Chapter X

WILDLIFE MANAGEMENT

What Is Wildlife?

THE creatures of field and forests, not domesticated by man are known as wildlife. Wildlife management is the art of producing and maintaining wild animal populations for recreational use. From the standpoint of the sportsman and recreationist, we are primarily interested in production and preservation of game animals, birds, and fish in coordination with other resources.

CLASSIFICATION OF GAME

Big game: Those dwellers of prairie or forest of large size such as moose, elk, bear, antelope, deer, mountain sheep, and goat.

Small game: The smaller animals of forest and field including squirrel, rabbit, raccoon, and opossum.

Fur bearers: Those animals of stream and lake such as beaver, muskrat, mink, and otter; and of forest and field such as fox, skunk, weasel, and marten which furnish much of the fur for women's apparel.

Game birds: Birds of forest and field such as grouse, quail, pheasant, and wild turkey.

Migratory fowl: Wild geese and ducks are the principal species.

Fish: Those fresh water fish, known as game fish, which furnish the maximum sport for anglers.

FORESTRY AND WILDLIFE

Wildlife Depends Upon Forests.

What is the relation of wildlife management to forestry, and what is the interest of the forester in relation to game management? Practically all the big game existent today lives in the forest. There they find adequate food and protection. Some game species, the squirrel for example, live only in the woods. Small game living in fields

Quail fly into the woods for protection.

seek forests for protection, and obtain a great deal of their food from wooded areas. Game birds fly into wooded cover to escape pursuing hawks. When dog and gun would take their lives, they fly into the underbrush of nearby forests. Opossums and raccoons live in hollow trees; game fish live in forest-fed streams.

WILDLIFE AND RECREATION

The forests of today are designed to yield their greatest values to the greatest number of people. One of the greatest of these values is recreation, and here wildlife plays a major role. There is a close relationship between wildlife and forestry, between the forester and game management.

WILDLIFE OF THE PAST

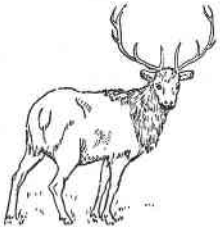
Enemies of wildlife.

Wholesale Destruction.

Most persons are familiar with stories revealing the abundance of game in frontier days—about the hundreds of thousands of buffalo, elk, and antelope which grazed the prairies, and the abundance of forest game which furnished food, clothing, and sport for decades. Wholesale destruction of the prairie game animals reduced their numbers to small herds which were driven by civilization to the rougher, mountainous, forested areas. Small game in some regions has increased since the coming of the white man. In some agricultural sections cottontail rabbit and quail populations have greatly increased.

WILDLIFE OF TODAY

Big Game Is Driven Out.



In the United States today the countless numbers of wildlife have been greatly reduced. The buffalo no longer exists as a game animal. A few remain in national preserves, parks, and zoos. Elk are found in the more isolated parts of the mountain regions, where they are protected on national park and forest lands.

Deer, like the elk, live principally in the secluded portions of the West; a few remain in the North Central States, small herds exist in New York and New England, in the Carolinas, and in Florida. In Pennsylvania lumbering operations, which greatly increased the available food for

deer, linked with a good game-protection organization, has built up an optimum deer population (the greatest number that can thrive in an area) from the few that remained 25 years ago. Bear are found in only a few States, and their numbers are rapidly declining in some of these.

Big game is so scarce that it is a curiosity.

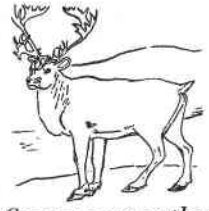
In many sections of the United States small game is very scarce. Although some species are increasing in a few sections and some areas occasionally become overstocked, there is a general decline in game population as a whole. Some species are almost extinct. The native pheasant and sage hen are seldom found, and migratory waterfowl, like other game birds, are on the decline. The wild goose is becoming scarce, and the various species of ducks are declining in numbers. Fish populations, like animals and birds, have also decreased.

Scarcity of Game.

There is urgent need for more information on wildlife. Surveys to determine numbers and available feed are necessary for good game management. Estimates for national forest areas show big game population, 1934, as follows:

Little Information Available on Wildlife.

Grizzly bear	5, 172
Black and brown bear	55, 122
Moose	8, 127
Elk	120, 638
Deer	1, 038, 416
Antelope	15, 013
Mountain goat	17, 962
Mountain sheep	13, 145



Game management has saved the caribou from extinction.

PROBLEMS OF GAME MANAGEMENT

Game-management problems are often baffling, even to the expert. Some of the principal problems are listed here:

Problem No. 1.

(1) *Prevention of extermination of species:* Few species of game have been lost in the United States. The bison (buffalo) was saved at the last moment, but the passenger pigeon and a few others have vanished. Game management should protect all species and prevent any further extermination.

