked out of the daily records.

Temperature is the first condition of possible growth. These four figures enable one to see what are the extremes to be encountered, as well as the mean and average— neither of which alone would uncover the possibility of unseasonal frosts or drought.

Under precipitation there are also four figures for each season: Annual Normal, Season Normal, Highest in Any One Day, and Lowest in Any One Day. The annual is copied, the normal is the sum of monthly figures, and the highest and lowest in any one day are picked out of the tables of daily precipitation.

Precipitation is the other component of growing conditions. It includes rain, snow, hail, sleet, and dew. Within any temperature range the precipitation determines the height and luxuriousness of vegetation. But the highest amount in any one day may be a more important figure than any other, since a cloudburst or excessive downpour might wash out the entire planting. The lowest in any one day might be so striking as to seriously modify the apparent chance of success indicated by an average.

TEMPERATURE AND PRECIPITATION TABLES

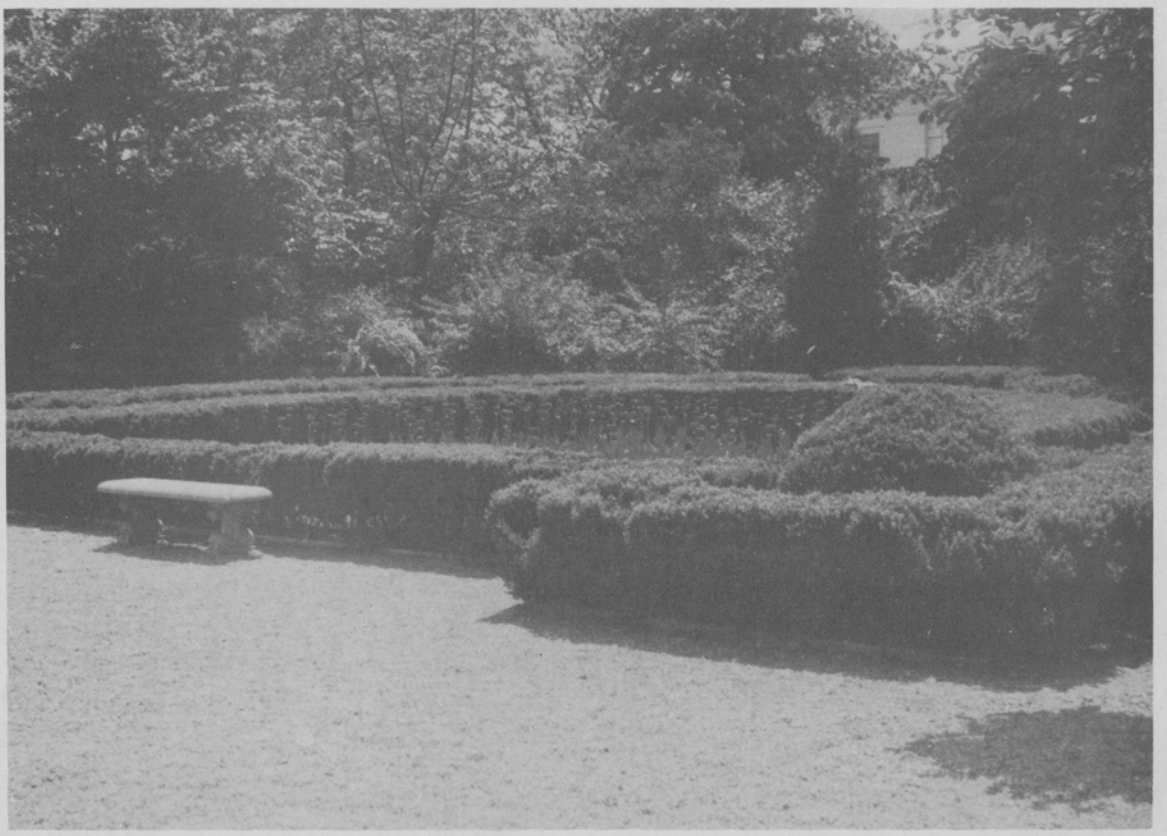
Compiled Monthly Weather Review of the U. S. Weather Bureau, in the Department of Agriculture.

STATE	TEMPERATURE									PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High Low (Above) (Below)				ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
Alabama:																		
						51	75	80	77						.21	.22	.20	.17
Birmingham	63	46	64	79	64	44	51	75	59	53	15	14	14	9	.09	.09	.12	.05
						57	78	81	80						.04	.23	.33	.22
Mobile	67	53	66	81	69	51	57	78	54	61	16	15	19	12	.10	.11	.11	.08
Arizona:																		
						57	79	90	86						.06	.05	.05	.03
Phoenix	69	53	67	87	71	50	58	70	55	8	3	1	2	2	.00	.00	.00	.01
Arkansas:																		
						48	73	81	77						.19	.21	.18	.19
Little Rock	62	43	61	79	63	41	48	74	47	48	13	14	11	10	.09	.12	.07	.07
California:																		
															.16	.14	.01	.06
Los Angeles	62	56	60	69	65	54	56	64	58	15	8	4	.11	2	.05	.01	.00	.00
						52	66	73	71						.14	.09	.02	.09
Sacramento	60	47	58	72	61	44	52	66	49	18	9	5	.15	3	.07	.01	.00	.00
Colorado:																		
						35	61	72	67						,04	.04	.10	.09
Denver	50	31	47	69	51	29	35	61	35	14	3	5	4	2	.01	.02	.01	.01
Connecticut:																		
						36	62	72	67						.19	.15	.18	.15
New Haven	50	30	46	69	53	27	31	62	36	46	13	12	11	10	.10	.10	.08	.10
Florida:																		
						63	78	81	81						.12	.18	.56	.27
Tampa	72	61	71	81	73	59	63	78	65	49	8	7	25	11	.05	.05	.16	.04

Pan American Union Grounds. Washington.

Above: South Side. English box forming alcoves.

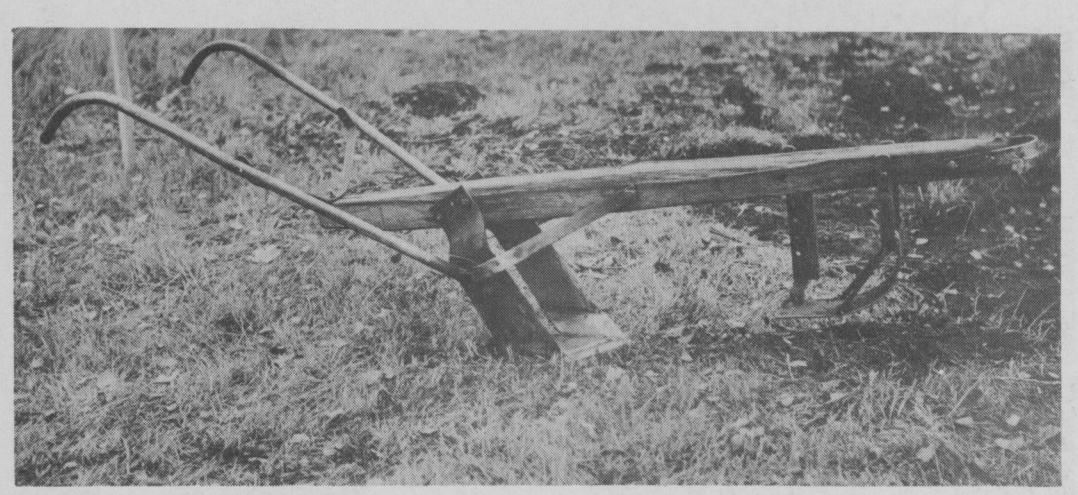
Below: Red tulips in a formal enclosure.



STATE	TEMPERATURE										PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High Low (Above) (Below)					ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.			W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
Georgia:																			
						47	73	78	75							.20	.23	.19	.14
Atlanta	61	44	61	77	62	42	48	73	47		48	15	12	13	8	.11	.06	.10	.07
						56	76	81	79							.15	13	.35	.22
Savannah	67	52	66	80	67	51	56	76	54		47	9	9	19	10	.07	.07	.12	.04
Idaho:																			
						38	60	74	67							.08	.06	.04	.06
Boise	51	32	50	69	51	29	38	61	36		13	5	4	1	3	.04	.03	.01	.01
Illinois:																			
						41	72	79	75							.16	.15	.15	.16
Cairo	58	36	58	77	59	34	42	73	41		41	11	11	10	9	.07	.08	.04	.06
						34	63	74	70							.09	.16	.14	.12
Chicago	50	27	47	71	54	24	31	63	35		33	6	9	10	8	.04	.06	.06	.06
Indiana:																			
						40	71	79	74							.16	.18	.17	.14
Evansville	57	35	56	77	58	33	40	71	41		43	11	11	12	9	.07	.08	.06	.06
						34	67	76	70							.12	.18	.16	.16
Indianapolis	52	30	51	73	54	28	34	68	36		40	8	14	11	9	.05	.08	.06	.05
Iowa																			
						31	66	75	69							.06	.21	.20	.14
Des Moines	49	23	49	73	52	19	28	66	31		32	4	8	12	8	.03	.04	.08	.02
Kansas:																			
						39	69	80	75							.06	.20	.19	.14
Wichita	56	33	55	77	58	31	39	70	38		30	3	9	11	7	.02	.03	.07	.02

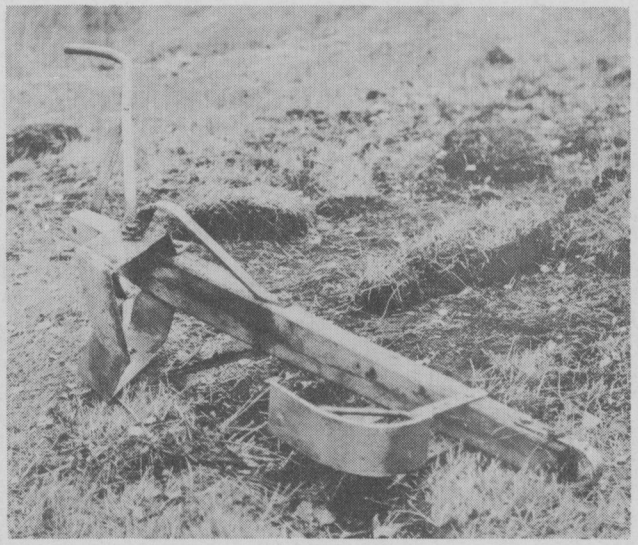
STATE	TEMPERATURE										PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High (Above) Low (Below)					ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.			W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
Kentucky:																			
						41	71	78	74							.16	.17	.15	.16
Louisville	57	36	56	77	59	34	40	71	41		43	11	12	11	9	.08	.07	.08	.06
Louisiana:																			
						59	78	82	81							.17	.21	.28	.20
New Orleans	69	56	69	82	71	54	59	78	58		57	13	15	18	11	.08	.08	.12	.07
						54	77	83	80							.17	.18	.17	.19
Shreveport	66	49	66	82	66	46	54	77	52		43	11	13	10	9	.08	.09	.05	.05
Maine:																			
						32	58	68	63							.16	.16	.15	.16
Portland	46	25	43	66	49	21	26	58	32		42	12	11	9	10	.07	.08	.08	.08
Maryland:																			
						40	68	77	72							.15	.15	.18	.14
Baltimore	55	35	53	75	58	33	37	69	41		42	10	11	13	8	.08	.07	.10	.07
Massachusetts:																			
						39	56	68	65							.15	.14	.15	.14
Nantucket	49	33	44	65	54	30	32	56	39		38	11	9	9	9	.09	.07	.07	.06
Michigan:																			
						32	63	72	67							.10	.11	.15	.15
Grand Rapids	48	25	46	70	51	22	27	63	32		34	8	8	9	9	.07	.06	.06	.07
Minnesota:																			
						18	60	68	63							.04	.11	.19	.11
Moorhead	39	7	39	66	43	3	15	60	18		23	3	6	10	4	.01	.02	.06	.03

Cutting Sod
Turtle River State Park. SP-5
Larimore, North Dakota.



The Cutter was Made at this Camp
Side View of Sod Cutter

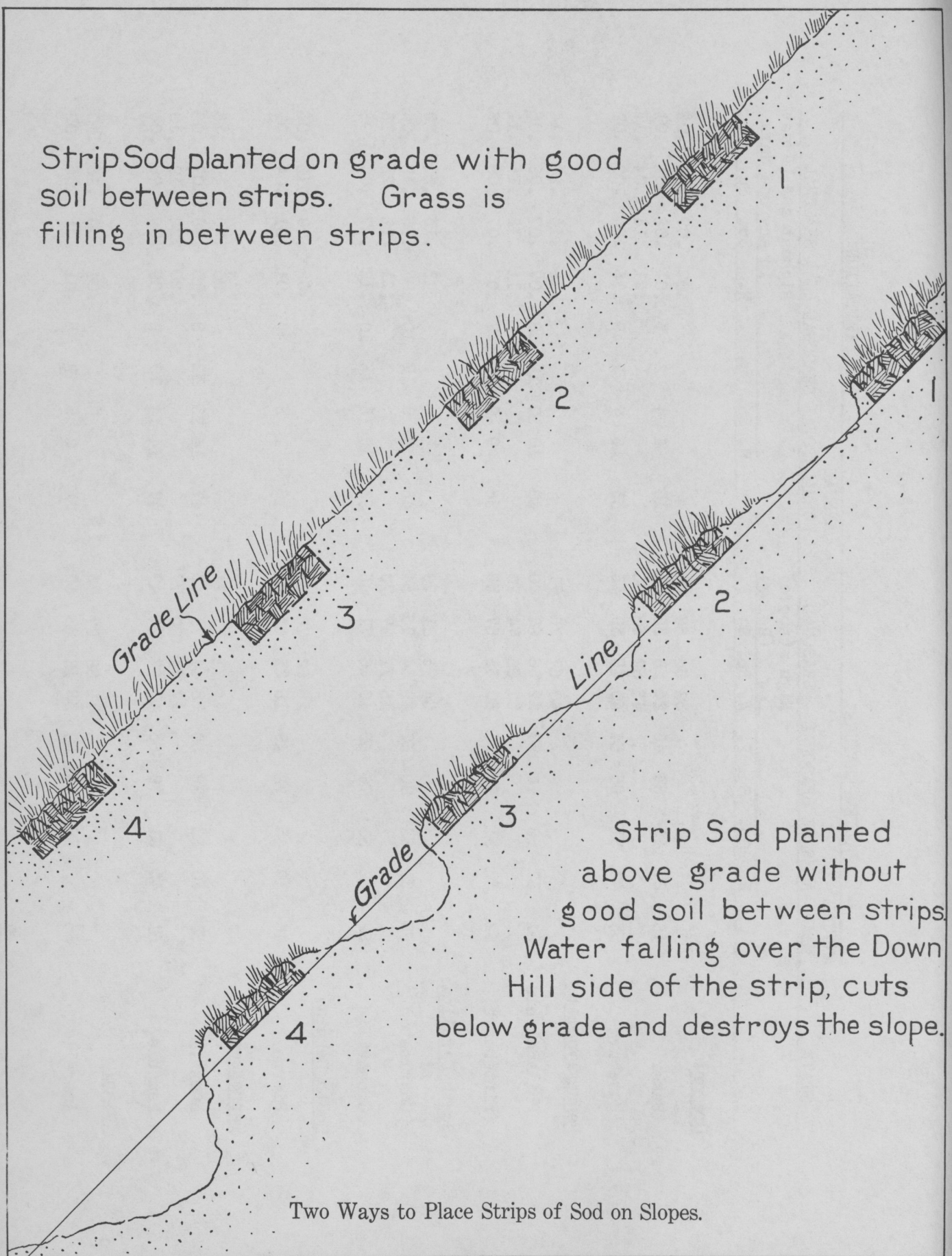
The blade is sharpened on the V-shaped bottom, and also on the two sides. The shoe determines the depth of the cut.



STATE	TEMPERATURE									PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High Low (Above) (Below)				ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
Mississippi:																		
						54	76	81	79						.24	.24	.20	.18
Vicksburg	65	50	65	80	66	47	54	76	52	52	16	15	13	8	.13	.10	.08	.05
Missouri:																		
						37	68	77	72						.10	.17	.22	.19
Columbia	54	31	54	75	56	28	36	69	49	38	7	11	11	9	.04	.05	.06	.06
Montana:																		
						28	54	67	67						.04	.09	.11	.07
Helena	43	22	42	63	45	19	26	55	38	13	2	4	4	3	.02	.02	.02	.01
						28	54	65	58						.07	.07	.08	.06
Kalispell	42	23	42	61	43	19	27	54	28	15	4	4	4	3	.03	.02	.02	.02
Nebraska:																		
						30	63	73	67						.03	.13	.16	.06
North Platte	48	25	48	70	49	22	30	63	31	18	2	5	8	3	.01	.02	.06	.01
Nevada:																		
						36	57	72	64						.04	.04	.03	.03
Winnemucca	48	31	47	68	48	27	36	58	33	9	3	3	1	2	.02	.02	.00	.00
New Hampshire:																		
						31	58	69	63						.12	.13	.13	.12
Concord	45	23	42	66	49	21	25	59	31	37	9	9	10	9	.08	.07	.08	.08
New Jersey:																		
						40	62	73	70						.15	.14	.17	.12
Atlantic City	52	34	48	70	56	32	35	53	40	40	10	10	11	9	.10	.07	.07	.06

STATE	TEMPERATURE									PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High Low (Above) (Below)				ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
New Mexico:																		
						36	60	69	64						.03	.06	.10	.07
Santa Fe	48	31	47	67	50	28	36	61	34	14	2	3	6	3	.01	.02	.02	.01
New York:																		
						38	65	74	70						.16	.15	.18	.17
New York	52	32	49	72	56	30	33	65	39	43	11	10	12	10	.09	.07	.08	.07
						33	62	71	66						.12	.12	.12	.11
Rochester	47	26	44	69	51	23	26	62	33	32	8	9	8	7	.07	.06	.07	.06
North Carolina:																		
						52	72	78	76						.20	.18	.22	.24
Hatteras	62	48	60	77	66	46	49	73	52	52	13	11	15	13	.09	.08	.09	.08
						45	72	78	74						.15	.15	.21	.16
Raleigh	60	42	59	77	61	41	45	72	46	46	11	11	15	9	.09	.09	.12	.05
North Dakota:																		
						20	58	70	63						.03	.10	.15	.05
Bismarck	40	11	40	67	44	7	15	59	20	16	2	4	7	3	.01	.02	.04	.01
Ohio:																		
						36	67	75	70						.12	.16	.14	.14
Dayton	52	31	52	73	54	29	34	67	36	37	9	10	10	8	.06	.08	.08	.06
						35	62	71	67						.11	.13	.13	.16
Cleveland	49	28	46	69	53	26	30	63	35	33	7	8	9	9	.06	.06	.07	.07
Oklahoma:																		
						44	71	81	77						.07	.20	.15	.11
Oklahoma City	59	38	59	79	61	36	45	72	43	31	4	10	9	8	.02	.04	.07	.04

STATE	TEMPERATURE									PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High Low (Above) (Below)				ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
Oregon:																		
						32	54	66	60						.07	.07	.05	.05
Baker	45	27	45	63	46	24	33	55	31	13	4	4	2	3	.03	.02	.01	.01
						45	59	68	66						.21	.14	.04	.17
Roseburg	53	42	51	66	54	40	45	59	43	33	15	7	2	9	.13	.04	.00	.02
Pennsylvania:																		
						40	67	76	71						.15	.14	.20	.14
Philadelphia	54	37	52	74	57	32	36	67	40	40	10	10	12	8	.07	.07	.09	.06
						37	66	74	70						.11	.12	.15	.11
Pittsburgh	52	32	51	73	55	30	35	67	38	36	9	9	11	7	.07	.07	.09	.06
South Carolina:																		
						54	76	81	79						.13	.13	.31	.20
Charleston	66	51	65	80	67	49	54	76	54	45	9	9	17	10	.07	.06	.12	.04
						45	71	77	73						.21	.22	.25	.18
Greenville	59	42	58	76	60	40	46	71	45	53	15	13	15	10	.12	.07	.08	.06
South Dakota:																		
						26	62	76	68						.02	.10	.15	.06
Pierre	46	19	45	72	49	15	23	63	27	16	1	5	7	3	.01	.01	.04	.01
Tennessee:																		
						44	71	77	74						.20	.20	.19	.13
Knoxville	58	40	58	76	59	38	44	71	43	47	14	13	12	8	.10	.08	.07	.06
						47	74	80	77						.20	.22	.19	.19
Memphis	61	43	61	79	63	40	47	74	47	47	14	14	10	9	.09	.09	.08	.04
Texas:																		
						41	68	77	73						.04	.09	.15	.10
Amarello	56	37	56	75	58	35	42	68	40	21	2	5	9	5	.01	.01	.05	.02



Two Ways to Place Strips of Sod on Slopes.