Problem No. 2.

(2) *Space for game:* Home and farm lands now occupy areas formerly inhabited by game. The problem of finding and reserving space for homes

for wildlife, especially those species requiring large areas of wilderness, is a major one.

Problem No. 3.

(3) *Feed for wildlife:* Protection of game often results in animals multiplying until there is not enough food to maintain the population. Feed must be furnished in some form. Winter feeding is sometimes necessary. Forest fires destroy all types of feed for wildlife, and after fires ravage wildlife homes the feed problem may become acute.

Problem No. 4.

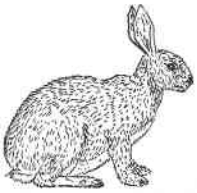
(4) *The problem of overpopulation:* Game has a tendency to collect in areas, and, rather than wander great distances in search of feed, deer and elk will starve in the crowded areas. Where overpopulation occurs, good forage plants are destroyed by overgrazing and trees are sometimes stripped of browse. Animals in overcrowded areas, weakened by hunger, are easily infected with diseases and many die.

Problem No. 5.

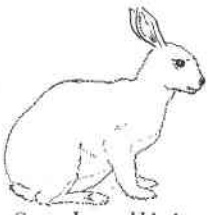
(5) *Protection for game:* Nature has provided some protection for wildlife against man and their natural enemies. For example, the rabbit is a swift runner, the slow turtle has a protecting shell, the porcupine has spines, the skunk has odor, and the squirrel is a swift climber. Adults of large species have horns, antlers, or long teeth. The newborn animals have no scent until they are a few days old, and predators, not being able to

Bears are usually harmless if unmolested.

smell them, cannot find them where they have been hidden in vegetation by the mother. Protective coloration also prevents animals being easily seen. Some species of the North, such as snowshoe rabbit and weasel are brown in summer and white in winter; their color blends with the earth and leaves in summer seasons and with snow in winter. Such protection serves animals well against their natural enemies, but Nature did not consider the fire arms, traps, fences, and dogs of man. The game manager must aid in protecting wildlife against over-attack by predators and man.



Summer coat of snowshoe rabbit.



Snowshoe rabbit in winter.

VALUES OF WILDLIFE

Some of the values of wildlife were shown in Chapter II. It is impossible to show true dollar and cents values for game because it is so related to almost every forest land use; but it has definite economic, social, and scientific values. Of course, there is a negative value also. For example, forage eaten by big game might well support domestic stock. But the positive values seem to surpass the negative.

In the past game values were largely economic.

The United States Biological Survey estimates the annual economic value of wildlife in the United States as follows:

Meat and fur	$190, 298, 270
Destruction of insects by birds	404, 502, 707
Fish	14, 206, 099
Hunter's fees (1930–31)	9, 860, 067
Spent by hunters	22, 304, 425
Spent by tourists in big game country	254, 349, 685
Total	1, 031, 779, 528

Birds are hard workers.

Social values of wildlife cannot be estimated in dollars and cents. The values of recreation, especially forest recreation, were pointed out in Chapter II. Game is attractive to the huntsman, fisherman, nature lover, and photographer. Wildlife attracts us to zoos or to the circus and likewise to forest areas.

Social Values.

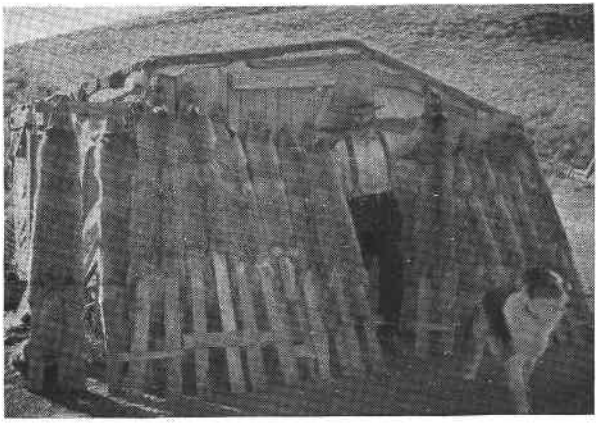
There is beauty about wildlife in its forest home which appeals to us. Artists paint pictures of it and designers of beautiful things weave in the

Esthetic Values.

Scientific Values.

beauty of wild beasts and birds. Something stirs us deeply when we see a graceful, antlered buck standing alert among green trees, or a V-line of south-winging wild geese.

Besides its economic, social, and esthetic values, game has a scientific value best explained by zoologists and the medical profession. Studies of animals, birds, and fish have made possible invaluable contributions to the Science of Zoology and have benefitted human existence.



The professional hunter and trapper finds an economic value in wildlife.

It has been said that everyone should have some sort of hobby. The health and the recreational value of an outdoors hobby can hardly be questioned. An interest that takes one out of doors and away from cares does much to make for better health and more interesting living. A hobby which interests one in the production and management of wildlife has a twofold value—first, to the individual practicing it and second, to society, in helping to build up the quantity of wildlife.

MANAGEMENT OF SMALL GAME

The management of small-game species extends to every part of the country. Prairie and mountain, forest and field, all have some kind of game. The problem of small game protection is largely one of education. Sportsmen's and businessmen's clubs can do much to improve game conditions. Boy scouts, girl scouts, 4–H

clubs, and the Future Farmers of America are mediums for proper dissemination of game-management information. Game has definite value to the landowner just as crops of fruit and grain. His interest in the protection of the game on his farm is a natural one as is his interest in protecting his livestock and crops.

Such an interest is very helpful in restoring and protecting game population, since the existence of game in this country is largely up to the attitude and activities of the farmer. He can, through his efforts, do much to maintain an optimum small-game population throughout the country.

COVER

Game needs a place to live. It must have protection from predators (animals or birds which kill game for food), from dog and gun, and from severe weather. One of the best forms of protective cover for farm game is the farm woodland. There rabbit, squirrel, quail, pheasant, and other species may live. Squirrels stick closely to woods. Quail work in and out of timber, using woods and underbrush as emergency protection when molested. Hollow trees furnish living quarters or storehouses for squirrels. Brush left on the ground makes excellent cover and protection from owls, hawks, and other predators. Thickets growing on rough corners of the farm, creek banks, and rocky land make suitable breeding places and good habitat for small game. Landowners may provide game cover by leaving hollow trees for homes, and brush and thickets for protection.

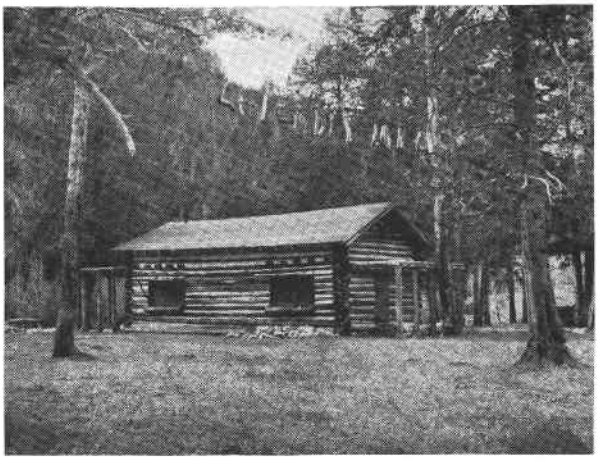
FEED

Regardless of the amount of cover for upland game, it cannot exist without sufficient food. The farmer may help to furnish food for game and birds during winter seasons by leaving uncut patches or corners of food crops such as corn, wheat, sorghums, kafircorn, millet, sunflowers, soybeans, and field peas. This is often added to by permitting weed seeds to ripen before mowing, or allowing weed fields to stand through the

winter. Seed trees left in woodland or scattered on the farm furnish additional feed for small game.

Emergency Feeding Is Sometimes Necessary.

Emergency feeding of some game species is successful and may be necessary in unusually hard winters when it is extremely cold and snow



Hunting lodges are built in forest game areas.

is deep. Suitable inexpensive feeding bins can be built which require little attention. These should be placed in secluded places frequented by game, but near enough to be under periodic observation. It is, preferable, however to give nature the opportunity to provide for the denizens of field and forest since artificial feeding tends to make beggars of them and they lose their game qualities.

STOCKING

Obtaining Game.

If desired species are not present on lands to be put under management, they may often be obtained from the game organization of the State or from sportsmen's clubs. Sometimes game for introduction may be had free. The farmer-game manager has opportunity to raise, release, and protect certain species on his farm. Native species are usually most successfully introduced,

"Go Easy" with New Species.

and new species should not be released in large quantities in any locality until they have proved to be both desirable and suitable to the habitat. Introduced game species must be given complete protection and the necessary environment factors must be provided for them.

LAWS

If game laws allow hunters to take their limits in the home State and then go into the neighboring State at the opening of its hunting season and take the limit there, each State is supporting a double population of hunters. A national organization seems necessary to bring about united effort in restoring wildlife populations, creating better game laws, and providing law enforcement.

Poor protection means scarcity of game.

The management principles relating to small game apply alike to animals and game birds. Furbearers require similar conditions, except that they prefer and are most abundant in streamside and swamp land.

How the Game Farmer Can Help.