STATE	TEMPERATURE									PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High (Above) Low (Below)				ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
Texas: (Contd.)																		
						52	75	81	77						.02	.02	.10	.06
El Paso	63	46	64	80	63	43	52	75	48	9	1	1	4	3	.01	.00	.01	.01
						52	76	84	80						.08	.18	.12	.10
Fort Worth	65	47	65	82	66	45	52	76	50	33	6	11	9	7	.04	.04	.07	.07
						59	78	83	81						.17	.18	.20	.20
Houston	69	54	69	83	70	52	59	79	57	47	11	12	12	12	.07	.07	.07	.07
Utah:																		
						37	62	77	70						.07	.09	.05	.08
Salt Lake City	51	31	50	72	53	28	37	62	36	16	4	6	2	4	.03	.04	.01	.02
Vermont:																		
						25	57	66	60						.09	.12	.16	.14
Northfield	41	17	40	64	45	14	20	57	26	33	7	7	10	9	.06	.06	.08	.07
Virginia:																		
						42	71	77	72						.14	.14	.16	.14
Lynchburg	57	39	57	75	58	37	43	71	42	40	10	10	11	9	.08	.08	.10	.05
						46	70	79	74						.12	.18	.22	.12
Norfolk	59	42	57	77	62	40	44	70	46	44	10	11	15	8	.08	.08	.07	.06
Washington:																		
						43	56	64	61						.22	.11	.05	.25
Seattle	51	41	50	62	52	39	43	56	43	34	14	7	3	10	.10	.04	.00	.04
						34	58	70	64						.09	.07	.06	.08
Spokane	48	30	48	67	49	27	35	59	34	16	6	4	2	4	.04	.02	.01	.02
West Virginia:																		
						35	63	70	66						.15	.15	.21	.12
Elkins	50	32	49	69	52	30	35	63	35	45	10	12	14	9	.08	.10	.09	.07

Sod Will Not Spread in Sterile Soil.

Above: This sod was planted in ditches four years before this picture was made. Very little spreading has taken place.

Below: This sod may have been planted in rows. Only patches of it are left. The sterile soil washed out, taking the sod with it.

STATE	TEMPERATURE									PRECIPITATION								
	ANNUAL MEAN	AVERAGE SEASONAL				SEASONAL High (Above) Low (Below)				ANNUAL NORMAL	TOTAL SEASONAL				SEASONAL Highest and Lowest in any one day.			
		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.		W.	Sp.	Su.	F.	W.	Sp.	Su.	F.
West Virginia: (Contd.)																		
						38	68	75	71						.15	.14	.18	.14
Parkersburg	54	34	53	74	56	32	37	68	38	39	10	10	12	7	.07	.08	.08	.05
Wisconsin:																		
						26	59	70	64						.07	.16	.17	.14
Green Bay	44	18	42	68	47	14	22	60	27	31	5	8	10	8	.04	.05	.07	.06
Wyoming:																		
						27	55	68	61						.04	.12	.09	.06
Lander	42	20	42	64	43	18	27	56	24	13	3	5	2	3	.01	.03	.01	.01
District of Columbia:						39	68	77	72						.14	.15	.19	.16
	55	35	53	75	57	33	38	68	40	42	10	11	13	8	.07	.07	.08	.06

This is the kind of wear turf has to take on some recreation areas.
Spring Mill State Park, Indiana.

CHAPTER V

KINDS OF GRASS

There are about 6,000 species of grass in the world, and this order of vegetation contributes more to the welfare of the human race than any other. A very small number of the species are cultivated plants, but we depend upon these directly for bread, cereals, rugs, hay, animal feed and forage, hats, ornamentation, rope, bamboo lumber, receptacles, furniture, and soil binders, as common examples. By processes we obtain from them sugar, syrup, paper, all kinds of meat, milk, oil, starch, plastics, and many other things. Incidentally we use a few species for lawns.

Wild grasses are separated into families having peculiar characteristics, and varieties occupy certain areas because of their superior ability to thrive in conditions prevailing there. Grasses have spread out in this way around the world, more persistently than any plants except the mosses. All cultivated stalks have been developed from wild grasses by slow and painstaking selection. Our familiar Indian corn (maize) is bred from a Mexican fodder grass.

A thorough study should be made of local conditions. It should weigh carefully any experience which has been had in the neighborhood with grasses, for lawn, food, or pasture purposes, before beginning to choose varieties. But making a lawn should be as simple as possible, and it is unnecessary to attain the last minute fraction of suitability in any one grass, or the last degree of accuracy in any mixture.

One of the saving things about making a lawn is that the planting can usually be modified at some later date if the first effort has not been satisfactory. Another kind of seed can be spiked in, even on sod. It may be highly desirable to first get a strong sod, and later refine by spiking in the seed of other species. So the choice of grasses to be used alone or in mixtures depends upon expediency more than upon pioneering. Any choice should be checked for practicability by inquiries and comparisons in the immediate neighborhood.

There is usually little surplus in the budget for fancy brands. One should not distrust his own study, and accept too credulously the superverdant velvetiness of some commercial mixture pictured in the catalog. If the study of local soil conditions, of experience in the neighborhood, of precipitation and temperature by seasons, of the results which may be expected step-by-step as the lawn progresses, and of the amount of money which can reasonably be spent for seed or sod or stolons; — if this study produces a list of grasses which will serve these temporary and permanent purposes, then the seed can be bought from reputable seedmen and mixed on the job.

Last in this study we may remember that all grasses originated somewhere and all have their own special sections in which they thrive with the least care. Since

the fescues and bent grasses are indigenous to the Rocky Mountains, it would be wise to include these in any mixture in those regions. Since Bluegrass prospers beyond any other in Kentucky and adjoining States, it would be foolish to overlook it. There are regions for Bermuda, and for rye grasses in the same way. Each has its place. Much work will be saved if these local varieties are employed to the full.

The grasses described here are those used by camps in seeding and sodding projects, plus a number of others selected from dependable sources for particular purposes, and a few more which seemed to fall naturally into the scope of the general treatment. Only a brief listing of important characteristics is given for each one. For exhaustive study we recommend the sources given in the preface.

One hope in the classification of grasses, which was to tabulate the same information for each one, has not been fully realized. The tabulation on page 39 is the best that can be done at present, but we invite anyone having dependable information to check this table and send in their criticism, citing authorities, so that in the next printing of the book the table can be improved.

In this tabulation the first choice, most common usage, or preference is indicated by X; the second choice or tolerance is indicated by o, and definite failure conditions are shown by —. Thus a species may be excellent on a heavy alkaline soil in a hot area with plenty of rain, but it might do well enough on a light acid soil in a cooler place with less rain. It might be the only species suitable in these ways which will grow in shade.

To select grasses for any place, run across the table on the most distinctive or most limiting condition; such as shade or intensive heat, and list the grasses which will live in these conditions. Then run across the table on other conditions, and cross species off the list as they are found unsuitable in other ways. By thus eliminating unsuitable species, the most suitable species will be left.

Any selection made from the table should be checked carefully against the description of the species in this text, for the table at best is not an adequate description.

In this table "Range" refers to the map on page 42 which is reproduced from Farmer's Bulletin No. 1677 entitled, "Planting and Care of Lawns", published by the U. S. Department of Agriculture. The listed price is 5 cents.

The use of common, or local, names makes any study of this kind more confusing than it should be. Here we use the most commonly accepted name for each species, with its scientific name, and then follow with all the local names which occur in our sources. A table appears on page 46 in which the most commonly accepted name appears in capitals, thus: BERMUDA, and the local or other names like this: Wild Onion. In the second and fourth columns are the names under which the species are described. In this way any common name can be quickly identified with the name which we use here in the description.

While we feel sure of the dependability of this chapter, we are especially desirous that all those who have to do with grasses shall check the information against any that they have, and send in any comments or criticism. Additional local names or local information about the behavior of these species under their conditions will be appreciated. If any additional species are in common use for lawns, please send in full information about them and the reasons for using them.

PROPERTIES OF GRASSES

X - First or most common use o - Second choice or second degree -- Will fail, or negative

CHARACTERISTICS		BENT: Redtop	BENT: Colonial	BENT: Creeping	BENT: Velvet	BENT: German	BLUEGRASS: Bermuda	BLUEGRASS: Kentucky	BLUEGRASS: Canada	BLUEGRASS: Rough	BLUEGRASS: Wood	Bluestem	Bromegrass	Carpet Grass	Centipede Grass	Clover, Sweet	FESCUE: Red	FESCUE: Fine Leaved	FESCUE: Sheep	FESCUE: Meadow	RYE: Millett, Foxtail	RYE: Orchard Grass	RYE: Prairie Beardgrass	RYE: Rhodes Grass	RYE: Italian	RYE: Perennial	Tall Meadow Oatgrass	Timothy
TERM OF LIFE	Annual															X				X			o	X				
	Perennial	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X
KIND OF SOIL	Acid	X	X	X	X	X	X	o	o	o	o			X			X	X	X		o						o	
	Alkaline		-					X	X	X	X	X		X	X	X	o	X	o	o	X	X	X	X	X	X	X	X
	Heavy		X		X	X	X	X	X	X	X	X				X				o	X	X		X	X			X
	Light	X					X	o	X	X	X			X		o		X		X		X	X	o	o	o	o
	Sandy	o		X			o		o	o	o			X	X		X	o	X	o	X		o				X	
	Rich	X	X	X	X	X	X	X	X	X	X	X		X	X	X	o		o		X	X	X	X	X	X		X
	Poor			o					X						X		X	X	X	X	o	X	o					o
TEMPERATURE	Hot						X	-						X	X								X	-	-	-		
	Warm	o	o	o	o			o	X	X	X	o		X		o					X		X	o	o	o	X	
	Cool	X	X	X	X	X	-	X	X	X	X	X				X	X	X	X			X			X	X	X	o
	Shade							X		X	X					X	y										-	
WETNESS	Dry	-		-							X					o				^		X					X	
	Moist	o	X		o	X	X	X	X	X		X		X	X	X	X	X	X			X			X	X	o	X
	Wet	X		X	X		o							X		X			X				-	X				
	Salt		X	X												o												
PROPAGATES BY: -	Seed	X	X	X	X	X		X	X		X			X		X	X	X	X	X	X		X	X	X	X	X	o
	Stolons		X	o	o		X																					
	Creepers	X					X			X					X								X					
	Rootstocks						X	X	X	X				X									o					
	Bulbs											X																
PECULIAR QUALITIES	Soil Binding						X		X			X			X					o								X
	Legume															X								X	X			
	Bunchy																X	X		X	X							X
QUALITY OF TURF	Loose	X																	o	X	X						X	X
	Open			X					X		X						X		X		o						X	
	Dense		X			X	X	X		X		X		X	X	X								X	X			
	Deep Rooted	X	X	X			X					X		X	X	o						X					o	X
	Shallow Rooted	o	o	o				X	X							X	X	X	X	X				X	X	X		
See map, page 42	1	X	X	X	X	X		X	X	X	X	X			X	X	X	X	X	o	X	X		X	X	X	X	X
	1 a	X	X	X		o																					X	
	2			o			X		X					X	X					X	o	X					o	
	3						X							X	o								X				-	
SEED	No. per lb. - Hundred Thousands	80	80	80	80	80		22	25					13.5		6	6	6	6	2	6		17	2.2	3.3	1.5	12	
	Pounds per Bushel	14-30	40	14-45	14-45	14-45		14	14-24					18-36		10-15	10-15	10-15	10-15	50	14		8 12	24	24	10-16	45	

GRASS FAMILIES

BENTS

The bents prefer acid soil. They are slow in starting in the spring, do not mature until fall, and retain their color very late. They make the finest textured turf. Propagate from stolons. Pure seed cannot be obtained for some species. Seeds are the smallest of all lawn grasses, 8,000,000 to the pound, varying from 14 to 45 lbs. to the bushel.

COLONIAL BENT (Agrostis tenuis) Rhode Island B, New Zealand B, Prince Edward Island Rhode Island B, Rhode Island Colonial B, Astoria B, Oregon Colonial B, Brown Top, Redtop, Fine Top, Burden Grass. Perennial. Acid soil, moist, heavy well-drained loam preferred. Makes fine textured lawn. Resists drought. Injured rather than improved by lime. One of the best varieties for northern lawns. Preferred for golf courses in north. Seeds 40 lbs., to bushel. May be planted by stolons, which can be scattered and covered with soil. Range, northern States south to Virginia and Missouri. Indigenous to Rocky Mountains.

CREEPING BENT (A palustris) Coos Bay B, Cocoos B, Metropolitan B, Washington B, Carpet B, Oregon B, Oregon Grass, Fiorin Grass. Perennial. Many strains of this species. Grows wild in the marches of both Atlantic and Pacific Coasts. Most important is Seaside B (A. maritima). Withstands salt spray and occasional high tides. No value for inland use. Used extensively for putting greens. Range, British Columbia to northern California, and South to Texas and New Mexico along ditches.

GERMAN BENT (A. stoloniferous varieties) Mixed B, South German Creeping B. Perennial. Typical mixture contains 40%-60% of Colonial, 10%-30% Velvet, 10%-30% of Redtop, and 15%-30% of true creeping bent. Makes an excellent turf in which the varieties show up in patches of varying shades in pleasing patterns.

REDTOP (A. alba) White B, White Top, Fiorin, Herd's Grass. Perennial. Creeping habit. Makes coarse, loose turf. Does best on moist soil, too wet for other grasses. Soil may be sour. Weather may be humid. No other grass will grow in as great a variety of conditions. The best wet-land grass we have. Vigorous grower. Strongly drought resistant. Must be mowed closely to produce a dense turf. Recommended as a nurse crop only, and should never be sown alone. Chaffy seed 14 lbs. and recleaned seed 30 lbs. to bushel. Range, cooler parts of the United States.

VELVET BENT (A. canina) Dog's B. Perennial. Ideal for golf greens, meadows and open ground. Usually contained in German Bent seed. Dark green foliage with velvety texture. Range, New Foundland to Quebec, south to Delaware and Michigan.

BERMUDA (Cynodon dactylon) Wire Grass, Bahama Grass, Dog's Tooth Grass. Perennial. Spreads by runners. May be planted with seed or stolons. Likes hot sun. Resists drought. Soil binder. Dense sod. Stands abuse. Superior to any other grass in South for lawns, golf course, highway shoulders and pasture. Prefers acid soil. Best growth on clay and silt, but does well on sandy soils. Dies out in winter, so Italian Rye is commonly sown in the fall to make a winter lawn, the rye in turn killing out under summer heat. Common strains are Atlantic, considered the best, and Common, St. Lucie, Giant, Florida Giant, Brazil Giant. Survives after submergence at Roosevelt Dam, Arizona. Range is from the Gulf north to Maryland, Kansas, and warm valleys in the Northwest.

GRASS FAMILIES

BLUEGRASS

BLUEGRASS. Bluegrass is almost another name for grass in most of the United States, and is often planted in regions where it has little chance to thrive, because its qualities are so desirable. Contrary to the popular notion it is not native in the United States, but in the Old World. It was brought in, some say, by colonists, in mixed grass seed, but more likely, like some other plants, in the horse feed of the British Army during Colonial and Revolutionary times.

Four varieties are described here, two of which are more commonly known by local names, Rough Stalked Meadow Grass, and Wood Meadow Grass. All four are worthy of consideration for their varied and good qualities.

CANADA BLUEGRASS (Poa Compressa). Perennial. Makes tough, but not dense turf. Sometimes succeeds where the Kentucky variety fails in poor soil. Has a poor habit of growth which does not recommend it for lawns. About the same soil as Kentucky, leaning more to alkaline. Often mixed with Kentucky by seedsmen because it keeps its color better. Soil binder on poor clay, silt, and gravel knolls. Will crowd out Kentucky in good soils. Spreads by rootstocks. Should be mixed with Red Fescue to make a good turf. Must be closely mowed. Range, Georgia and New Mexico north. Seeds 2,500,000 to the pound, 14 to 34 lbs. to bushel.

KENTUCKY BLUEGRASS (Poa Pratensis). Perennial. Most noted grass in North America. Dominant in Kentucky and adjoining States. Requires 2 or 3 years to make a good turf. Alfalfa or other nurse grasses may be planted with it. Fares best on rich soils, preferably alkaline. Shaded and northern slopes. Seriously affected by heat. Spreads by rootstocks. Will crowd out other grasses. Seed low in vitality. Fall sowing recommended. Range, northern States, except arid and alpine regions. Seeds 2,200,000 to the pound, 14 lbs. to bushel.

ROUGH BLUEGRASS (Poa trivialis). Rough Stalked Meadow Grass, Bird Grass. Perennial. Creeping. Resembles Creeping Bent. Damp and shady locations. Makes good turf. Injured by heat but seldom killed. Responds particularly well to fertilization with nitrate of soda. Range, northern States down to Virginia and northern California.

WOOD BLUEGRASS (Poa nemoralis). Wood Meadow Grass. Perennial. Flat, low-growing, non-creeping. Dark color, medium texture. Some experts say it will not live in America, but it does, nevertheless. Dry, shady locations. Should not be used alone.