In addition to protecting, feeding, and helping to secure and enforce proper game legislation, the farmer-game manager can assist in game conservation by:

1. Posting his land against open hunting.
2. Regulating the kill of his game.
3. Killing stray cats.
4. Controlling natural enemies of game.
5. Tying up his dogs during game breeding seasons.
6. Preventing destructive fires.
7. Organizing with his neighbors, a game protective association.

How the Sportsman Can Help.

The sportsman can insure more game and better hunting by:

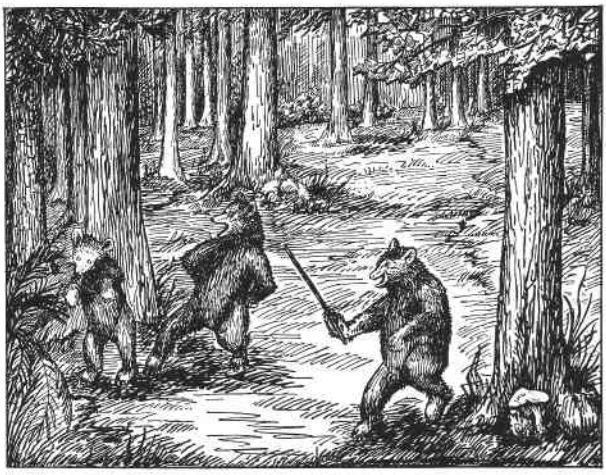
1. Cooperating with the farmer in his efforts to better game conditions.
2. Being more considerate of the wishes of landowners.
3. Being careful of the farmer's property, especially livestock.
4. Being governed by existing game laws and helping to improve and enforce laws where necessary.

MANAGEMENT OF BIG GAME

In the denser populated regions the management of big game is a greater problem than small game management. Game of the larger species was named earlier in the chapter. Wolves, coyotes, foxes, wildcats, and mountain lions are game of the predaceous type, commonly called predators.

HOMES

The lack of space and conditions for homes for big game limits their numbers. The national



The clowns of the forest.

Park Service Provides Space.

forests and parks therefore provide most of the homes for the larger species. In the Rockies and the Far West, the extensive forest areas under National, State, and private ownership are well adapted to the raising of big game. In the East and South, forest areas are broken and more thickly settled, furnishing poor habitat. The purchasing of more land by the Federal Government will help to solve the problem of living space.

Big Game Seek Secluded Areas.

THE YELLOWSTONE HERDS

Excellent examples of the problems involved in managing big game and of the methods of solving these problems are to be found in the Yellowstone Park and the adjacent national forests, where America's big game abounds. The elk have offered an especially difficult problem.

Summer Conditions Good.

In summer, forage is abundant in the park and adjacent areas, but since the altitude ranges from 6,000 to 10,000 feet, deep snows in winter prevent elk from feeding. They must seek the lower altitudes north and south of the Yellowstone area. There, forage is becoming so scarce that the animals are unable to find sufficient feed. Much of the tree browse has already been consumed. Cold winters with deep snows prevent elk from pawing away the snow and finding forage. Even though the elk are able to reach ground they may find no feed, because heavy grazing of any area

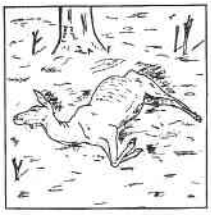
Winter Conditions Bad.

by either game or domestic stock during the summer leaves no reserve for severe winter weather. In the winter of 1919, it was estimated that 8,000 head of elk of the north Yellowstone herd starved to death.

Park and forest rangers have for years fed the elk hay during hard winters. This prevented starvation but brought about partial domestication of the elk, which is undesirable.

The Jackson Hole Herd.

Conditions are similar on the south side of the Park. The elk winter in Jackson Hole where they have been so limited in range that little forage is left. The section is overpopulated in winter and many starve. The Government has fed this herd, and the animals have become practically domesticated beggars. They make no attempt to forage for themselves, which adds to the management job. Hay is scarce and hard to produce, and contains species of plants harmful to animals. Poisonous weeds and such plants as foxtail grass, having spines which irritate the mouth and digestive organs, often cause death.



Starvation often comes to game in overcrowded areas.

Diseases.

Crowded together as they are in the Jackson Hole herd, the animals are easily infected with diseases. Animals weakened by hunger are more susceptible to disease than stronger ones.

Causes of Diseases.

The common diseases of the elk of the Yellowstone region may be caused by (1) parasites, (2) bacteria, (3) physical deficiency, or (4) mechanical injury. The *parasites* causing serious infections are ticks, deer bot fly, tapeworm, and lungworm. The greatest of these is probably the lungworm, which causes infections and congestion of lungs, often resulting in death.