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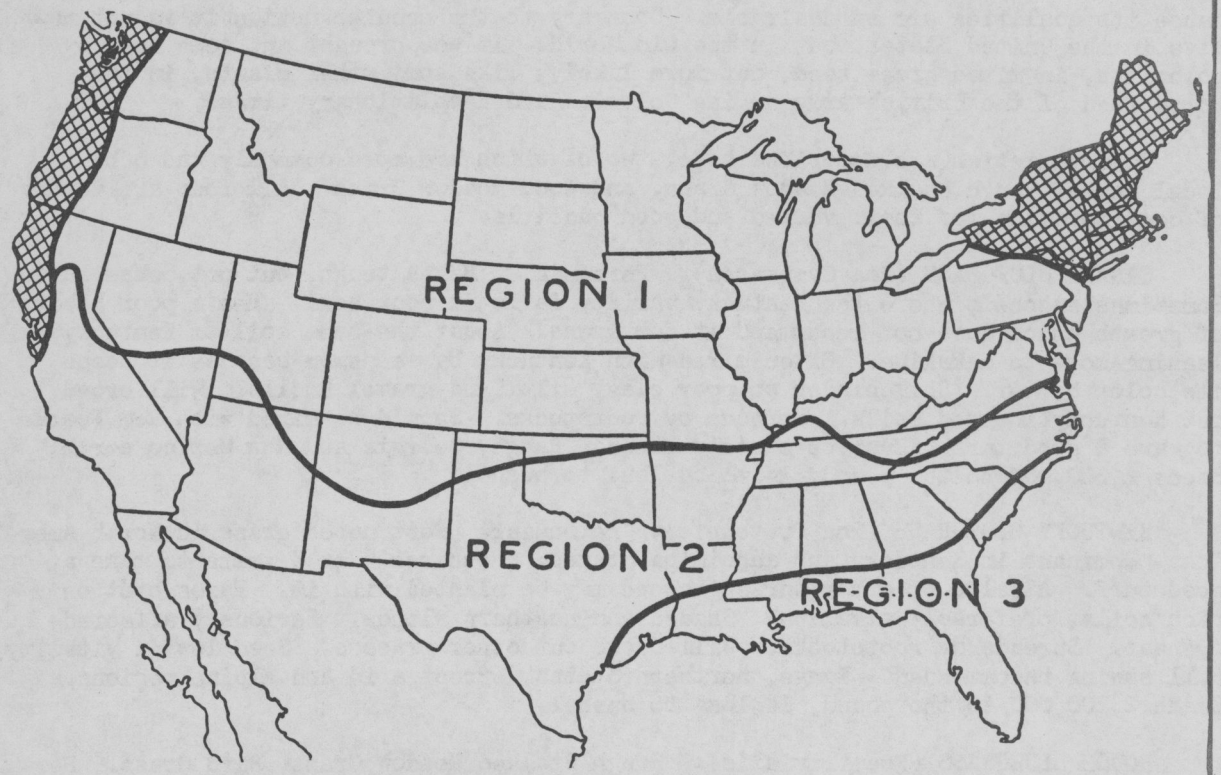
BLUESTEM (Agrophron smithii). Western Wheat Grass, Colorado Bluestem. Perennial. Moist soil, preferably alkaline, and deep. Is bunchy on thin soils and hillsides. Spreads by rootstocks. Makes a dense sod with large body of small surface roots. Soil binder. Range, northern States and south to Texas and California.

BROME GRASS (Brome inermis). Smooth B, Hungarian B, Russian B. Awnless B. Perennial. Spreads with rootstocks. Makes dense sod. Stands severe abuse. Soil binder, and commonly used to stop erosion. Resists drought, but not excessive heat. Range, Minnesota and Kansas to Washington and Oregon, introduced eastward in Ohio and Michigan.



Range of Grasses.

Reproduction from Farmers' Bulletin No. 1677, Planting and Care of Lawns, U. S. Department of Agriculture. While this is the basis for the range given in the table entitled, "Properties of Grasses," it should be noted that favorite grasses are rapidly carried beyond fixed bounds by careful cultivation and adaptation. The bents are an example, for they are now used over broad areas where they were not even known a few years ago. Reference to this map from the table should be checked in the descriptions of the particular grasses under construction.

CARPET GRASS (Axonopus compressus). Louisiana Grass, Petit Gazon. Perennial. Spreads by rootstocks. Rich loam, sandy soil, preferably neutral. Moist, hot conditions. Easily started. Makes dense, close turf. Low growing. Grows throughout the year. Will not mix with Bermuda, but Lespedeza seems to do well with it. Seeds 1,350,000 to the pound, 18 to 36 lbs. to bushel. Range, in Coastal Plain soils from Virginia to Texas, and inland in Arkansas and Alabama.

CENTIPEDE GRASS (Eremochloa orhiuroides). Perennial. Spreads by runners. Loose, sandy soil, alkaline. Very aggressive, crowding out weeds, legumes, and even other grasses. Makes a close turf. Recommended for lawns in the South by experiment stations. Range probably the same as cotton.

GRASS FAMILIES

FESCUES

The fescues are not particular as to their soil reaction, except that Red Fescue seems to do better in acid soil than in alkaline. All have fine leaves, very low-growing and bunchy. They thrive on poor, sandy soils. Red fescue alone is a basic grass. All other species are for special locations and uses, and none are really desirable for lawns. Seeds large, 600,000 to the pound, 10 to 15 lbs. to bushel. Seeds low in vitality, and only new-crop seed should be sown.

FINE LEAVED FESCUE (Festuca capillata). Hair F. Perennial. Fine, short leaves less wiry than any other fescue. Probably the best grass for dense shade that we have. Tufts not more than 2" in diameter. Beautiful dark green turf. Blends well with Rough Bluegrass (poa trivialis).

MEADOW FESCUE (F. elatior). English bluegrass, Randall grass, Tall fescue. Perennial. Bright green. Coarse leaved. Wet soil. Makes a rank growth. Close mowing makes it coarse and open in texture, not a continuous, well-filled turf. Generally appears as a filler in seed mixtures. Will not spread by rootstocks. Is not bunchy. Tall fescue (F. pratensis) and Meadow fescue (F. elatior) are merely tall and medium varieties of the same species. Range, cooler parts of the United States into Canada.

RED FESCUE (F. rubra). Chewing's F, European Red F, New Zealand Red F, Various Leaved F, Shade F. Perennial. Said to be the only fescue adapted to lawns. Spreads quickly, one plant often becoming 6 feet in diameter. Wiry, and difficult to mow. Does well under trees. Resists drought. Propagated by seeding. Excellent for sandy or gravelly soil. Range, meadows, bogs, marshes in cooler parts of northern hemisphere, and in coastal marshes south to Georgia. Two strains are important, True European Red (var. genuina) and Chewing's (var. fallax). Chewing's does not grow in bunches.

Various Leaved Fescue (F. heterophylla). Shade fescue. A variation of Red Fescue, for shady places in rich soil. Bunchy.

SHEEP FESCUE (F. ovina). Perennial. Spreads by seeding. Grows in stools or tussocks 4" to 8" in diameter. Not good for lawns. Excellent for fairways. Can be grown in about the same range as bluegrass, north to limits of agriculture. Thrives in poor sandy or gravelly soil. Tough. Stands abuse. Should not be used alone because of bunchy growth. Hard Fescue (F. duriuscula), a variation of Sheep Fescue. Tussocks larger and higher. For use only in most difficult locations.

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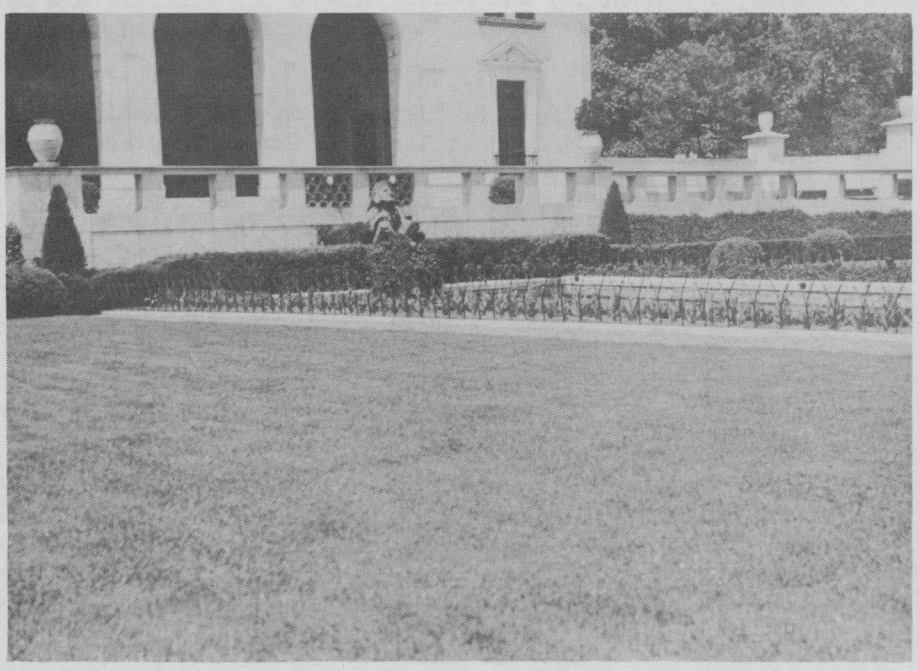
Black Marble Fountain. Federal Reserve Building.
Washington, D. C.



Garden. Pan American Union Grounds.
Washington, D. C.

FOXTAIL MILLET (Setaria italica). German M, Italian M, Common Hungarian M, Golden Hungarian M, Siberian M, and Kursk M. Annual. Short-lived. Grows best in dry regions. Used as a summer catch-crop. Its value in lawns is as a summer nurse grass. Smaller forms are known as Hungarian Grass. One of the oldest grasses. Seed has been found in early remains such as those of the Swiss Lake Dwellings of the stone age. Still cultivated as a cereal for food, which is in wide use. Seeds 200,000 to the pound, 50 lbs. to bushel. Range, over warmer parts of the country, especially from Nebraska to Texas.

ORCHARD GRASS (Dactylis glomerata). Cocksfoot. Perennial. Generally considered unfit for lawns, but its ability to grow in the shade warrants some mention. Bunchy habit of growing. Must be kept mowed closely or will become woody. Thrives on a variety of soils. Seeds 600,000 to the pound, 14 lbs. to bushel. Range, northern States south to Florida and California.

PRAIRIE BEARDGRASS (Andropogon Scoparius). Little Bluestem. Perennial. Bunch grass. Easily started. Resists drought. Good for dry places. Range, northern States and south to Florida and Arizona.

RHODES GRASS (Chloris gayana). Perennial. An annual in the north. Spreads by running branches having a tuft at each joint or node. Little known of its qualities for lawn use, but said to be worthy of experimentation. A good grass for irrigated areas. Is completely destroyed by temperatures as low as 18 degrees, therefore limited in range to a strip along the Gulf Coast, Texas, and southern California. Seeds 1,700,000 to pound, 8 to 12 lbs. to bushel.

GRASS FAMILIES

RYE

ITALIAN RYE (Lolium multiflorum). Really only a variety of Perennial rye. Australian R, Argentine R, Westerwold R, Domestic ryegrass. Annual. Legume. Soil builder. Quick germinating. Fast growing. Planted by seeding. Cool conditions. Makes beautiful lawn for the winter in the South, and common practice is to sow it in Bermuda lawns for the winter season. It dies out when warm weather comes, leaving the lawn to Bermuda. Must be sown in the spring in the far northern States. Used as a nurse grass in northern States. Domestic is a mixture of Italian and Perennial grown in the United States. Seeds 220,000 to the pound, 24 lbs. to bushel. Range, Newfoundland to Alaska and south to Virginia and California.

PERENNIAL RYE (Lolium perenne). Pacey's R, English R, Australian R, Domestic R, Darnel and Randall grass. Distinguished from Italian, which is really only a variety of Perennial, by the absence of the awn. Perennial. Tufted. Qualities same as given for Italian. Domestic is a mixture of Italian and Perennial grown in the United States. Pacey's is a trade name for small seeds which have been screened out from the larger ones. Darnel is an ancient name which is now used for many grasses, the original supposed to have been the tares of the parable in the New Testament. Randall is another name applied to several grasses. Seeds 330,000 to the pound, 24 lbs. to bushel. Range, same as given for Italian.

SWEET CLOVER (Trifolium repens). White, bi-annual; Yellow, annual; White Dutch; Ladino. Legume. Seed low in price. Wider adaptation than other legumes. Easy to get a good stand on most soils. Used as a nurse crop. Low growing, with white blossoms on short stems. Volunteers in alkaline soils. Remains green in dry weather. Disappears from lawns at times without apparent reason, leaving bare spots. Some say that clovers are not lawn grasses but weeds, and some seedsmen have quit includ-

ing them in lawn mixtures, supplying them separately to those who want them. They are still included in most lawn mixtures.

TALL MEADOW OATGRASS (Arrhenatherum elatius). Tall Oatgrass, Meadow Oatgrass, Evergreen Grass. Perennial. Thrives on well-drained soil, especially light-sandy or gravelly land. Will not grow in shade. Mixes well with clovers and orchard grass. Seed is low in vitality, and only new-crop seed should be sown. Seeds 150,000 to pound, 10 to 15 lbs. to bushel. Range, over entire United States except hot belt.

TIMOTHY (Phleum pratense). Perennial. Herd's Grass. Many strains. Leading hay grass. Too coarse for a lawn, but may be sown with grass for some purposes, such as a nurse crop, or soil binding. Seeds 1,200,000 to the pound, 45 lbs. to the bushel. Range, northern States south to northern limit of cotton.

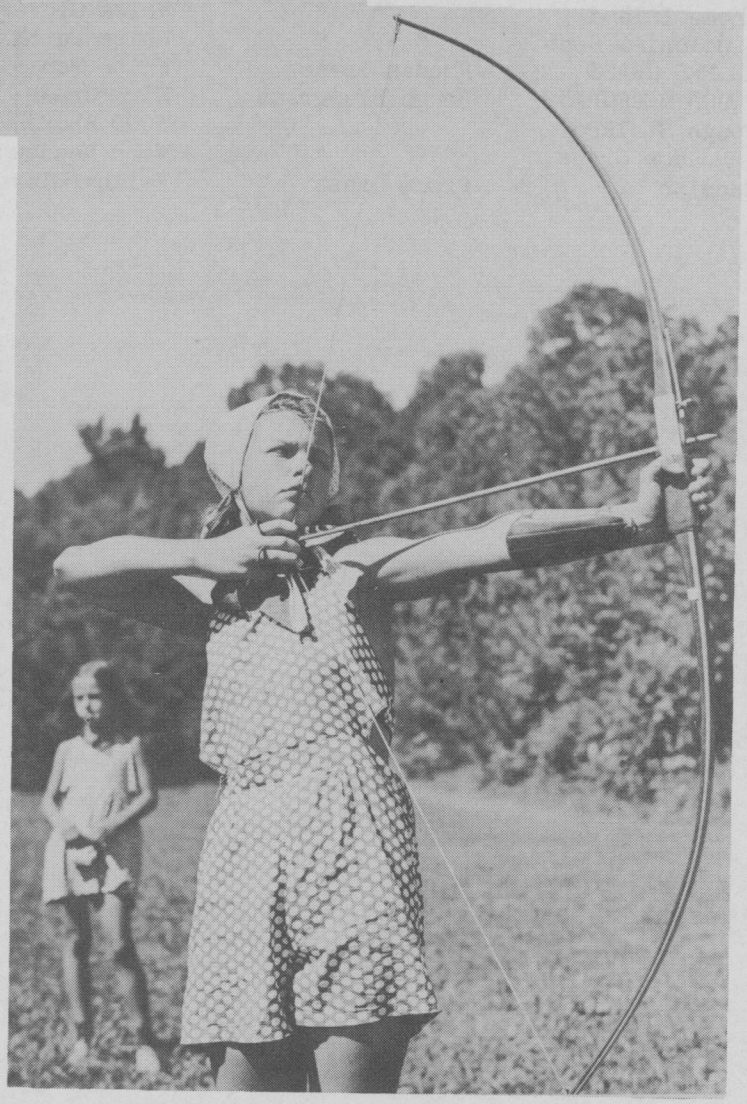
REFERENCE LIST OF GRASSES

Species are described in this chapter under their most commonly accepted, or most accurate names. In the first column of this table, which is in alphabetical order, these names are in capitals, thus; TALL MEADOW OATGRASS. Other names, which are current in various localities, are listed in capitals and small letters, thus: Herd's Grass.

Common Name	See	Common Name	See
Argentine Rye	Italian Rye	Domestic Ryegrass	Italian Rye
Astoria Bent	Colonial Bent	English Bluegrass	Meadow Fescue
Atlantic	Bermuda	English Rye	Perennial Rye
Australian Rye	Italian Rye	European Red Fescue	Red Fescue
Australian Rye	Perennial Rye	Evergreen Grass	Tall Meadow Oatgrass
Awnless	Brome Grass	FINE LEAVED FESCUE	Fine Leaved Fescue
Bahama Grass	Bermuda	Fine Top Bent	Colonial Bent
BERMUDA	"	Fiorin	Redtop Bent
Bird Grass	Rough Bluegrass	Fiorin Grass	Creeping Bent
BLUESTEM	Bluestem	Florida Giant	Bermuda
Brazil Giant	Bermuda	FOXTAIL MILLETT	Foxtail Millett
BROME GRASS	Brome Grass	GERMAN BENT	German Bent
Brown Top Bent	Colonial Bent	German Millett	Foxtail Millett
Burden Grass Bent	" "	Giant	Bermuda
CANADA BLUEGRASS	Canada Bluegrass	Golden Hungarian Millett	Foxtail Millett
Carpet Bent	Creeping Bent	Hair Fescue	Fine Leaved Fescue
CARPET GRASS	Carpet Grass	Hard Fescue	Sheep Fescue
CENTIPEDE GRASS	Centipede Grass	Herd's Fescue	Redtop Bent
Chewing's Fescue	Red Fescue	Hungarian	Brome Grass
Cocksfoot	Orchard Grass	Italian Millett	Foxtail Millett
Cocoos Bent	Creeping Bent	ITALIAN RYE	Italian Rye
COLONIAL BENT	Colonial Bent	KENTUCKY BLUEGRASS	Kentucky Bluegrass
Colorado Bluestem	Bluestem	Kursk Millett	Foxtail Millett
Common	Bermuda	Ladino Clover	Sweet Clover
Common Hungarian Millett	Foxtail Millett	Little Bluestem	Prairie Beardgrass
Coos Bay Bent	Creeping Bent	Louisiana Grass	Carpet Grass
CREEPING BENT	" "	MEADOW FESCUE	Meadow Fescue
Darnel Rye	Perennial Rye	Meadow Oatgrass	Tall Meadow Oatgrass
Dog's Bent	Velvet Bent	Metropolitan Bent	Creeping Bent
Dog's Tooth Grass	Bermuda	Mixed Bent	German Bent
Domestic Rye	Perennial Rye		

Common Name	See	Common Name	See
New Zealand Bent	Colonial Bent	Seaside Bent	Creeping Bent
New Zealand Red Fescue	Red Fescue	Shade Fescue	Red Fescue
Orchard Grass	Foxtail Millett	SHEEP FESCUE	Sheep Fescue
Oregon Bent	Creeping Bent	Siberian Millett	Foxtail Millett
Oregon Colonial Bent	Colonial Bent	Smooth	Brome Grass
Oregon Grass	Creeping Bent	South German Creeping Bent	German Bent
Pacey's Rye	Perennial Rye	St. Lucie	Bermuda
PERENNIAL RYE	" "	SWEET CLOVER	Sweet Clover
Petit Gazon	Carpet Grass	Tall Fescue	Meadow Fescue
PRAIRIE BEARDGRASS	Prairie Beardgrass	TALL MEADOW OATGRASS	Tall Meadow Oatgrass
Prince Edward Rhode Island Bent	Colonial Bent	Tall Oatgrass	" " "
Randall Grass	Perennial Rye	Various Leaved Fescue	Red Fescue
RED FESCUE	Red Fescue	VELVET BENT	Velvet Bent
REDTOP BENT	Colonial Bent	Washington Bent	Creeping Bent
Rhode Island Bent	" "	Western Wheat Grass	Bluestem
Rhode Island Colonial Bent	" "	Westerwold Rye	Italian Rye
RHODES GRASS	Rhodes Grass	White Bent	Redtop Bent
ROUGH BLUEGRASS	Rough Bluegrass	White Clover	Sweet Clover
Rough Stalked Meadow Grass	" "	White Dutch Clover	" "
Russian	Brome Grass	White Top	Redtop Bent
		Wire Grass	Bermuda
		WOOD BLUEGRASS	Wood Bluegrass
		Wood Meadow Grass	Wood Bluegrass
		Yellow Clover	Sweet Clover

"To All Intents and Purposes"
He's Going to Wallop that Ball



No Less Determined is this Lass
With Her Wee Bow and Arrow

CHAPTER VI

FERTILIZERS AND HUMUS

There should be no mystery about fertilizers and humus. If they can be discussed openly, without claiming to produce rabbits from opera hats, they are not difficult to handle. The old notion that fertilizers are magic is pretty well worn out.