The most threatening *bacterial* disease is a disease of the mouth and head which attacks tissues, bones, and eyes. The bacteria begins its work in the mouth, entering the wounds caused by barbs on foxtail grass which grows profusely in the area. Thousands of these tiny spears work their way into tissues of the mouth causing infections and decomposition. The bones of the head are infected and become soft or decomposed. When the barbs or bacteria reach the eyes blindness results. This disease has the common name

Foxtail, barley grass (Hordeum jubatum).

of "sore mouth," but is scientifically known as *necrotic stomatitis*. Bang's disease, which is an infection of organs of pregnant animals which cause them to drop their young before maturity, is also caused by bacteria.

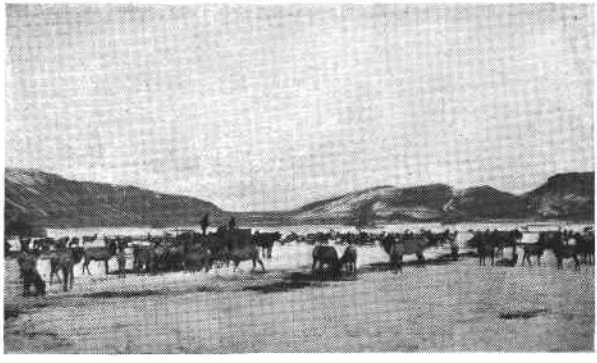
Deficiency Diseases.

Deficiency diseases are caused by improper and insufficient feed. Lack of sufficient mineral elements causes softening of bones. A weakened and undernourished animal contracts other diseases easily and has no vitality to combat them. Wounds from gunshot, broken bones, and lacerations, if not fatal in themselves, may cause diseases of bone and joints.

The disease-prevention problem is most easily solved by providing ample forage. Good forage and browse prevent most of the diseases mentioned. Prevention of overpopulation and crowding checks the spread of bacterial diseases. Salting on ranges may provide some of the necessary mineral elements which are deficient. Either rock salt, molded blocks, or loose salt may be used. Much of the granulated salt is lost by weathering. Coarse, lump, or block salt is better. Salt should be placed in salt logs, boxes, or natural depressions in rocks. Containers may be made by chopping cups or troughs in logs, or they may be made from heavy lumber.

Salting helps to provide mineral elements.

The situation encountered in managing the elk herds of the Yellowstone suggests the difficulties met with in managing big game elsewhere. On some areas, such as the Kaibab Forest in Arizona, deer offer an equally difficult management problem.



Overpopulation and lack of forage necessitate artificial feeding methods.

Solving the Problem.

By a careful range and game survey the needs of game and the amount of feed available for them may be determined. The reduction of livestock and game on overgrazed ranges and artificial reseeding on some areas will do much to increase the quantity of feed and otherwise improve such areas. It seems desirable in such cases as the Yellowstone elk herd to prohibit domestic livestock grazing. However, under present conditions on much of the western range lands, a sane adjustment between live stock and game range will allow for ample numbers of both classes, if properly managed.

Regulating Game Population.

State and Federal authorities have cooperated in improving the conditions encountered by the Yellowstone herds. Areas near the park have been closed to livestock grazing. Purchase areas which will provide adequate winter range have been recommended for the southern herd. Properly managed, such areas should help to solve the game-management problem.

Preventing forest fires favors game production.

Timber management can do much to increase feed for game. Young trees and lower branches of mature trees often furnish the major part of winter feed for browsing animals. In crowded areas, especially in hardwood stands, all the lower branches of trees as high as the animals can reach are often consumed. Timber management of hardwood stands can, by encouraging smaller timber sales and breaking up large areas of even-aged stands, produce more food for browsing and other game animals. Timber-stand-improvement work which opens up the stand, stimulates sprout growth, and allows other vegetation to come in, also increases game feed. On areas in hardwood forests (refuges, etc.) where tree browse is getting out of reach and which must support certain numbers of game, the removal of the more worthless species gives nature a chance to produce more food. Abandoned farmsteads which do not support tree growth can be improved by planting game food and cover species, provided the game population on adjacent areas is not so high as to make planting impossible. Deer in Pennsylvania,

Deer line, below which all leaves and twigs are eaten.

for instance, eat the seedlings almost as fast as they are planted.

Regulating Game Population.

Preserves and breeding grounds are necessary to protect game populations which are on the decline, and provide a good means of restocking depleted areas. State and Federal agencies have established many protected areas, but there are still many sections where preserves could rebuild game populations. However, after animals have become established on protected areas, overpopulation often occurs, which results in feed shortage. Such overpopulation can be prevented by live-trapping the animals and shipping to unpopulated areas. Areas similar to the Kaibab Forest in Arizona, where a crisis existed and immediate reduction of large numbers was necessary, may be opened to controlled hunting. After the required number of animals has been taken, the area may be closed again.

Transporting the Animals.

Controlled Hunting.

MANAGEMENT OF CARNIVORE

The management of carnivorous (meat eating) game requires a different type of control. The larger predators are wolves, coyotes, and mountain lions. Hunting and trapping of these predators by State and Federal authorities has greatly reduced their numbers. The smaller predators are likewise controlled but are not being exterminated.

Many States now classify bear as a game animal. If food is scarce bears often rob beehives and kill domestic stock, but bears as a group are considered desirable game animals.

MANAGING MIGRATORY FOWL

The management of migratory fowl ranks with management of other game in importance. Wild geese are becoming very scarce, and the duck population is definitely decreasing. Some migratory species of pigeons have completely disappeared and doves and woodcock are becoming scarce.

Wild Ducks Are Decreasing in Numbers.

Marsh and waterfowl are the principal species of game birds that migrate. Of these, ducks and

geese are most important. Both these species are good breeders, and if unmolested, multiply rapidly on marshland waters. Wild geese breed and summer in the Northern States or in Canada. In winter, these same fowls are found in the marshes of the Southern States. Ducks breed and rear their young in the northern or temperate regions. They migrate for shorter distances than do geese and some species spend the entire year in the same locality.

Ducks and Geese Principal Migratory Fowls.

PRESERVES AND BREEDING GROUNDS

Preserves and breeding grounds provide retreats for waterfowl where they are not molested. Additional food plants may be introduced in preserves such as wild rice, eel grass, marsh grass, pond weed, and wild millet. In many areas wild rice is the best marsh food for ducks and geese.

SANCTUARIES AND REFUGES

Inland sanctuaries and feeding grounds furnish places where birds in migration can rest and feed. In sections where a great deal of shooting is done refuges give birds a chance to flee from hunters when driven from their customary haunts. Sanctaries may prevent the extermination of the entire flock, thus providing breeders for the next season.

Wild turkeys digging for acorns on the Ouachita National Forest game preserve.

The enforcement of recent Federal and State shooting laws gives additional protection to waterfowl. In some sections laws are inadequate and enforcement so poor that proper management is difficult to practice. In such cases better laws and enforcement would greatly improve waterfowl conditions.

FISH MANAGEMENT

The Forests and Fish Management.

Fish management is also closely related to forestry and to management of other wildlife. Streams in forests are good game-fish streams because protection from the direct rays of the sun makes them cooler. Various species of trout and other game fish are especially adapted to forest streams. Trees and other forest vegetation are conducive to fish-food production.

Fish ladder built at dam.

Fresh-water fishing claims the greater number of amateur anglers. State organizations in cooperation with Federal agencies have done and are doing much to improve stream conditions for fish production. Private agencies and individuals can also help in fish management.

PROTECTING FISH STREAMS

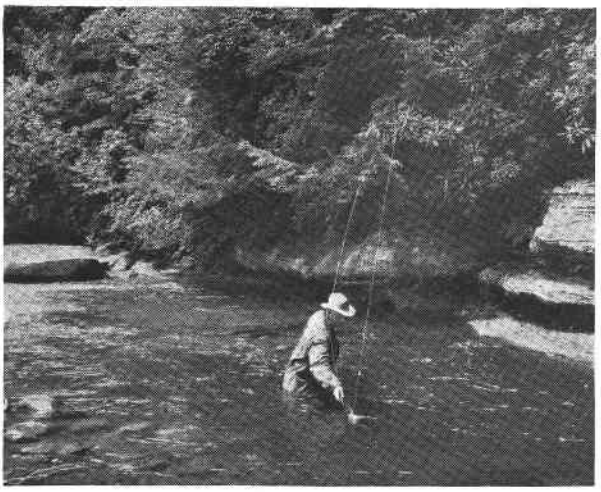
Why Do Floods Destroy Fish?

Constancy of stream flow is particularly advantageous to fish culture. Rivers having extreme flood and low-water stages present conditions adverse to fish life. Floods sweep away fish food, destroy protected homes of fishes, and wash away or cover eggs and nests. Eggs and fry (very small fish) may be destroyed by heavy silt carried in flood water.

Pollution of fish streams by chemicals from industrial plants often kills fish and makes the streams unfit for fish to live in. Prevention of such pollution is necessary if fish are to live in the stream.

Effect of Forest Fires on Fish.

The burning of watersheds is harmful to fish. As shown on page 64, forest fires destroy fish food and stream shelters, such as trees and logs, which furnish shade and food. Protection of watersheds from erosion is favorable to fish protection.



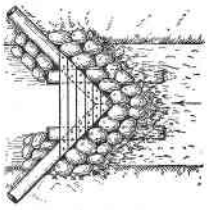
Fishing in forest streams is a popular form of recreation.

Slopes covered with vegetation control water run-off and do not easily erode, thus maintaining clearer, more constant streams.