Plants grow in soil. But recent developments show that they will also grow in excelsior or moss, and even in water, provided the essential food elements are introduced into these otherwise sterile materials. Then soil is only a carrier for food elements. Someone may ask, "Isn't soil this brown stuff that we plow up?" Yes, it is, and it is a prepared product just like an excelsior or moss seed bed. Soil is not an original or elemental material at all. It is manufactured by nature.

The basic part of soil is earth; --- rock dust. It is utterly sterile, and could not grow anything. It is red, gray, whitish, brown, and even black, depending upon the color of the rock from which it has been reduced by the slow and relentless forces of erosion. Retaining the nature of these rocks, it may be tough clay or loose sand. In order to understand the functions of fertilizers and humus it must be clear that this earth is lifeless and inert.

Along with this it must be understood that basic earth contains some chemical elements which will not support plant life, but which will act upon other materials to modify their structure and their action. Thus lime, present in this ground-up rock, is not a fertilizer in itself, but exerts definite influence upon some other materials which combine with the earth to make soil. It neutralizes an acid soil. In the form of quick-lime it acts to release plant food from insoluable compounds which would not be broken down otherwise, and quick-lime re-forms the structure of clay soils so that they become porous for aeration and draining.

Vegetation grows in the rotting remains of vegetation. Remains of animal life stimulate this rotting and the formation of plant food compounds. This is a never-ending process. Some vegetation dies where it stands and adds to the thickening bed of decaying leaves and stalks. Some of it is eaten by animals and birds, and is returned in concentrated animal wastes which have picked up highly valuable elements in the digestive processes. Wild creatures die in their haunts and are reduced to their elements by decay. When animals are killed for food commercially, waste parts and scrap are reduced to concentrated fertilizers in processes which imitate nature.

This rotting animal and vegetable matter becomes mixed with dust and eroded earth and over long periods becomes a bed of soil, the compounded product. It takes from 600 to 1,000 years to form one inch of soil. No fertilizer is such

potent magic that it will make soil. In fact, unless there is a body of decayed vegetable matter in the earth, it is unlikely that the fertilizer will add any permanent or enduring value. The only gain is in the increased growth of the plant, and this is a gain in soil only if the plant is plowed under to form humus.

Commercial fertilizers are properly used for two purposes: (1) to supply needed plant food, and (2) to activate unused plant food in the soil. We think of commercial fertilizers too loosely, and expect the impossible from them. They are not magic. Too often we grade a site down to the original rock dust packed below the top soil, scatter a few pounds of some evil-smelling stuff out of a bag, plant grass seed, and expect to exclaim in the morning: "Great jumpin' cats, where's that scythe!"

The following discussion of commercial fertilizers is contributed by Mr. Robert H. Engle, Assistant Agronomist of The National Fertilizer Association, in Washington, D. C., who has been studying the fertilizer needs of turf, particularly of special turfs for golf courses, for many years.

COMMERCIAL FERTILIZERS

There is no general recommendation for the use of commercial fertilizers that will satisfy all soil and climatic conditions, or all varieties of grasses and legumes growing in turf. In earlier turf culture liberal applications of manure supplied the fertility but at the present time manure is difficult to obtain and in addition, if it is used, weed seeds may be introduced into the ground. For this reason commercial fertilizers are being used to a large extent to enrich turf soils.

The growing plant needs some 14 different elements to make normal growth. These are oxygen, nitrogen, hydrogen, carbon, potassium, calcium, phosphorus, magnesium, sulphur, iron, boron, manganese, copper, and zinc. Of these the oxygen and carbon are obtained from the air and hydrogen from water. All of the others are obtained from the soil and are taken into the plant through the roots. Most of the elements that plants get from the earth are found in sufficiently large quantities in most soils so that we do not need to add them. Nitrogen, phosphorus, and potassium are the three elements most frequently lacking, and it is these three that are usually meant when we speak of fertilizers.

To get a clear understanding of fertilizers we will consider each element contained in fertilizers and its function in plant growth, also a few of the minor elements necessary to plant growth.

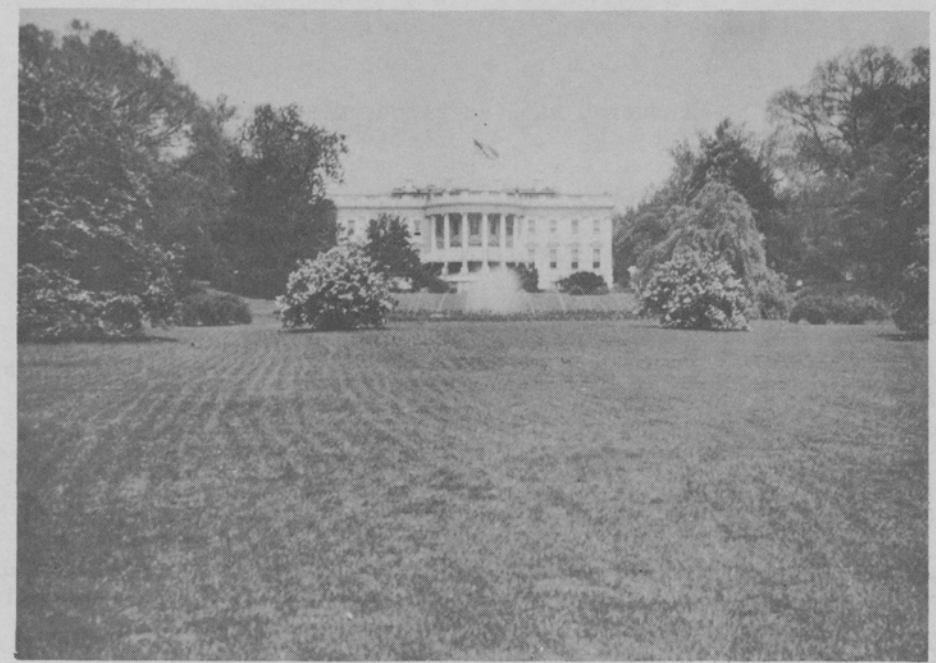
Plant Food Elements

Plant food elements necessary for plant growth may be divided into three groups - (1) nitrogen, phosphorus, and potassium, the essential or primary group, (2) calcium, magnesium, and sulphur, the secondary group, and (3) boron, iron, manganese, copper, and zinc, the minor group.

Each element has an abbreviation or symbol - Group 1, essential element, nitrogen (N), phosphorus (P) or phosphoric acid (P_2O_5), potassium (K) or potash (K_2O); Group 2, calcium (Ca.), magnesium (Mg.), sulphur (S); Group 3, boron (B), manganese (Mn.), copper (Cu), iron (Fe), and zinc (Zn).

Nitrogen

The nitrogen-carrying materials may be grouped under two general heads: organic and inorganic.



White House Lawn. Washington, D. C.

One of the largest areas of carefully maintained turf.

National Academy of Sciences Lawn.
Washington, D. C.

Gravel walks in a well kept lawn.

I. Organic

1. Slaughterhouse by-products, such as blood, meat scrap, tankage, bone meal, etc.

2. Fish scrap and dried ground fish.

3. Garbage tankage, sewage sludge, etc.

4. Vegetable meals and waste, cottonseed meal, and castor pomace.

These organic nitrogen materials are good conditioners, are not quickly lost through leaching, and rarely have a "burning" effect on the crop; on the other hand, they are more expensive, pound for pound of nitrogen, than the inorganic materials.

5. Synthetic organics, urea, calcium cyanamid.

These materials, unlike the natural organics, are readily available and not as expensive, pound for pound of nitrogen. When applied to turf they should be washed into the soil, if the element nitrogen is applied in excess of three pounds per 1,000 square feet, to prevent burning.

II. Inorganic

6. Chilean and synthetic nitrate of soda.

7. By-product and synthetic sulphate of ammonia.

8. Calcium nitrate.

9. Potassium nitrate.

10. Ammo-Phos and ammonium phosphate.

These inorganic materials have the advantage of being quickly available and are cheaper than the first group of organic materials. If the element nitrogen in the fertilizer is applied in excess of three pounds per 1,000 square feet, it should be washed into the soil to prevent burning.

The general function of nitrogen in plant growth, is to produce vigorous, succulent growth, dark green color, and broad leaves. Young plants need nitrogen for best development. It stimulates early growth of forage grasses, particularly noticeable in backward or late springs. An excess of nitrogen may tend to make some plants more subject to certain diseases and cause plants to receive greater injury during dry or adverse weather, while lack of nitrogen will cause a stunted growth and greenish-yellow foliage. Nitrogen is usually a most important element in lawn and turf culture but must be used with good judgment.

Phosphorus

The most important phosphatic fertilizer is superphosphate. Several grades are on the market, as 16 per cent, 20 per cent, 32 per cent, and 40-48 per cent. Other forms are steamed and raw bone meal, mono- and di-ammonium phosphates, and finely ground phosphate rock. Ground fish and tankage also supplies a small amount of phosphorus.

Available phosphorus does not leach from the soil but becomes fixed and is retained in a less soluble form.

Phosphoric acid in the form of superphosphate and ammonium phosphate is readily available; in the form of ground phosphate rock and bone it is slowly available.

Phosphorus stimulates early root growth, tillering and leaf development, thereby causing the early development and maturity of the plant.

The majority of soils are low in phosphorus and must be supplied with it.

Potash (Potassium)

Among the more common potash materials are muriate and sulphate of potash, manure salts, and kainit.

Potash salts are readily available and do not leach from the soil to any extent.

Potash develops the sugars and starches in fruits and seeds, and increases the disease resistance of plants.

Potash applied to growing turf will burn the leaves.

The supply of potash in the soil varies. Light soils are usually low in potash, while heavy soils may contain a large total supply, although applications of potash frequently show good response.

Calcium and Magnesium

Calcium and magnesium are carried in liming materials. The percentage of each element contained varies widely. Liming materials are applied primarily to correct soil acidity and are not usually considered as fertilizer. Applications of liming materials to correct acidity, usually supply enough of the elements Ca. and Mg. for plant food purposes.

The Minor Plant Food Elements

The minor plant-food elements are not of general importance in growing grasses in lawns and golf courses. Only in special cases are they used to advantage.

Fertilizers for Turf

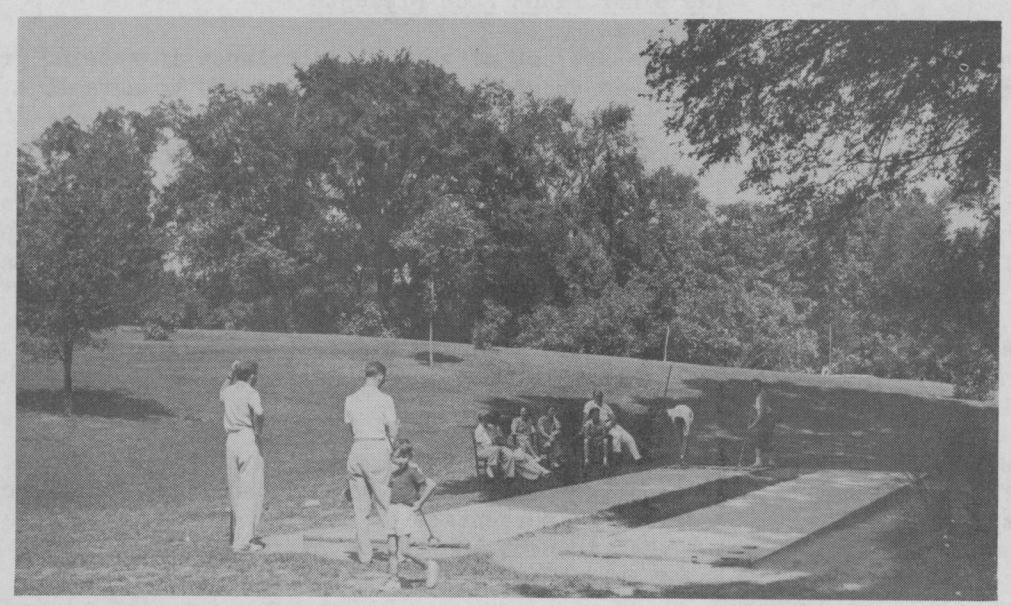
Nearly all lawn soils need complete fertilizers which should be incorporated with the soil before seeding. Fertilizers for lawns should contain a large proportion of nitrogen, because it stimulates leaf growth, and enough phosphorus and potash to promote adequate root growth, health, and vigor.

There are, however, cases when a single food element may be used to good advantage on turf. These single element treatments are usually applied to turf that is established to correct a deficiency.

The fertilizer grade or analysis is written as a series of three numbers. The first figure indicates the percentage of nitrogen, the second figure the percentage of phosphoric acid, and the third the percentage of potash. For example, the grade 10-6-4 when interpreted means that in each 100 pounds of fertilizer there is 10 pounds of nitrogen, 6 pounds of phosphoric acid, and 4 pounds of potash.

Above: Few games need as little equipment as horse shoes, but dirt boxes would save wear on the turf. Virginia Kendall State Park, Akron, Ohio.

Below: Concrete shuffle boards in Pokagon State Park, Indiana.



Lawn fertilizers should usually have a descending analysis, as the example given in the preceding paragraph, for spring application. For fall application, the amount of nitrogen is frequently reduced and the phosphoric acid increased, for example, 4-12-4. The analysis will of course vary to meet local conditions.

The amount of fertilizer to apply also depends on local conditions. It is better to make two or three applications rather than one heavy application. Each application may vary from 10 to 30 pounds per 1,000 square feet of turf. Golf greens and constantly used turf are fertilized more frequently. As a rule, not more than one pound of nitrogen to 1,000 square feet of turf should be applied at one time. Thus a 10-6-4 mixture should be applied at the rate of ten pounds to 1,000 square feet, and 8-6-2 at twelve and one-half pounds, and a 4-12-4 at twenty-five pounds.

Ammonia and urea tend to make the soil acid, while nitrates have a tendency to make the soil alkaline.

If the soil is too acid, apply nitrate nitrogen; if it is too near alkalinity, apply ammonia nitrogen.

Turf Fertilizer Facts

Different turf plants respond to varied treatments. Bent grasses prefer a slightly acid to moderately acid soil and usually respond best to fertilizer having an acid reaction on the soil. Blue grasses prefer a slightly acid to neutral soil and usually respond best to fertilizers having an alkaline reaction on the soil. Fescues must be fertilized more carefully and not overfed providing a clear stand of this grass is desired. They usually do best on a moderately acid soil.

Continued use of acid or alkaline reacting fertilizer is inadvisable. Fertilizers applied on soils that are strongly acid are not as efficient nor will turf grow as well at this degree of acidity; likewise alkaline soils do not sustain the best turf.

Neutral fertilizer mixtures contain a sufficient amount of basic material, such as dolomitic limestone, to neutralize the residual acidity caused by certain nitrogen compounds. Acid-forming fertilizer mixtures do not contain sufficient basic material to neutralize the residual acidity.

Lawn and golf course turf is clipped frequently. This is an abnormal condition for the plant, causing it to change its habit of growth. In addition, the clipped leaves contain food taken from the soil and will return a large portion to the soil if they are not removed from the lawn. To sustain a continuous growth of turf grasses, a constant supply of available plant food must be maintained in the soil.

As a rule grass grows vigorously in the spring and fall and slower during the summer.

The ideal fertilizer practice on lawns calls for three applications - the first in spring before growth starts, the second after growth is well started, and a third in early fall.

Golf greens are frequently fertilized every month of the growing season. This practice requires keen observation of turf development and experience. Many lawns

have been ruined by keeping a vigorous succulent growth of vegetation far into the summer. Grass of this kind is easily injured by hot, dry weather conditions. During the summer months the plants are more or less dormant. Fall applications of fertilizers prepare the turf for winter, and results in an early and vigorous growth the following spring. New lawns started in the fall should receive about half the normal fertilizer application the following fall.

Constant careful observation of turf conditions is necessary for the judicious use of fertilizer.

Weed control becomes a secondary matter when turf is well fertilized because the desirable grasses take complete possession of the ground, choking out weeds.

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MANURES

While we know now that plants can be grown in other mediums than soil, and that humus is not needed in these processes, --- which operate by feeding plant food in solution, we will still make our lawns and gardens in the old way, with humus as a prime necessity.

Humus is the carrier for plant food. It is any decaying vegetable matter, preferably with some animal waste added to speed up the process and to make the product richer in food value. The most important service of manures is to add humus, and the advocates of manuring insist that proper rotation of crops, coupled with systematic manuring to add humus, is all that any good land needs. They have less faith in the need for commercial fertilizers than others.

We can hardly emphasize too strongly that an abundance of humus should be worked into every lawn site. On cropped fields it is possible to add more humus each season to make up what is taken off in the crops. Green crops, stubble, and manure are plowed down, and put back all the plant food which has been taken off.

In the lawn, however, valuable plant food is taken off with every mowing, yet replacement is impossible. It is clear, then, that an excess of humus making material should be incorporated in the beginning.