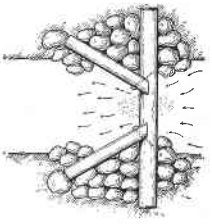
IMPROVING STREAMS AND PONDS

Streams and ponds may be improved to make better homes for fish. In the first place, fish need protected places where they can escape from larger fish. Small and large fish alike must have protection from swift water and debris during flood periods. Additional protection can be artificially established by building dams which retard swift water and make hiding places for fish. Current deflectors also slow up swift water and make undercuts in banks. Where stream bottoms are settled with silt, devices can be built to speed up the current which cleans the gravel, thereby providing spawning grounds and food-producing areas. Fish ladders installed in dams allow fish to travel upstream for breeding. In slow-running streams changes can be made which will speed up the current, thereby decreasing stream temperature and at the same time providing pools for shelter, and riffle areas for feeding grounds.

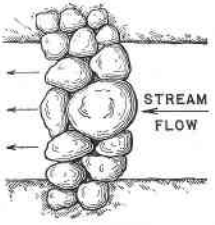
The creation of better stream conditions brings about an increase of fish foods. Experiments in the planting of aquatic fish foods are being carried on, which may prove successful. Poor types of



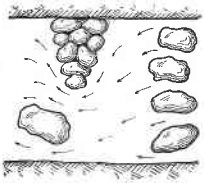
Platform dam.



Underpass deflector.



Rock dam.



Single boulder deflectors.

fish, unfit for food, should be seined from waters where game fish are being managed, to prevent losses of young game fish and fish eggs.

PLANTING AND RESTOCKING

Fish planting or restocking in suitable streams is one of the important jobs in fish management. Streams formerly unstocked often make excellent rearing streams when fish are planted. Where considerable fishing is done, it often becomes necessary to restock with young fish every year to furnish an adequate supply of game fish for the hook. In some cases even legal-sized fish are planted in streams for breeders or to furnish fish for anglers. Fish for stocking are produced in hatcheries which are managed by various Federal and State agencies, and the fry (very small fish), when matured enough to take care of themselves (fingerlings), are transported and released in streams. Many millions of baby fish are planted in forest streams of the United States annually.

Illegal fishing defeats the best fish management.

LAWS

Just as animal wildlife must be protected by adequate laws and proper enforcement, so must fish be protected. Catching small fish at any time, and mature fish during spawning season, reduces the available supply and results in poor fishing. If fishermen would be governed by the laws, this practice would be greatly diminished.

A sportsman's code

1. Obey the game laws of county, State, and Nation.
2. Be extremely careful of all firearms.
3. Look before you shoot—it may be another hunter.
4. Wear red when hunting.
5. Don't be a game hog—a true sportsman doesn't kill wantonly or maliciously.
6. Be careful with fire—fire kills game and destroys their homes.
7. Leave plenty of game for breeders.
8. Respect the rights and property of others.
9. Love nature and the denizens of forest, field, and stream.

SUMMARY

What Is Wildlife Management?

Wildlife management is the art of producing crops of wild animals, fish, and birds for recreational purposes. Game may be classified as follows: Big game, small game, furbearers, game birds, migratory fowl, and fish. Management of wildlife is closely related to forestry.

Small game can exist in nearly all sections of the country. Its management, therefore, is more important to a greater number of people than management of big game. The management of small game relates also to game birds and to furbearers. The problems of small-game management are to provide cover and habitat, feed, stocking and restocking, and legal protection.

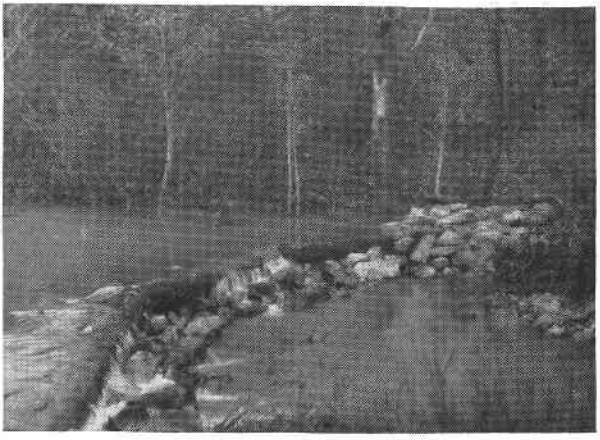
Big Game Management.

Big game, although fewer in numbers than small game, involves more complicated management problems. Big game requires adequate space of forest or wilderness area, proper and sufficient feed, and protection from man, predators, and disease. Prevention of overpopulation, transportation, and restocking are also problems of big-game management.

Control Predators.

The management of carnivorous animals should control them rather than exterminate them. Predators often prey upon other game or on domestic stock or fowls, and populations must necessarily be kept low. In managing migratory fowls, principally wild geese and ducks, the main problems are providing preserves and breeding

Homes for Waterfowl.