Stable Manure

There is nothing superior to good stable manure for building up fertility, but it is too rich and coarse to be used alone for lawns. The straw and vegetable matter in it are excellent material for humus, but the animal waste should be spread over a larger area by adding more straw, hay, vegetable tops, hulls from peanut or cotton plants, moldy feed, pulp from fruit and vegetable packing plants, orchard wastes, or anything else that can be obtained.

Artificial Manures

A great deal of experimenting has been done with wheat straw as a basis for artificial manures, and other waste products could be used in the same way. The process is described here briefly to show what importance is attached to such possibilities. But it should be noted that this does not produce a compost. It merely turns out a green manure which may then be used to make compost.

Several patented formulas for artificial manures are on the market, but Agricultural Experiment Stations have developed others which are fully as good, reducing the straw to a brown substance appearing like stable manure.

The New York Station at Geneva recommends the following to be added to each ton of dry straw:

Sulphate of Ammonia	60 pounds
Ground Limestone	50 "
Superphosphate	30 "
Muriate of Potash	25 "

Each 6-inch layer of straw is treated with the chemicals, and the pile is built up layer by layer until it is 4 feet high. Each layer is wet down as placed, and the whole pile is kept moist until it decays. It is said that a pile started in July was thoroughly broken down to manure in three months.

A Missouri Station has used a mixture of 45% ammonium sulphate, 40% ground limestone, and 5% acid phosphate, used at the rate of 150 pounds per ton of straw. The mixtures may be applied to wheat straw through the thresher. Iowa has used two mixtures---one 45% ammonium sulphate, 32% limestone, and 23% ground rock phosphate, and the other of 45% ammonium sulphate, 40% limestone, and 15% superphosphate.

Plowing Under

The simplest way to add humus is to plow under all the vegetable matter that can be gathered. The process will be greatly hastened if a reasonable amount of stable manure is added to the material. Bones, leather, animal wastes of any kind, fish wastes, home butchering wastes, packing house scraps, all help. Since this plowing under can be done only once over several months, to allow time for the stuff to rot, all the material that can be obtained should be used at one time. If the area is to be spaded, each new furrow should be left open, filling it with the waste material, and then covering it with the dirt from the next furrow.

Compost

Compost is any mixture of vegetable matter and soil, with or without animal matter, for fertilizing purposes. It is constantly being made in nature. River bottoms are compost heaps, manufacturing soil, and the process goes on in upland areas also, though not so noticeably.

The process is imitated by men in every agricultural country, and it alone has preserved the fertility of intensively used cropping areas in densely populated countries. It is so simple that it is a wonder that every farm, park, country club, and recreation area does not operate a compost pile continuously.

All that is required is to provide some suitable enclosed place, preferably with a concrete pit under it for collecting the fluids. Whenever enough vegetable matter accumulates for a layer it is spread on whatever is already in the pit, and covered with a few inches of soil. A little stable manure should be added with each layer to start decay. Toward the end of the season the place should be full, for the pile will sink down slowly through the winter. Any kind of active waste may be used, either of animal or vegetable matter. Soapy or greasy materials, cans, bottles, rags, and such things should be kept out. The liquid which collects in

the concrete pit should be poured or pumped back over the pile at intervals.

A sliding door, or boards in a slot, should be provided for taking the compost out, in order to get at the completely rotted material at the bottom first if necessary.

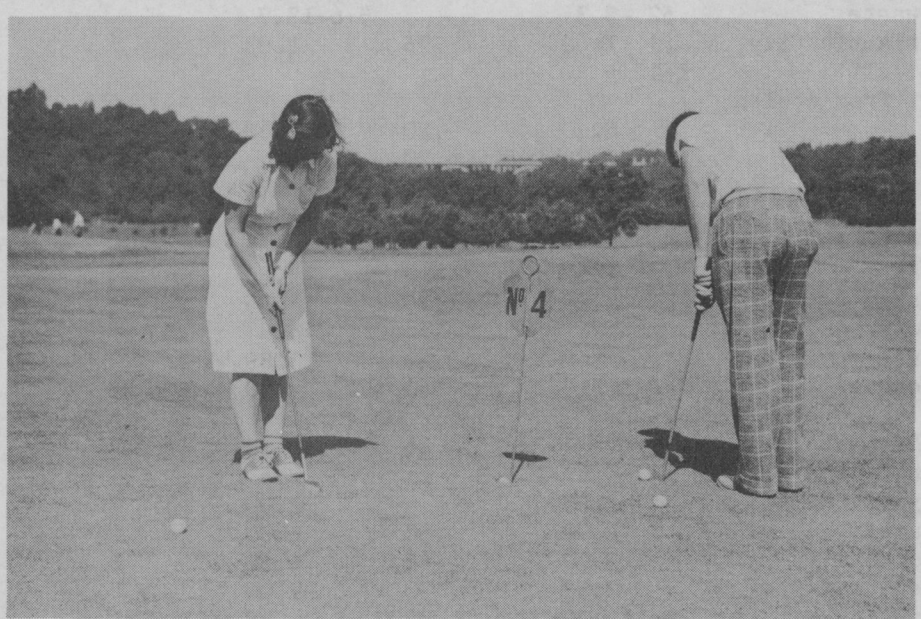
Chemicals may be added to introduce special forms of plant food, or to hasten the decomposition. Bone meal, superphosphate, or ground phosphate rock may be added to supply phosphoric acid, and any of the potash salts to supply potash. Wood ashes supply both potash and lime. Lime can be added to reduce acidity so that the bacteria will act more satisfactorily. Nitrogen is introduced in stable manure, but it has long been recommended that additional nitrogen should be added in chemicals.

The following table will aid in estimating the fertilizing value of any materials, in terms of Nitrogen, Phosphoric acid and potash, using the usual system of indicating proportions.

Material	Nitrogen	Phosphoric Acid	Potash
Alfalfa hay	2.45	0.50	2.10
Apple, fruit	.05	.02	.10
Barley (grain)	1.75	.75	.50
Beet roots	.25	.10	.50
Cattail reed and stems of waterlily	2.02	.81	3.43
Coal ash (anthracite)		.1- .15	.1- .15
Coal ash (bituminous)		.4- .5	.4- .5
Corncobs (ground, charred)			2.01
Corncob ash			50.00
Corn (green forage)	.30	.13	.33
Cottonseed	3.15	1.25	1.15
Cottonseed-hull ashes		7-10	15-30
Cottonseed-hull (ash)		8.70	23.93
Cotton waste from factory	1.32	.45	.36
Cowpeas, green forage	.45	.12	.45
Cowpeas, seed	3.10	1.00	1.20
Feathers	15.30		
Field bean (seed)	4.00	1.20	1.30
Field bean (shells)	1.70	.30	.35
Fish scrap (red snapper and grouper)	7.76	13.00	.38
Fish scrap (fresh)	2- 7.5	1.5- 6.	
Ground bone, burned		34.70	
Kentucky bluegrass (green)	.66	.19	.71
Kentucky bluegrass (hay)	1.20	.40	1.55
Leather (aciduated)	7-8		
Leather (ground)	10-12		

Golf Makes Heavy Demands Upon Turf.

Above: Turf tee at Green Lakes State Park, New York.
Below: Good turf on a green in Cleveland Metropolitan Parks.



Material	Nitrogen	Phosphoric Acid	Potash
Lemon Culls, California	.15	.06	.26
Lemon skins (ash)		6.30	31.00
Limekiln ash		.75	2.00
Molasses residue in manufacturing of alcohol	.70		5.32
Oak Leaves	.80	.35	.15
Oats, grain	2.00	.80	.60
Olive refuse	1.22	0.18	0.32
Orange culls	.20	.13	.21
Orange skins (ash)		2.90	27.00
Peanuts, seeds or kernels	3.60	.70	.45
Peanut shells	.80	.15	.50
Peanut shells (ash)		1.23	6.45
Pine needles	.46	.12	.03
Potatoes, tubers	.35	.15	.50
Potatoes, leaves, and stalks	.60	.15	.45
Potato skins, raw (ash)		5.18	27.50
Powder-works waste	2-3		16-18
Prune refuse	.18	.07	.31
Pumpkins, flesh	.16	.07	.26
Redtop hay	1.20	.35	1.00
Residuum from raw sugar	1.14	8.33	
Rhubarb, stems	.10	.04	.35
Sagebrush (ashes)			4.10
Salt, marsh hay	1.10	.25	.75
Saltpeter waste	.52 -3.3		5.6-13.7
Seaweed (Atlantic City, N.J.)	1.68	.75	4.93
Shoddy and felt	4-12		
Shoddy dirt from woolen mill	4.40	.20	.68
Shrimp heads (dried)	7.82	4.20	
Shrimp waste	2.87	9.95	
Silkworm cocoons	9.42	1.82	1.08
Soot from chimney flues	.5-11	1.05	.35
Spanish moss	.60	.10	.55
Sunflower seed	2.25	1.25	.79
Sweetpotato skins, boiled (ash)		3.29	13.89
Sweetpotatoes	.25	.10	.50
Tanbark ash		.24	.38
Tanbark ash (spent)	1.5-2		1.5- 2.5
Timothy hay	1.25		1.00
Tobacco leaves	4.00	.50	6.00
Tobacco stalks	3.70	.65	4.50
Tobacco stems	2.50	.90	7.00
Tomatoes, fruit	.20	.07	.35
Tomatoes, leaves	.35	.10	.40

Material	Nitrogen	Phosphoric Acid	Potash
Tomatoes, stalks	.35	.10	.50
Waste from hares and rabbits	7.00	1.7- 3.1	.60
Waste from felt-hat factory	13.80		.98
Waste product from paint manufacture	.028	39.50	
Waste gunpowder (sweepings from powder mill)	10.28		34.50
Wheat, bran	2.65	2.90	1.60
Wheat, grain	2.00	.85	.50
Wheat, straw	.50	.20	.30
White clover (green)	.50	.20	.30
Wood ashes (leached)		1- 1.5	1-3
Wool waste	5-6	24	1-3

A Dandelion Phantasy.

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CHAPTER VII

WEEDS AND OTHER PESTS

Weeds and other pests come into lawns in accord with rules and times which only they know. They come aggressively. We pretend to surrender to the idea that weeds will grow despite everything we do, and that our tenderly nurtured lawn is bound to be overwhelmed. Most of this is on a humorous plane, such as the run of jokes about the ever-present, undefeated, dandelion, and it is better to keep it on that plane because, when we want to, we can rid a lawn of any pests.

Every method of combatting weeds and other pests has come out of someone's experience, and success has come from guesswork and trials as well as from scientific experimenting. To simply collect such experiences from reliable sources, and print them as paragraph contributions, seems to be an effective way of compiling this chapter. No pretense of exhaustive treatment is intended. We have drawn heavily upon Lawn Care, the publication of O. M. Scott & Sons Company, Marysville, Ohio, for material, because it prints excellent contributions from vexed and victorious lawn builders all over the country.

Caution

Attention is called to CCC regulations concerning the use of poisons by enrollees, and to the rules and restrictions imposed by the several bureaus which specialize in work requiring poisons and other dangerous materials. Thus the Fish and Wildlife Service has certain practices and regulations applying to its work, and the Bureau of Reclamation does not permit enrollees to handle sodium chlorate.

Work with rodents and weed pests employs chemicals and poisons which are dangerous and even deadly. A chapter dealing with the subject cannot ignore these practices, and must include the use of such materials, but the supervisory personnel in every camp must assume the responsibility for complying with all rules and regulations concerning them.

LAWN DISEASES

Leaf Spot

The appearance of a fungus disease known as Leaf Spot is one of the first difficulties to be reported after a wet spring. These spots make their appearance as tiny brown specks scattered over the blades. As they enlarge they may extend right across the leaf with the center becoming straw colored. The bordering area varies in color from dark brown to black. Sometimes the grass plant dies when the causal fungus infects the stem and root and develops foot rot. In that case the whole plant turns brown and dies.

The best way to combat the disease is to follow cultural practices that will induce a strong growth of grass. At times fertilizing will stimulate greater growth. Higher clipping is also advisable because that means a stronger plant.

Damping-Off

When seedling turf is spotted with dead patches varying in diameter from one inch to several inches it is likely that damping-off has occurred. Sometimes this fungus disease kills the sprouts before they emerge from the ground, making it appear that the seed failed to germinate. At other times the disease comes after the grass is well started. The young grass turns black at first and then withers and turns brown.

The growth of damping-off is favored by an ample supply of water near the surface of the ground and an over supply of fertilizer. After an attack there is nothing to do but let it spend itself and then repair the damage by reseeding.

Mildew

At times a nice stand of grass suddenly appears to have been dusted with flour. This is caused by powdery mildew, which resembles the mold that grows on old shoes left in damp places. If the mildew is wiped off the surface, it will usually be found that the grass blade is green and not injured. Fortunately mildew causes little real injury and soon disappears.

Green Scum

It is not uncommon to find a green scum on wet lawn soils. This is a growth of algae which in itself is generally harmless. If conditions are favorable for it, the algae may make such growth as to form a tough parchment like coating over the ground which grass shoots cannot penetrate. In such cases the scum should be loosened by a severe raking and the area then top-dressed with sand or a sandy loam. The formation of scum can usually be checked by spraying with Corrosive Sublimate at the rate of one ounce to the 1,000 square feet.

Slime Molds

There are many different species of slime molds, all of which produce different types of spore-forming masses. Certain species appear as small capsule-like spore masses growing upright from the surface of the leaves. They are steel gray in color, later changing to black. If a large patch of grass is affected it has the appearance of having been dusted with soot.

Sometimes the mold appears as thin, white, yellow or gray layers of a slimy paste-like substance that covers the grass blades. These layers soon change shape to build up a mass of gray or yellowish gray spores. These molds occur most commonly on soils abundantly supplied with organic matter and during warm, wet weather.

Although slime molds may cover patches of turf completely they seldom cause injury. After the spores mature, which takes about two days, they can be washed or pulled off by hand.

Toadstools

Toadstools and even edible mushrooms have sprouted in a lot of lawns. These develop because of an excess of dacaying organic matter. They often sprout from old

tree stumps that have been buried in building the lawn.

Soak the ground thoroughly with sulfate of copper or bordeaux mixture or, loosen the soil and apply iron sulfate, at the rate of one pound to 1½ gallons of water.

Sometimes the regular mowing will eliminate these pests. If not the soil around the infested spots should be forked to permit penetration of a solution of Corrosive Sublimate (3 ounces in 50 gallons of water.) This should soak in to a depth of three or four inches. If this fails another possibility is to remove the soil to a depth of five or six inches, replace with fresh soil and reseed.

Brown Patch

The fungus disease brown patch causes much grass to turn brown during the summer months. This fungus (Rhizoctonia solani) is present in soils and on vegetation everywhere but it is usually inactive.

Attacks of brown patch usually come during periods of hot humid weather when grass is in a weakened condition and is more susceptible.

This fungus enters the grass leaf through a pore and then grows through and between the cells which make up the tissue. As the fungus spreads through the plant it absorbs food from the cells, thereby causing them to break down and the leaf to shrivel and turn brown. As the fungi are very sensitive to drying out or to the strong sunlight they are most active at night. At times they work very rapidly so that large areas of turf will seem to have been affected almost overnight.

A peculiarity of this disease is that the attack is usually in definite patches which are roughly circular in outline. Part of the grass within the circle usually escapes injury. Unless the disease is very severe and long lasting, the roots are not injured but only the top growth.

Grass in sections where there is not a good movement of air is also susceptible to brown patch since stagnant air is favorable to development of the fungus. That is why brown patch is more apt to affect lawns that are surrounded by a dense growth of trees or shrubs, or in sunken gardens or similar places. The disease is worse in lawns that are overfertilized or where the soil is very acid.

Brown patch can be prevented in many cases by remedying the factors responsible. If this is done and the disease is still troublesome it can be controlled by applications of mercurial fungicides. There are many of these on the market sold under such brand names as Calo-Clor, Semesan, NuGreen, Curex and Pfizer's Mixture, which should be used according to the manufacturer's directions. If no commercial preparation is available any druggist can quickly prepare one by making a mixture of two parts calomel and one part corrosive sublimate. This should be applied at the rate of two or three ounces per 1,000 square feet as a spray or mixed with soil.

If attacks are numerous, they may be held off by regular preventive treatments of fungicides to be made at ten day intervals during periods of hot, humid weather. Where turf is attacked only occasionally it is hardly worth while to attempt to control the disease. Ordinarily the disease will soon spend itself, after which the damaged spots can be repaired.

Dollarspot

Another fungus disease closely related to brown patch is known as dollarspot. The most noticeable difference is in the size of the injured spots. In the case of dollarspot these are usually limited to a diameter of two inches. The affected turf presents a motheaten appearance and the leaves are more bleached than after an attack of brown patch.

The dollarspot fungus is active at lower temperatures than brown patch, and so appears earlier in the spring and later in the fall. It is more likely to attack roots and stems as well as leaves.

Dollarspot can be controlled with the same fungicides that are effective on brown patch.

Spotblight or Pythium

Possibly the worst of the fungus diseases is spotblight, sometimes called pythium. It is most apt to appear in temperatures varying from 90 to 95 degrees accompanied by excessive moisture. The individual spots are small, from two to three inches in diameter, but they usually occur in groups which sometimes spread into streaks because of being distributed by the mower or running water.

It is very hard to distinguish spotblight injury from that of dollarspot or injuries from cutworms or sod web worms. The main difference is that grass attacked by spotblight has a reddish appearance. So far, no satisfactory control method has been discovered. The chance of having a spotblight attack can be lessened by avoiding over-watering during periods of excessive heat.

In cases where lawns suffer regularly in the summer a check-up is advisable to determine the causes of a susceptible turf. The soil condition should be analyzed both as to subsoil and surface soil. Possibly drainage is needed, or it may be that only the surface grade needs correcting. If the topsoil is sticky when wet and bakes hard when dry it probably needs to be turned over and a quantity of sand and organic matter incorporated. Under certain circumstances an application of lime may be beneficial. If air drainage is poor, this may be corrected by thinning out shrubbery plantings or trimming low hanging tree branches.

Excess Moisture

In some sections of the country the appearance of grass during the summer has been disappointing in spite of an abundance of rainfall. Much turf has shown signs of damage because of too much water.

An excess of moisture is not in itself unfavorable if the soil is well drained. Many lawns have poor surface or sub-surface drainage, sometimes both. If the subsoil is hard and impervious, moisture is trapped in the ground. Unless tile drainage is installed a soggy condition results. Clay soil becomes puddled and when it does dry out it bakes hard and cracks open. Alternate wetting and drying is good for a soil because it tends to keep it mellow, but standing water is harmful. A saturated soil forces out all the air so grass roots cannot get the oxygen they must have to live.

The first noticeable effect of too much moisture is a yellowing of the grass. This occurs when the grass is drowning because the roots are not getting air. The deeper roots are drowned and the grass is left with only a shallow root system.

These roots dry out quickly during a hot spell, thereby producing the paradox of a turf in an over-watered soil dying because of a lack of moisture. While excess moisture may not cause disease it always exaggerates it.

ANIMAL PESTS

Skunks

"A. 'I might say that my worst enemy last year was Mr. Skunk which indicated that my lawn was infested with dandelions. I dug them up as fast as possible but friend Skunk would always find some I had overlooked.'

"B. 'Your skunk was doubtless digging for white grubs, or other root-eating insects, in the lawn. So far as we know, skunks, in Maine as in Ohio, seek live game and not dandelion salad.' (Maine Experiment Station.)

"C. 'I might add, regarding the "Dandelion and Skunk" topic, that to my knowlege there is some sort of grub at the root of the dandelion or "Arneca" as it is called. (I believe there is a difference.) Mr. Skunk always leaves a cone shaped hole in the lawn and the plant which he has pulled up always lies beside it, so it isn't the plant he is after. Some of your LAWN CARE readers can give you the correct information. I do know that after a good moonlight night in midsummer, the lawn is very unsightly and perhaps you would agree with me that rather than shoot or trap a skunk on your front lawn, you would patiently repair the lawn. Yours for better lawns and less dandelions'. (E. W. Tapley)" --- and NO skunk.

Earthworms

"A friend of mine who is a great fisherman, or at least spends lots of time at the sport, conceived the idea of getting angle worms by soldering a three foot iron rod to the 'hot' side of a socket of a long extension cord. He bored a hole in a stick of dry wood for a handle and pushed the rod through, using the wood for a handle and insulator at the same time. He then wet the lawn and got every worm--big and little--as fast as his son could pick them up. They came up so fast they were almost entirely out of the ground before falling into a prone position. Try this method and see for yourself how a lawn can be denuded of worms. Forgot to say that the rod must be pushed quite a ways and the wetter you have the lawn the easier it is to push the rod in and the more effect the electricity will have. Be sure to wear good rubbers over your shoes and work fast as your meter will be working overtime while the rod is in the wet ground.

"When the above item was received we thought some one might be trying to have a little fun with us. Putting earthworms 'on the spot' seemed more like a gag than a practical method of warfare. But we tried the electrocution idea and are glad to report that the results exceed our fondest hopes. The worms began to arrive at the surface a few seconds after the 'juice' was turned on and the circle affected was probably two feet in diameter.

"With this experiment so successfully completed the thought came to us that here was an opportunity for someone to put a gadget on the market which would not only 'de-worm' a lawn but provide fishermen with bait in abundance. Like a lot of good ideas this one got away, for behold in the catalog of Marshall Field and Company is listed a worm catcher for fishermen and it is operated on the same principle. What an age!"

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A remedy which is efficient in destroying earthworms is arsenate of lead. Five pounds per 1,000 square feet is sufficient. To insure a uniform application mix with sand at the rate of one pound of dry arsenate of lead to a bucket full of sand or loam. Make your application when the grass is dry. Sprinkle it afterwards and repeat in three weeks if there is still evidence of worms. The same treatment will also kill grubs.

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Tests made at the New Jersey Experiment Station to determine the effect of arsenate of lead in connection with fertilizer treatments are quite interesting. Two applications of arsenate of lead each of five pounds per thousand square feet were made. This material was mixed with a liberal amount of top dressing which simply means soil, fertilizer and sand mixed and screened. The acidity of the soil was not affected. Weeds were reduced very noticeably and in addition to other slight changes in the growth of certain grasses, earthworms were eliminated. In check plots adjacent to those receiving arsenate of lead and which received no treatment there were 38 earthworms. It has been noted, however, that in certain types of soil arsenate of lead is not effective.

Moles

Within the boundaries of the United States there are five groups of true moles. They are quite alike in their activities. All species live chiefly upon earthworms and other insects that inhabit the ground. To the extent that they destroy harmful insects they are beneficial to the farmer but in lawns they do considerable damage by heaving the soil, which causes the grass to dry out quickly. It is in moist rich soils that moles usually operate. When a mole is living in a lawn it cannot conceal the evidence of its presence. The ridges show the direction and course of the animal's hunting paths which are so close to the surface that the sod or soil crust is raised in ridges. The mounds indicate deeper tunneling for they are formed of earth pushed up from lower workings where the soil is too compact to be simply crowded aside. In Farmers' Bulletin No. 1247, distributed by the U. S. Department of Agriculture, we find the opinion expressed that moles work only at regular intervals each day, morning, noon, and evening. But they are no more active at one time of day than another. If an opening is made into a mole's runway he will invariably repair the breach when he next comes that way.

Moles grow and develop with astonishing rapidity.

Many types of mole traps are manufactured in this country, all of them being made of metal and depending for their operation on some sort of tripping device. The trigger pin is designed to rest upon an obstruction, such as a board, placed in the mole's runway when the trap is set. The trap is sprung when the mole follows its natural instinct to reopen the runway by burrowing through or upheaving the obstruction. The American traps are of three types: (1) choker loops, (2) clipping or scissor jaws, and (3) impaling spikes. No importance need be attached to the admonition that one should use gloves to prevent the animal's getting the scent of human hands. Experience has shown that this doesn't affect the catch in any way. A good strong garden trowel is the best tool to use in setting mole traps.

So many satisfactory experiences have been reported in the killing of moles by poisons in lawns and golf courses that we feel inclined to recommend it rather than trapping. Various poisons and methods by which they are introduced are as follows:

Calcium Cyanide. Open the burrow every five feet and place in it a teaspoonful of this poison and close the opening without stamping it down.

Carbon Bisulphide. Pour a teaspoonful into the burrows at points about five feet apart. Close the holes as recommended for calcium cyanide to retain the poisonous fumes.

Strychnine. Take raw peanuts, squeeze the end of each shell, insert a crystal of strychnine and then put a peanut in each runway.

Paradichlorbenzine. This vicious sounding chemical is recommended by the Department of Agriculture for destroying the peach tree borer. It is commercially obtainable in the form of a powder which, when placed in the ground, gives off a heavy poisonous gas which penetrates the soil. It should be dropped into the runways every six to ten feet and the soil put back. About a teaspoonful should be used. The moles end their activities immediately.

Potassium Cyanide. Small cubes of raw potatoes were immersed in a 20% solution of this poison and inserted in the burrow at 10 or 12 foot intervals. There is no danger of injury to children or livestock in using the poison in this manner.

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Still another remedy has recently been reported by one of our thoughtful customers: "I successfully rid my lawn of moles by digging down in their runways at various places and putting in a handful of shelled corn that I had previously soaked in a water solution of arsenic. There is no danger to dogs or chickens because the poison is covered."

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Open the burrow at four on five intervals and put teaspoonful of lye crystals in each hole. Mole gets lye on feet and licks them off, dying soon from the effects.

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Black pepper put in their runs.

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Sixty grains of strychnine sulfate to one ounce of water. Soak a dozen grains of corn in this for 24 hours. Put 2 or 3 grains in runways every 6 or 8 feet. It positively kills them.

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Mix 3 parts of corn meal and 1 part hellebore. Put a teaspoonful every few feet in the runways.

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Powder Paris Green or London Purple over half inch squares of raw meat, and place in runways.

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Drop teaspoonful of flake napthalene or lye in the runways every 20 feet.

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Treat 1 pound of raisins with 1 ounce of strychnine, and put a small ball of this in the runways at intervals.

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Exhaust gas from an automobile. Attach a garden hose to the end of the exhaust pipe of an automobile. The connection may be made secure by using electricians' tape or by wrapping with an old inner tube. Insert the other end of the hose in the runway and allow the motor to run for twenty minutes. Carbon monoxide will kill the moles if the runway is tightly sealed. Any openings should be closed with mud.

Ants

The remedies herein described are accepted extermination methods recommended by experiment stations and golf course green keepers who have acres of fine turf under their care.

The burrows of ants may be fumigated or a poisoned bait used to feed them.

Carbon bisulphide and calcium cyanide are the two most generally used fumigants. One authority recommends that holes be made in the mound about a foot apart by driving a stake an inch in diameter to a depth of ten or twelve inches. About one-fourth pint of carbon bisulphide is then poured into each hole and the opening plugged with soil. The entire mound should then be covered with a piece of old carpet or burlap for twenty-four hours to prevent escape of the gas formed by the chemical.

Where the ants are not so numerous that they have formed mounds, carbon bisulphide may be injected into the openings by employing a mechanic's spring bottom oil can. About a teaspoonful of the fumigant should be squirted into each opening. The openings should be plugged with soil after the treatment so the fumes will be kept in.

Instead of carbon bisulphide one may use calcium cyanide provided the openings of the ant nests are enlarged. One teaspoonful should be used for each burrow. Care should be taken not to spill these chemicals over the lawn areas other than those being treated. Injury to plants may result if the material comes in contact with the roots. Carbon bisulphide is both poisonous and inflammable.

Poisoned bait may also be employed. This is the so-called Government formula.

1. Dissolve 2 pounds (1000 grams) of sugar in 2½ gills of water, add 1/10 ounce (3 grams) of tartaric acid (crystals), boil for thirty minutes and cool.

2. Dissolve 1/10 ounce (3 grams) of sodium arsenate in four teaspoonfuls (20 c.c.) of hot water. Cool and add 3 1/3 ounces (100 grams) of honey.

Mix the two solutions together thoroughly. Small pieces of sponge, cotton or wadded paper should then be saturated with the poison syrup and distributed where the ants work.

A more satisfactory plan, however, is to place the poison to the depth of a

The President's Garden at Princeton University

Princeton, New Jersey

These spacious grounds are characterized by irregular garden plots in a vast expanse of good turf.

half inch in small covered cans, in the sides of which holes have been punched from the inside out with a tenpenny nail, about an inch from the bottom. A piece of sponge, cotton or paper placed in the can will prevent the ants from drowning in the syrup. This poison is not strong enough to kill the ants immediately but they will carry it away to the nests and feed it to the queen and the young, thus destroying the entire colony.

This and the other treatments suggested will be found most successful during warm, sunny weather when the ants are most active.

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It is interesting to know how ants injure grass. The galleries which they form in the soil disturb plant roots and the earthern mounds which they build cover low growing plants. Some species carry away germinating seeds and still others are indirectly injurious because they protect certain plant pests such as bugs and insects. Ants' nests make very unsightly spots in lawns. It is useless to re-sow such spots with seed until the ants have been killed. These areas should then be raked thoroughly, new soil scattered over them, the ground fertilized and re-seeded.

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Two simple treatments which are sometimes successful involve the use of coal oil and Paris green.

Coal oil cannot be used on the lawn as it will kill the grass. However, in drives or other places without vegetation, a little coal oil poured into the holes will usually annihilate the ant colony.

Paris green mixed in equal proportions with brown sugar will often destroy a colony as the ants will carry the poison to their nests and feed it to the young.

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"I have tried all kinds of things for ants on clay courts where I could get at them with carbon bisulphide, gasoline, coal oil, boiling water, etc. The simplest and best method yet is to mix thoroughly tartar emetic (poison) 1 part to ten parts of powdered sugar (fruit sugar.) Sprinkle a little anywhere where the ants are working at any time when the ground is dry. Repeat for a day or two where some nests have been missed. I generally keep it in a can and just drop a pinch or two as I walk along near the ant heaps. The ants soon carry it away and don't return."

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Empty half a can of chloride of lime in a 10-quart sprinkling can and give the infested area a good watering. No damage to grass.

Evergreen, a pyrethrum extract, mixed according to directions and used in an ordinary watering pot, stops them from working. It may take a second treatment.

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Squirt any fly spray into the holes with an oil can.

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WEEDS

Caution

Spraying with chemicals involves some risk of injuring the turf. Kerosene, sodium chlorate and arsenic sprays are all likely to harm grass if conditions are other than favorable. Experiments indicate that cool weather of spring or normal fall weather in advance of frost provides safe periods for a weed-spraying campaign.

Anyone expecting to treat more than one lawn with gasoline or kerosene will not smoke, and keep all fire away.

Chickweed

Two varieties: Common and mouse-ear are found in lawns. Hardiest and most persistent weed on earth. Has been known to bear green stems, flowers and fruit within a yard of a melting snowbank in a January thaw.

Common. Familiar all over the world. Annual. Grows from seeds. Blooms throughout the year. Smooth, ovate leaves half an inch in length. Upper leaves will form a mat over entire ground. Small white flowers with 5-star petals.

Mouse-ear. Over North America to Arctic Circle. Perennial. Blooms May to September. Grows from seeds. Flowers in loose clusters, the central one solitary and usually the oldest. Only one flower open at a time. Whole plant covered with downy hairs giving it a dirty grayish look. Leaves oblong or lance shaped, resembling the ear of a mouse.

Eradication. Older remedies were by spraying with iron sulfate. More recently a better way has been discovered. Water the area. Then sprinkle with dry ammonium sulfate on the chickweed patches and let it stand for a day. Then wash the chemical down into the soil with thorough sprinkling.

Crab Grass

Wire Grass, Summer Grass, Fall Grass, Water Grass, and many other names which cannot be printed. Range, nearly all of North America, but worse in the South because it is a hot weather plant. Any soil. Summer annual. Grows from seeds. Seeding begins about April 10 in the latitude of Washington, D. C. Two varieties. Large or Common, the more objectionable, can be recognized because it grows faster than other grasses and stands above the lawn a few days after mowing. The other is Small or Smooth, not so bad as the other, and stands more nearly upright. Seed bearing spikes appear in July or August, and mature seeds whether standing upright or lying prone. Seed heads have ugly red or brown or purplish color. Single plant will mature 200,000 seeds, and 400 seedling plants have been counted on one square foot of ground.

Eradication. Mowing does not remove the seed spikes lying down, and scatters short pieces of the stems, which root where they fall. It is a hot climate plant, so light sprinkling makes it thrive all the more in hot months. Saturate the lawn frequently Will not grow in shade. Hand pull in early spring. Rake with tool having sharp teeth to lift the seed spikes before mowing. Rake in both directions after mowing.

Green Section of the U. S. Golf Association uses sodium chlorate mixed in water or in sand, screened soil, lime or inorganic fertilizers. Give three applications

starting in May when plants are in the two-leaf stage, using one pound to 1,000 square feet. Spray solution is five gallons to 1,000 square feet.

Caution: Sodium chlorate by itself is not dangerous, but when spray falls on wood, clothing, and dried vegetation, and dries, it can be ignited by friction or by the sun's rays. It must be stored as carefully as gasoline.

Dandelion

People become dandelion conscious at about the age of three. What little youngster upon first venturing into the yard on a bright spring morning has not toddled joyfully back into the house with a gorgeous bouquet of beautiful, yellow flowers which seemed to be growing everywhere? That early admiration later turns to consternation.

Man seems not to have made the slightest inroads upon the annual crop of dandelions. The weed is downright insolent. Botanists tell us that wherever civilized man has established himself he has carried and sown this weed. Cutting the crowns from the roots will not kill this pest as it will many deep-rooted species. Any part of the root will sprout leaves and make a plant if buried in warm, moist soil.

The dandelion is a perennial and propagates by seeds. It will bloom at all months of the year when weather is not at the freezing point. Of course, it is most abundant in the spring. The seeds are ready for dispersal within three weeks after the unfolding of the flower. The parachute-like equipment for spreading the seeds to the four winds is well known.

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Another plan of individual attack involves cutting off the plant with a spud or knife just below the ground. The plants sprout again and require a second cutting but if no leafy growth is allowed to feed the roots even the old ones will finally starve. A pinch of dry salt or a few drops of acid or gasoline will retard the recovery and often kill the plant entirely.

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Another suggestion, differing slightly, comes from a Colonel in the Field Artillery. He reported an almost complete kill by simply dropping hydrochloric acid on the crown of the plant. He says:

"I can place a drop or two in the eye of a dandelion with perfect accuracy and it never lives to tell the story. An ordinary medicine dropper is used and commercial hydrochloric acid is only 25¢ a quart."

Hydrochloric and sulphuric acid are highly caustic and should be handled carefully.

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A large area that is dandelion infested presents the most serious problem. It is difficult to say how large a plot can be treated at once. Much will depend upon the seriousness of the infestation.

Reports indicate that iron sulfate (copperas) is thus far the most commonly used chemical killer and incidentally it is likely to have a suppressing effect upon

many other weeds even though dandelion eradication may be the specific objective. The best way to apply iron sulfate is to spray it on the plants. If this is not convenient, it can be put on with a sprinkling can, although this is not as efficient or effective. To make a solution for spraying, use 1½ pounds in 2 gallons of water. This should cover 350 square feet of area. If the solution is to be sprinkled on, use 1 pound to 2 gallons of water for each 200 square feet.

On stone, cement, metals and cloth, iron sulfate solution produces a conspicuous yellowish-brown rusty stain which is extremely difficult to remove. Accordingly, care should be taken to avoid getting any of the spray on one's clothing or on sidewalks, building foundations, monuments, curbstones, and the like.

Iron sulfate blackens all leaves but does not kill grass blades. If the lawn is cut a few days after being sprayed, the blackened ends of grass blades will be removed. It is unwise to use any spray during the hot weather of late July and the first weeks of August.

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At the Iowa Experiment Station good results have been obtained with kerosene as the following account illustrates:

"During the latter part of September a spray of straight kerosene was applied to the lawn at the rate of one gallon to each two hundred square feet of lawn. Best results were secured when the spray was applied during damp, foggy weather or in late afternoon after the sun had set. The longer the kerosene can stay on the foliage without evaporating, the better the results. This kerosene spray will cause the grass to discolor slightly but an application of ammonium sulfate will green the grass up in a few days. From then on the regular lawn care procedure is followed, such as seeding and the use of a complete fertilizer in the following years. This spray should destroy the entire dandelion plant."

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The most commonly used fluid for injecting into the dandelion is gasoline. There are a number of plunger-type appliances on the market. By this plan the fluid is squirted into the crown of the plant. No stooping is involved. There are many variations of the nonstooping principle.

Various commercial dandelion killers with hollow cylinders for the discharge of fluids are available.

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In the East it is reported that kerosene has not been successful whereas sodium arsenate or arsenic acid has shown considerable promise. The dandelion does not like arsenic (neither does chickweed). The chief difficulty with arsenic is the fear of using it because it is such a virulent poison. The advantage is that it is cheap. Arsenic acid or sodium arsenate may be used in the dry form with sand or fertilizer, or in a liquid form as a spray. Sodium arsenate is preferable for the dry method or liquid arsenic acid can be readily mixed with dry sand. The rates vary from 2 to 6 ounces when applied as a spray and from 8 to 18 ounces to each 1,000 square feet when applied dry. The lighter rates, of course, cause less damage to grass but must be repeated more often than is required with the heavier rates. Where a serious burn is not objectionable, the heavier rate should be used. Where discoloration of turf must be held to a minimum, the lowest rates must apply.

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Each spring the first uninvited arrival in the lawn is the yellow-haired dandelion. There are three methods of combatting it:

1. Hand-digging---a sure plan but laborious on a large area. Care should be taken to kill the root by the application of a little salt or gasoline.

2. Killing with poison either applied to the crown of the plant or put on with a spray. In the latter case iron sulphate is most commonly used. This can be obtained at almost any drug store. A solution is prepared by dissolving 2 pounds of iron sulphate in a gallon of water. One gallon will spray 860 square feet. The iron sulphate comes in granular form and dissolves easily. Similarly a common salt solution has been successfully used. Two and a half pounds dissolved in a gallon of water makes the best solution. Even more deadly is sulphuric acid. This may be applied by using a sharp stick, dipping it into a bottle of sulphuric acid and then into the crown of the dandelion. Another killing method is to apply gasoline to the plants either by means of a long oiling can or a special dandelion killer of which there is one or more on the market.

It may be well to mention the fact that if iron sulphate is used in killing dandelions, care should be taken not to allow it to fall upon the cement walks as it will stain them.

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1. Sharpen an oak peg tapered pretty thin.

2. Make saturated solution sulfate or iron in three or four-ounce screw cap bottle.

3. Dip peg in solution.

4. Stab dripping peg down deep into heart of dandelion and let the sun do the rest.

5. After weed has withered and died, mix good soil with grass seed one pound to a bucketful of soil; put a little pinch of mixture in hole left by deceased dandelion.

6. Repeat ad infernalitum.

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The following appeared in Golfdom Magazine by Mr. John MacGregor, Greenkeeper of the Chicago Golf Club, on dandelion and plantain eradication.

The formula was one and a half pounds iron sulfate (copperas) to one gallon of water, the solution to be applied with 150 pounds pressure. I followed the instructions, choosing one of the worst infested areas I could find. The day following the application I looked over the result of the experiment and was disappointed. All that could be noticed was that the leaves of the dandelions were spotted with rust. Then I noticed that where the wheels of the sprayer had traveled the leaves were entirely black. I decided we had the correct formula, but our method of application would not give the desired results. I must devise some means of brushing the leaves so the iron could penetrate, and got the idea of using a chain drag and this solved the problem.

After two years' experimenting, we purchased a Fordson tractor. This was the first time results really began to show, as I found the rough could be sprayed in a week, and that five successive sprayings two weeks apart would kill ninety-eight per cent of the dandelions. The only ones left were some of the very largest, which were very easily destroyed with a weed stinger and gasoline.

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Linoleum knife with hook blade. Cut deep and pull root out. Then put a little ammonium sulphate in the hole.

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Nitric acid is found to be better than any other for dropping on plants, and remains to improve the soil through its nitrogenous byproducts.

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> Milwaukee Journal: A naturalist has written a fairly thick book on the intelligence of plants. Take the dandelion and the way it lowers its fair head as the lawn mower passes.

Foxtail

Pigeon Grass, Pussy Grass, Bottle Grass. Noxious annual. Propagates by seeds. Blooms July to September and seeds from August to October. Range, all over the world, introduced from Europe. No weed has made itself more completely at home. Normally a foot tall, but will mature seed when only three inches tall. Thrives in hot weather when better grasses are dormant.

Eradication. Consistent mowing to prevent formation of seed heads. Heavy growth may be burned off.

Goose Grass

Silver Crab Grass, Wire Grass, Crow-foot Grass. Range, nearly all of North America. Grows from seeds. Seeds July to October. A hot-sun grass. Came from India, probably 150 years ago. Like crab grass it does not start until hot weather and is killed off by the first frost. Coarser than crab grass, and grows from clustered fibrous roots. In some countries the seeds are ground into an inferior flour. Because it grows on poor soils it has become associated with poor and primitive people.

Eradication. Since it is an annual it can be controlled by preventing the production of seeds. Rake up the stems so they will be caught by the mower. Pull out by hand when the ground is soft. Spot the heads with a few drops of crude carbolic acid from an oil can. Feed the soil with an acid fertilizer like sulfate of ammonia.

Ground Ivy

Field Balm, Gill-over-the-Ground, Gill-Ale, Ale-Hoof, Cat's Foot. Perennial

creeper. Grows from seed and root stocks. Pale purple blooms between April and July. Seeds from May to August. Kidney shaped leaves scalloped, green on both sides. Thrives under close clipping and will take the entire lawn. Its association with ale comes of use of the plant years ago to clarify and flavor home-brewed ale. Rating this plant as one of the most obnoxious lawn pests the U. S. Department of Agriculture says in a bulletin: "One must learn to live with it rather than entertain hope of its extermination."

Eradication. It has been discovered that one treatment with sodium chlorate, at the rate of one or two ounces to a gallon of water, will destroy it. The spray will discolor the grass for a time, but that will come out again. Fertilizing and seeding may be necessary when the ground ivy dries out.

Caution: Sodium chlorate is non-inflammable in solution. But when the spray dries on clothing or dry vegetation it can be ignited by friction or by the sun's rays.

Heal-All

Hock-Heal, Heart-of-the-Earth, Carpenter's Herb, Sicklewort. Range, all over the world. Supposed to possess some medicinal value. Perennial. Grows from seeds and by creeping rootstalks or nodes. Seeds all summer long. Comes into lawns most frequently with topsoil from waste places or open woods. When mowed down it spreads out and takes complete possession of the lawn. Grows 10 or 12 inches high, but will flower and seed at two inches high. Blooms in clusters of three in various shades of purple.

Eradication. Iron sulfate, in an 8 per cent solution is a sure cure. One spraying should be enough. A newer method is to wet the plants and sprinkle with dry sulfate of ammonia, after which the chemical should be washed into the ground for its fertilizing value.

Henbit

Dead Nettle, Blind Nettle, Bee Nettle. From Eurasia. Red or purplish flowers at both terminals and where leaves join stems.

Nectar attracts bees. Cool weather plant, dying down in hot summer but reviving to produce second crop of seed.

Eradication. Hand pulling before blooming in spring and fall. Close mowing. Clover will smother it out.

Moss

Occurs on poorly drained soils. May be the only vegetation that will grow in some spots. Probably correct that it does best on poor soils. But it is incorrect to say that the presence of moss indicates a need for lime. Lime has been found to stimulate moss.

Eradication. Correct the bad soil conditions with better drainage and fertilizing with ammonium sulfate or nitrate of soda, separately or together. Spraying with iron sulfate will kill the moss but will not correct the soil conditions.

Nimble Will

Drop Seed Grass, Wire Grass. Range, Maine to Minnesota and southward to the

Gulf. Grows from seeds and by rooting at the joints. Seeds from September to October. Creeping type with underground stems and spreads rapidly in lawns. One plant may cover a square foot. Makes a thick growth which may seem to be good for a lawn. Unsightly when dormant in winter and early spring, similar to dead crab grass.

Eradication. There is no method except hand digging. May be smothered out by covering with boards or tar paper.

Peppergrass

Tongue Grass, Bird's Pepper. Winter annual. Range, North America east of Minnesota. Blooms May to September. Seeds late June to October. Seeds have been known to live for 40 years. Grows above the lawn grass.

Eradication. Pulling individual plants when the ground is soft. Or spray with iron sulphate.

Plantain

Buckhorn and common varieties. Rib-Grass, English and Black Plantain. Range, over all America. Blooms April to October. Seeds May to November. The seed spikes with the seed heads cut off stand above the lawn in the fall.

Eradication. Hand pulling when the ground is soft. Do not mow the lawn when plantain is in seed. Pierce the roots with a stick which has been dipped in gasoline, sulphuric acid, nitric acid, or crude carbolic acid.

Plantain in old folklore was known as "Devil's Shoestring" from its long spikes of seed-pods and the belief that wherever the plant was found, the devil was not far away. (Today, many report it is the devil himself.) This legend, accompanying the early colonists to America, may have been the basis for the Indian's name for plantain. They called it "Englishman's weed" for they claimed that whenever they saw the plant they knew an English habitation was somewhere near.

The greenkeeper of a golf course near Wilkinsburg, Pennsylvania, commented recently on his experience in controlling dandelion and plantain.

Applications were made, two weeks apart, of an iron sulfate solution prepared by dissolving 1½ pounds of iron sulfate (granulated form) per gallon of water. He ran this solution through four thicknesses of cheese cloth. The area was so large that a power sprayer of 200 gallon capacity was used. Spray nozzles were used to distribute the material and ahead of the spray a drag was improvised consisting of several steel door mats. Their function was to bruise these plants so that the solution would penetrate the stems. The fairways and rough of the course in question were so covered with dandelions and plantain that five applications were necessary to put them out of business.

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It will be noted that in the experiences of three persons the strength of the iron sulfate solution has varied from 1½ pounds in 1 gallon of water to 1½ pounds in 4 gallons. Note, however, that where the strongest solution was used it was strained through cheese cloth which no doubt removed some of the coarser particles. We suggest the weaker solution where the application is being made with a sprinkling can. Where a spray pump of either the hand or power variety is used the solution might

safely be more concentrated. It is estimated that 1½ pounds of iron sulfate in solution will cover about 350 sq. ft. (10 x 35). On this basis a lawn of 10,000 sq. ft. or about one-fourth of an acre would require 45 pounds of iron sulfate in about 60 to 70 gallons of water. Before the spray is applied, a drag of some nature, not heavy enough to injure the grass, should be pulled over the lawn to bruise the dandelions.

Purslane

Pursley, Pussley, Wild Poertulaca, Duckweed, Pursley Annual. Range, all over North America. Grows from seeds. Blooms late June to frost. Seeds from July to frost. Seeds live for 30 years, and may lie dormant until brought near surface of warm soils. Heat waves bring it on as a scourge. Reddish stems and yellow flowers. Stem holds a milky substance. Flowers open only on sunny mornings. Seeds burst out of urn-shaped capsule at slightest touch.

Eradication. Hand pull or hoe out plants when young. Rake before mowing to lift the stems.

Quack Grass

Witch Grass, Twitch Grass, Couch Grass, Dog Grass, Devil's Grass, Wheat Grass. Probably the most undesirable weed, yet a highly valuable grass if it could be kept in place. Excellent soil binder. Good pasture. Grows from fibrous roots which creep over an area very rapidly. Very tough and resistant to adversity.

Eradication. New ground should be thoroughly cleaned by plowing and repeated harrowing to destroy stolons in the soil. The best chemical is sodium chlorate, and enough must be used to kill all vegetation. Quack grass cannot be killed out without destroying all other grass with it. Dissolve sodium chlorate at the rate of 1 pound to a gallon of water. Summer and fall spraying are most effective. The treatment affects the soil, and a heavy application of lime, 500 pounds per 1,000 sq. ft., should be made, and the ground can be seeded again in September.

If the area can be covered with paper, manure, or other material to shut off the air the plants will die out in two or three months.

It is reported that wild ducks will eat the entire plant from the tops to the roots. This method has been called "combatting quack grass with quacks."

Caution: Sodium chlorate when sprayed on clothing or dry vegetation and dried, is inflammable and can be ignited by friction or the sun.

Sedge

Chuffa, Yellow Nutgrass, Yellow Galingale. Range, New Brunswick to Minneapolis and Nebraska, southward to Florida and Texas. Moist soils. Probably 3,000 species of the sedge family, (Cyperacae) scattered all over the world. A frequent adulterant in Kentucky Blue Grass. Grows from seeds, but more generally from tuber-bearing rootstalks. Seeds August to September. Blooms July to September.

Eradication. Must be starved out. Better drainage helps. Pull out by hand when the ground is soft. On new ground cultivate repeatedly through the summer and make the lawn in the fall.

Spotted Spurge

Creeping Spurge, Milk Purslane, Spotted Matweed. Annual. Grows from seeds. Blooms between June and October. Range, all over America except the extreme North. Dry soils of low fertility. Every part of this plant exudes a poisonous milky juice which will irritate the skin to a red rash and even blister it. Nothing eats it. Even insects avoid it. Notable because it grows up in the cracks and joints of walks and pavements.

Eradication. Pull up when the ground is soft. Iron sulfate will discourage it, but this chemical discolors stone.

Wild Garlic

Wild Onion, Crow Garlic. Noxious perennial introduced from Europe. Moist, sandy soils. Range, Massachusetts to South Carolina and west to Missouri River. Multiplies from aerial bulbs in seedhead, which is kept down by mowing in a lawn, and also by secondary bulbs or "cloves" below ground.

Eradication: Pulling when the ground is soft. Crude carbolic acid applied with common oil can on seed head or plant. U. S. Golf Association uses tear gas with eye dropper. Operator must wear gas mask.

REFERENCE LIST OF WEEDS

Following the method used for grasses, the weeds described in this chapter are here listed. All the known names for each species are given, using caps and small letters as a rule, but the name under which each species is described in the text is in capitals, thus: DANDELION.

Common Name	See	Common Name	See
Ale-Hoof	Ground Ivy	HENBIT	Henbit
Bee Nettle	Henbit	Hock-Heal	Heal-All
Bird's Pepper	Peppergrass	Milk Purslane	Spotted Spurge
Black Plantain	Plantain	MOSS	Moss
Blind Nettle	Henbit	Mouse-ear	Chickweed
Bottle Grass	Foxtail	NIMBLE WILL	Nimble Will
Buckhorn	Plantain	PEPPERGRASS	Peppergrass
Carpenter's Herb	Heal-All	Pigeon Grass	Foxtail
Cat's Foot	Ground Ivy	PLANTAIN	Plantain
CHICKWEED	Chickweed	PURSLANE	Purslane
Chufa	Sedge	Pursley	"
Common	Chickweed	Pursley Annual	"
Couch Grass	Quack Grass	Pussley	"
CRAB GRASS	Crab Grass	Pussy Grass	Foxtail
Creeping Spurge	Spotted Spurge	QUACK GRASS	Quack Grass
Crow Garlic	Wild Garlic	Rib-Grass	Plantain
Crow-foot Grass	Goose Grass	SEDGE	Sedge
DANDELION	Dandelion	Sicklewort	Heal-All
Dead Nettle	Henbit	Silver Crab Grass	Goose Grass
Devil's Grass	Quack Grass	Spotted Matweed	Spotted Spurge
Dog Grass	" "	SPOTTED SPURGE	" "
Drop Seed Grass	Nimble Will	Summer Grass	Crab Grass
Duckweed	Purslane	Tongue Grass	Peppergrass
English Plantain	Plantain	Twitch Grass	Quack Grass
Fall Grass	Crab Grass	Water Grass	Crab Grass
Field Balm	Ground Ivy	Wheat Grass	Quack Grass
FOXTAIL	Foxtail	WILD GARLIC	Wild Garlic
Gill-Ale	Ground Ivy	Wild Onion	" "
Gill-over-the Ground	" "	Wild Poertulaca	Purslane
GOOSE GRASS	Goose Grass	Wire Grass	Crab Grass
GROUND IVY	Ground Ivy	Wire Grass	Goose Grass
HEAL-ALL	Heal-All	Wire Grass	Nimble Will
Heart-of-the-Earth	" "	Witch Grass	Quack Grass
		Yellow Galingale	Sedge
		Yellow Nutgrass	"

CHAPTER VIII

MAINTENANCE

Most of the articles written on lawn maintenance begin bravely with remarks on that subject, and then spread out into the discussion of soil, drainage, planting, fertilizing and other matters which belong away back in the planning stage of the project.

Maintenance is maintenance. It begins with the completion of the building of the lawn. If the project has been done on contract, maintenance begins when the owner accepts the job from the contractor. Discussion of planning and construction is out of place. And on this basis maintenance calls for vigilance, timeliness, patience and common sense.

Maintenance continues some of the operations of building the lawn. Seeding may be required for bare spots and to correct mistakes in selection. Fertilizing may be indicated at times. Weeds must be controlled and some kinds must be eradicated. Animal or insect pests may compel the rebuilding of portions of the lawn. Then there are a few points which are maintenance and nothing else.

The height of mowing is a familiar subject for discussion. Some seem to think that unless the lawn is kept as short as a putting green it is not neat. If we were to mow our forests down to bare trunks, below the lowest branches, we would expect nothing but a collection of dead trunks as a result. Each grass plant has its own branching structure, which maintains its system of foliage. This structure draws up water from the soil, and breathes it out into the atmosphere. The process is necessary to continuing existence for any vegetation. If the lawn is mowed down below its branching system, it is only fair to expect it to languish in any growing weather, and fail in the hot months.

Most lawns would look better if mowed at least 1-1/2 inches high and they would surely be more sturdy. Such mowing leaves a good body of branches and foliage and gives the grass a chance to combat all enemies with its own healthy resistance. Most grasses will protect themselves adequately if given a chance. It is notable that they have few difficulties when allowed to attain their full height and vigor as field crops.

Many weed types take full advantage of close mowing. This mowing not only reduces the strength of the grass so as to make weed intrusion easier, but the weeds persist by adopting a low-growing or creeping form, and spread to occupy the whole ground underneath. They are a greater menace when stunted by low mowing than when compelled to fight with higher grass for a place in the lawn. When the grass thrives weeds usually do not.

Another dispute rages around the disposition of lawn clippings. The argument against leaving them as they fall is that they scorch under the hot sun, and that this heat hurts the grass in contact with them. This might happen. Hay fields get very hot in harvest. Green hay will catch fire by spontaneous combution at times. Any decaying vegetation generates heat. But heat is noticeable only when the vegetation is confined and compressed.

Grass clippings on the lawn are exposed to every current of cooling air. They are subject to evaporation the instant they are cut so they are really in a cooling condition. There is more superstition than anything else in this notion that clippings will scorch a lawn. However, there is a practical answer to the argument. If the clippings seem to be burning the grass it is because they are hanging in the foliage. Sweep them down to the ground by going over the lawn with a lawn rake, working across once in each direction.

Akin to this claim is the one that decaying clippings make a soil acid. They do, because all vegetation is acid. But what soil we have has been made through countless ages by the decay of acid vegetation, and most of this soil is far better than we can make. We overlook the fact that nature is normally in balance, on the front lawn as well as in the jungle. Alkaline materials are always flying around in the air, as any one will agree after watching a limestone road waft up in clouds and spread itself out in finest particles on the adjacent field and lawns.

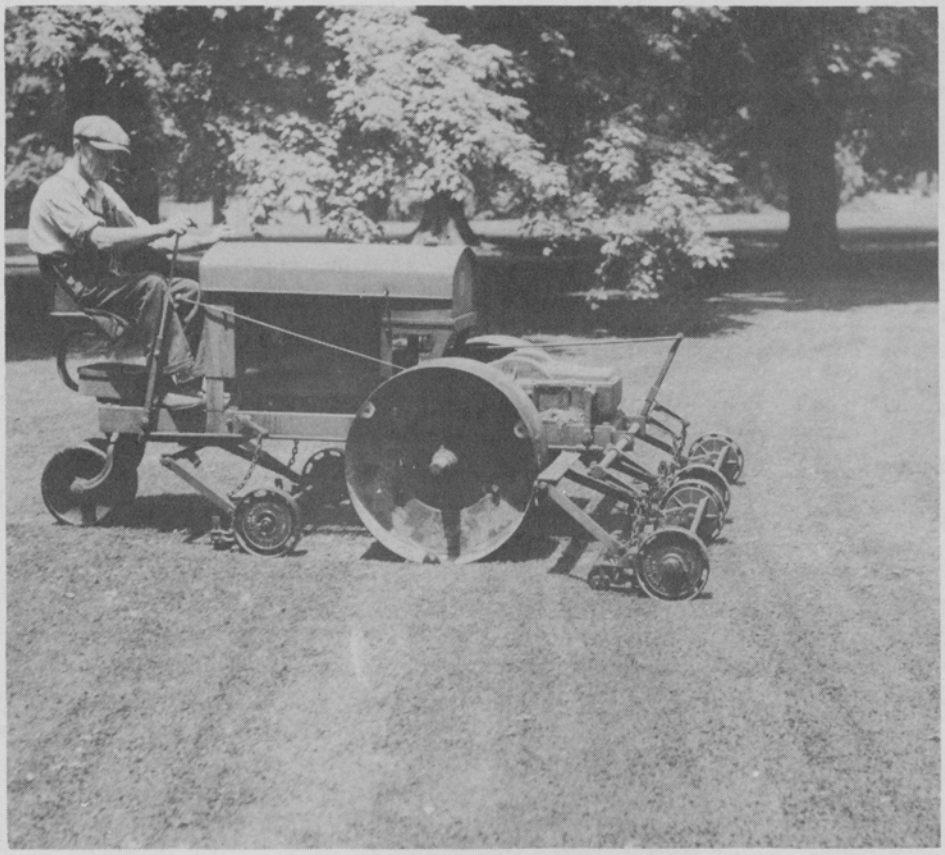
No place in the universe is insulated from forces which operate to balance one another. At times we need to assist, but we butt in far more often that there is any need to. If we cannot descry any alkaline hosts to combat the acidifying legions, we can scatter a little finely powdered hydrated lime over the lawn some night when there promises to be enough light rain or dew to wash it off the foliage before the sun strikes it in the morning, or when it can be washed down onto the ground with light sprinkling.

In any case, throw away the grass catcher. Let the clippings fall where they may. Rake them down if necessary and let them make humus, which is the end of all vegetation. It is a grand thing to have this constant building of soil, even on lawns.

Fertilizing is a distinct process in maintenance, different from fertilizing uncovered soil. All chance of introducing humus into the soil is past. Grass clippings will accumulate on the surface, and by slow degrees build more soil there, but nothing will put humus into the soil except the growing processes of the roots within the soil. Therefore, fertilizing in maintenance is limited to two functions: It will stimulate the plant food already in the soil by activating it, or it will introduce concentrated plant food in liquid form. Fertilizing in maintenance is only a corrective measure.

This emphasizes the statements made in other chapters about the necessity for putting into the lawn area all of the humus, drainage, and fertilizer when the lawn is being built. Once the lawn has come to be a maintenance project it is too late to supply any of these basic essentials.

Fertilizing to correct conditions should be done with the utmost reluctance and care. Expect the lawn to behave as a normal, balanced, vegetated area. If given a chance it will take good care of itself. But if an area planted in sun-loving grasses becomes shaded, that calls for seeding with shade grasses as required. If it is evident that an area needs stimulation, go back to the chapter on Humus and Fertilizer and choose the one ingredient or the combination which seems likely to supply the



Two Common Types of Power Mowers.

deficiency. Scatter it sparingly. Do it at evening, and only when rain or dew or sprinkling will wash it off the grass foliage and down onto the ground. It is far better to spike the spots and then wash the fertilizer into the holes.

When we inject the subject of watering the discussion becomes much livelier. Some seem to think that a lawn is aquatic. If their excessive watering stayed on the surface, or within the reach of grass roots, --- as they fondly think it does --- every lawn could be a part-time duckery. The ducks could swim in it for their regular morning setting-up exercises, and feed on it after the flood subsides. Then the area could do its act as a lawn until again submerged in the evening sprinkling.

If a lawn is well built, and is not mowed too close, it requires no more water than a pasture, or hay crop, or other shaded ground. It does not require as much moisture as cultivated soil, such as a garden or corn field. To leave a sprinkler on all night, as is often done on lawns and gold greens, might be equivalent to three inches of rainfall.

By a meter test the Water Division of the Municipal Government of Washington found that a 3/4" line would deliver 229 cubic feet of water an hour. This is equivalent to 2.75 inches of water on each 1000 square feet of lawn, or an area 25 feet x 40 feet. On page 24 the Annual Normal Precipitation for Baltimore, Maryland, the nearest point to Washington in the tables, is 42 inches. It would take only 15 hours of sprinkling on this 1000 feet of lawn to equal the annual rainfall. It would require only 8 hours to equal the precipitation in the growing season, that is, the summer plus half of the spring and fall.

This is the case in one large city. It may not be the same for all cities, nor for all parts of any city. There are friction losses in any long main, and in pumping up hills. Corroded pipes in the house system will reduce the flow, and friction will reduce the flow in a long hose. But it will be found in any city that sprinkling is usually excessive.

It is no more reasonable to believe that the grass needs this much water than that it uses it. If it needs that much then why doesn't the wheat crop a short distance away shrivel up and fail utterly?

The grass does not use water in excess of its requirements, any more than we drink all the water that will run out of the faucet. The excess is detrimental in two ways. First, because the excess water either flows off the surface, and erodes little channels which must be doctored up with soil and seed later on. Or, second, it finds, or makes, channels down into the subsoil, far below the point where the grass roots can ever reach, and leaches good plant food down into the subterranean depths where only the most befuddled Chinese earthworm will ever find it.

When the water has passed on down, these channels are open to excessive evaporation from below the level of the grass roots. In soils that crack when they dry, such as heavy clays, these channels become cracks and the whole surface of a lawn may become cracked and dry, not because it needs more water, but because it has already had too much.

Equally bad is another effect of over-watering. To be really normal and strong, grass should lead a natural existence. It should have to send its roots deep into the soil for food and water, thus developing a strong root system to resist dry spells and hard winters. But if it is made a hot-house case by watering it so regularly that it can get all its required moisture on the surface, the root system will

Rolling the Bowling Green
Haverford College, Haverford, Pennsylvania.

Sprinkler System
City Park. Casper, Wyoming.

be thin and stunted. It will spread out on the surface, exposed to all the heat of summer, and all the freezing of winter. If anything should break up the daily watering routine, the lawn will fail. It has not been made to stand on its own feet--- or roots.

Sprinkling should imitate a light, misty rain. The water should fall as small drops. Sprinkling should not be done more than once a week, and then only when it is certain that there has not been enough rain. The soil should be wet only two to four inches deep. The correct amount of water is about 75 per cent of the water-holding capacity of the soil.

Irrigating is necessary for watering lawns in the arid sections of the West, and while the remarks concerning sprinkling do not apply, the comments on the right amount of water and the times for watering are the same. People in the humid areas of the country could learn a lot from owners of the irrigated lawns about the amount of water needed and the right intervals between watering. Water is precious there, and it is made to perform its full duty.

Small earth dikes are thrown up around the lawn, and the area is then ponded. All of the water thus concentrated on the lawn goes down into the soil structure, and experience determines accurately how much is to be applied and at what intervals. A few feet outside this ponded area the vegetation may be brown and withered, but within the dikes the lawn will be a vivid and luxuriant green.

The best way to maintain a lawn is to expect it to be natural and keep it under control. If it is allowed a normal existence it will take care of itself in all ordinary conditions, just as we do in our daily living, and in emergencies or catastrophes or plague visitations it may need some help---just as we do. It is no less natural than a field of cotton or any orchard of prunes. If it is kept on that basis, it will be a pretty good lawn.

CHAPTER IX

SUGGESTIONS FOR PROJECT TRAINING

Men who know grass, the varieties suitable for different conditions, how to prepare the ground for it, plant it, transplant it and maintain it, may be pioneering a new vocation. Today all of this is listed under groundskeeping, and a caretaker is supposed to know all about grass as one of many duties. But grass is receiving more attention, and special knowledge concerning it, backed up by successful experience, may well find special employment.

Every country club, private estate, park, preserve, landscape architect and contractor, public recreation place, and extensive city home is a prospect for steady employment or technical supervision of occasional work. It may take a good deal of effort to induce people to build lawns properly, and to convince them that maintenance of the right kind calls for experienced help, but this will develop just as the public has learned to accept advice about trees and crops. The notion that anybody can make a lawn by scratching up the dirt and sowing seed recommended by the drug store clerk will persist for a long time, but on large areas where cost is a controlling factor, and where success must be assured, a specialist in grasses and their growing will find a job.

For best results in training this book should be used to point enrollees directly toward jobs. Off-the-job training should come ahead of actual work. There is so much foundation information necessary, and so much field work in identifying species and analyzing conditions, that there will be little time to become well grounded after the job starts.

It is suggested that an open field be selected for a laboratory, preferably fronting on a road. It makes no difference how rough or eroded it may be, nor what --- except a field crop --- is growing on it. It should have slopes which would have to be sodded in actual practice, and should present a variety of conditions calling for drainage systems, extensive grading and molding, and preferably poor soil.

Before the work project starts on lawns the crew should be given preliminary training on this field, following the chapters in the book. After the lawn building on the work project starts the field laboratory can be abandoned except for experimental growing of a few well-known grasses.

The following suggestions for use of the book are not exhaustive by any intent, but should stimulate off-the-job training, as well as point out some possibilities in the preliminary work.

Chapter I, Analysis of Conditions.

1. Is the land flat, gently sloping, or with steep slopes?

2. How does it drain? Does the runoff move slowly, stand on the land, soak in fairly well, run off rapidly, rush off in torrents?

3. Is the place covered with vegetation, with sparse grass, with weeds, brush, trees? Or is it bare, gullied, rocky?

4. Is there any soil on it? Or is it all worn down to subsoil?

5. What can be learned about the soil from the vegetation growing on it? Refer to the table of Properties of Grasses, page 39.

6. Is the soil acid or alkaline? Dig a hole two feet deep and take samples of soil at intervals of about three inches down the side of the hole. Test these samples for acidity with litmus paper. Any seedsman or agricultural college will send the complete test.

7. What can be learned from crops or grasses on adjoining property to indicate what can be done with this piece? Is the soil the same? Are adjoining fields fertilized, is crop rotation practiced, are they terraced to prevent erosion? What grasses are grown for hay or for clover?

8. How hot does it get here? Do they have droughts in mid-summer? When do they get their rains, and how much rain or snow? When is danger of frost past in the spring, and when do frosts come in the fall? Is the ground covered with snow through the winter? Do lawns grow through the winter? Do they have destructive rains during the spring planting season? Are there dry spells in the spring months?

9. Are there any country clubs or large estates in the neighborhood where they have had experience with lawns and grasses?

10. Has any landscape concern in the neighborhood had experience with grass here?

Have eacn man in the crew write up his analysis of the field, and give his ideas about the features which will control the treatment of the area. If he has a clear understanding of the conditions which have to be met he will be able to proceed to prepare and plant the area. The crew should not be allowed to go beyond this point until each man understands the methods of analysis.

Chapter II, Preparation for Planting.

It is assumed that no plan has been prepared for molding the area into a lawn. If a plan has been prepared it should not be shown. The men in the crew should be required to proceed as though there were none, and then compare their ideas with the plan provided.

1. Stake out the area with grade stakes showing the grading to be done. The finished plan must provide adequate drainage with all concentrated water carried away by surface or sub-surface structures. There must be proper slopes for walks and drives.

2. Describe the cutting of high places and the filling of low places and eroded channels, washes and gullies. How should dirt be settled in fills?

3. What equipment would each man use in grading and molding the area? What will the work cost by two or three methods?

4. Is the soil good enough to warrant building it up with manures and cover crops? How do they know?

5. Check the crops and grasses growing on the other land nearby, to see what can be expected of this soil. Is this area better or worse than these other fields?

6. What procedure would each man follow in building up a seed bed with the present soil?

7. Cover crops will be used through this summer in any case. What crop will take hold here? Which one will make the best sod and best prevent erosion?

8. If the soil is not good enough to be built up, what assurance is there that "top soil" purchased outside will be better? Where will top soil be obtained? What will it cost delivered to the job?

9. What was growing in this top soil before it was dug up? Was it acid or alkaline? Was it infested with weeds?

10. What will it cost to spread and settle this top soil?

Have each member of the crew make up his own plan for preparing the area for planting. This should include all the details, and explain why he does each part in his way.

Chapter III, Planting.

1. How will each man plant the area? Assign a certain way to each man and have him write up his approval or rejection of the plan, giving adequate reasons for his opinion. Grading of papers should be done on the reasoning and analyzing done by each one, rather than on his opinion alone.

2. Have each man stake out the areas for each method of planting in a combination scheme.

3. Should strip sodding be planted above grade or level with grade? Why?

4. What is the fastest way to get a lawn regardless of cost?

5. Referring to the temperature and precipitation tables in Chapter IV, when would each man choose to plant this lawn by several methods?

6. By what method would each man feel most sure of getting only good species of grass in his lawn?

7. What will it cost to make a lawn here by each of several methods over a period of one year?

8. What special areas must be recognized in the site, supposing the existence of a house, outbuildings, gardens, and several large trees?

Chapter V. Kinds of Grass.

1. Assuming that the lawn is to be seeded, have each man make up a plan of the area showing what kinds of seed would be used in each part of the area. This seeding is to be done in two periods, the first to get a firm sod to protect the surface, and the second to make up deficiencies in the basic sod, and to refine it by adding better species.

2. Is one or more of these varieties to be used as a "nurse grass"? Why is a nurse grass necessary?

3. Suppose there was only half as much rainfall, what change would be made in the choice of grasses?

4. Suppose the summer was 20 degrees hotter, what kinds of grass would be substituted?

5. Suppose there was a 3-weeks dry spell in April, what change would that make in the planting plans? Could the same grasses be used?

6. Why do they want to use white clover? Is it dependable here?

7. Suppose this lawn has to be mowed down close, will that alter the list of grasses which can be used?

8. What about the shady places? Have grasses been selected for them?

9. What grasses would be planted in a sod nursery for this neighborhood?

10. How can different kinds of grasses be mixed when a lawn is sodded?

11. How can grass be mixed when the lawn is planted with a combination of methods?

12. How can different species be used to make both winter and summer lawns, or both spring and hot summer lawns?

13. Plant several kinds of lawn grass and allow them to grow to full height and go to seed.

Chapter VI, Humus and Fertilizers.

1. What is humus? Have the crew find some, and make some.

2. What do humus and fertilizers do?

3. Is manure humus or fertilizer? What does it do for land?

4. What humus does this field require? How much does it have now? How do you test for humus in soil?

5. What are the principal plant foods, and how are they indicated in fertilizer formulas?

6. Is all of a commercial fertilizer available as plant food?

7. Will fertilizers "burn" a soil?

Turf on Play Areas
Goodyear Heights Reservation, Akron, Ohio.

It must serve under little feet, too.

8. What is lime for? What kinds of lime change the structure of a soil? What kinds will temper acidity? Will lime "burn" a soil?

9. Can fertilizers and manure be spread at the same time? Lime and manures?

10. Can manure be made artificially? How? Why would this be better than plowing green stuff under?

11. What is compost? How does it compare with manure, humus, fertilizer? Will it take the place of any of these three?

12. Should manure and fertilizer be mixed into compost? What about animal wastes?

13. Should the compost be taken out from the top or the bottom of the pile? Why?

14. What does this field need in humus, fertilizer, compost, manure? How much? What will it cost? Where will you get it?

15. Could the same result be obtained with green crops plowed under?

16. How could you combine green crops and some of these other materials?

17. Should grass be planted for a lawn on freshly treated soil?

18. Does this place need lime to make a lawn? State the case fully for or against the use of lime here. Have someone else argue the opposite view.

Chapter VII, Weeds and Other Pests.

1. Are CCC enrollees permitted to handle poisons?

2. What is a weed? Explain fully. Ask each member of the crew to write his answer at length.

3. What other pests are there on lawns?

4. Is it necessary to destroy all of them?

5. What is the best way to get rid of dandelions?

6. What would it cost to spray ten acres of lawn with iron sulphate with a good spraying outfit?

7. What weeds should be dug out of a lawn?

8. What is it that grows through cracks in walks? How is it destroyed?

9. What popular and effective chemical is dangerous on clothing or grass? How should it be handled? What weeds is it used on?

10. For what weeds should the mower blades be set high, especially during the seeding season?

11. What animals are troublesome on lawns? Do they all live in the lawn?

12. Are earthworms really troublesome? How?

13. Do some grasses become weeds, and are some weeds suitable as grasses? Is this truer in some sections than in others? Is it permissible to encourage some so-called weeds in certain places if kept under control?

14. Give thorough instruction in identification of weeds for this locality, and have each member of the crew find his own specimens and describe them.

Chapter VIII, Maintenance

1. Can sprinkling be harmful to a lawn? In what way?

2. Must mower cuttings be taken off the lawn? Have each member of the crew study this and write out his answer, explaining his view in detail.

3. How much water will be put on a lawn in ten hours of steady sprinkling through one outlet? Compare with the annual rainfall for this place.

4. Should fertilizing be done on a going lawn? When, and how?

5. Is seeding or other planting ever necessary in maintenance? Can this planting be done with sod or stolons? Would these methods be better than seeding? Where would you get a few stolons for patching bare places?

6. How long should a lawn be mowed? Explain the growing habit of grass to make your answer clear.

7. How would each member of the crew control undesirable species in the lawn, such as dandelion, plantain, orchard grass, Canada bluegrass, chickweed?

8. What would each one try for ants?

9. Can mildew and brown patch be controlled or eradicated? How?

10. What undesirable growth indicates the presence of rotting wood under the lawn? Can the growth be stopped?

11. Is there ever a condition which can be eliminated by allowing the lawn to grow without mowing?

12. Under what conditions would each member of the crew turn a lawn under and start over?

GENERAL

The most important general subject is the cost. No work of any extent or importance is done without an estimate, and only by constantly checking actual costs against estimates can any confidence be acquired in estimating work. Since lawns are a new line of work, not much information can be obtained on costs, and the conditions vary so sharply from place to place that it will be a long time before any dependable costs will be obtainable. Therefore, it behooves every man in the crew to begin to collect his own figures on the cost of doing lawn work.

Assume a general plan for a five-acre lot in the field we have been using, with

a house, other structures, and a garden in the area, with shade trees and fruit trees influencing certain parts of the lawn, and draw the area which is to be made into a lawn and maintained for one year.

What will it cost? Set up a complete set of imaginary conditions for each member of the crew, each one to be different, and have estimates prepared in detail, just as though each man was taking the job and had to make a profit out of it.

Set up certain overhead costs to be common to all the estimates, with a certain percentage of profit, say 25%, and have each man go through the steps necessary to bid the job and go through with the contract.

THESE QUESTIONS ARE ONLY SUGGESTIONS! MAKE UP YOUR OWN QUESTIONS AND OUTLINES!

EACH AREA IS DIFFERENT. SO IS EACH PROJECT. THEREFORE, EACH FOREMAN SHOULD MAKE UP HIS OWN OUTLINES FOR TEACHING, GOING THROUGH THE SUBJECT STAGE BY STAGE, REQUIRING EACH ENROLLEE IN THE CREW TO BECOME PROFICIENT IN EACH PART OF THE SUBJECT.