Dams in forest streams provide breeding pools for game fish.

grounds, sanctuaries and refuges, and introducing feed plants.

Improving Conditions for Fish Life.

Fish management has to do with rearing and stocking streams, improving streams for fish homes, and protecting fish. Afforesting and preserving forests on watersheds and prevention of forest fire helps to maintain better fish streams.

THE OUTLOOK

It has been estimated that from 1920 to 1930 the number of hunters and fishermen increased 400 percent in the United States.[1] A study of 14 Southern States showed that there were practically as many hunters and fishermen as participants in all other major sports.[2] Americans by nature and environment are sportsmen. Will there be wildlife in the future to supply the recreational needs of these sportsmen?

The CCC Has Helped.

Many State and Federal agencies, foresters, conservationists, naturalists, and sportsmen are interested in game management that will provide for production of wildlife in sustained crops for this recreational use. Emergency Conservation Work performed by the CCC has materially improved wildlife conditions. Erosion control, forest and stream improvement, and fire protection have helped the cause of wildlife reproduction.

The Ideal Situation.

Under an ideal situation ample game would be distributed over all available areas, instead of being heavily concentrated in fewer areas. With adequate food and protection, and with regulated kill based upon optimum population, sufficient quantities of wildlife should be made available for all forms of recreation in America.

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[1] *Senate Committee Report on Conservation of Wildlife*, S. Rept. 1329.

[2] *A National Plan of American Forestry*, vol. 1, p. 494, U. S. Government Printing Office, 1933.

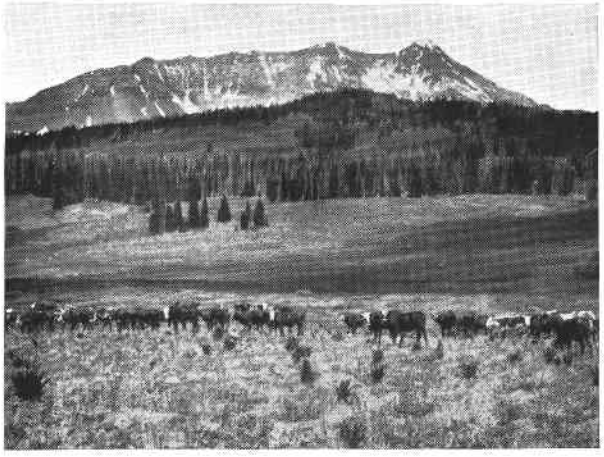
Chapter XI

RANGE MANAGEMENT

INTRODUCTION

THE term "range" is generally associated with stock raising in the Western States. While it is true that most of the unimproved grazing land in the United States lies in the West there are vast areas in the Eastern States which are grazed. In the South, it is estimated that 149 million acres of forest lands are grazed by domestic stock. In the Central and Northeastern States, of 63,000,000 acres of forest lands, principally farm woodlands, over half are grazed.

Forest Lands Furnish Valuable Forage.



Western forest ranges provide forage areas for cattle.

Most of the forest lands contain forage suitable for grazing either in natural openings, prairies or parks in the timber, or as undergrowth beneath the trees themselves. This forage furnishes a valuable crop which, with proper management, may be used year after year in addition to the timber which is grown on these lands. Aside from the forests, there are vast areas of prairies, deserts, brushlands, and other unimproved lands which are used primarily for grazing purposes.

Good feed in openings in timber.

Altitude often determines range use.

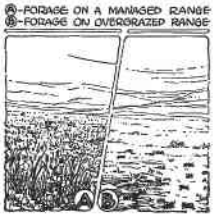
All classes of domestic stock graze to some extent. The particular class—cattle, horses, sheep, goats, or hogs—is determined by the type of range land, character of forage, available water, and other factors.

The same plants do not grow under all conditions. On the desert, there are usually many coarse shrubs and other plants which normally grow in an open stand. In dense timber, there often is little or no forage on the ground, while an open stand of trees usually contains a considerable amount of undergrowth in the form of shrubs, weeds, and grasses.

The Forest Service has classified ranges into 10 types:

Sagebrush range.

1. Grassland.
2. Meadow.
3. Weed range.
4. Sagebrush range.
5. Browse range.
6. Grass, weed, or browse range under coniferous timber.
7. Waste range in dense timber or brush.
8. Barren (no forage).
9. Woodland (Pinon-juniper or broadleaf trees).
10. Aspen range.



"Range-fat" Animals Bring High Prices.

The type of range and its condition affect the animals which are grazed on it, as well as the profits to be made from such grazing. If the range is overgrazed, eventually it will support only smaller numbers of stock. Lamb and calf crops ordinarily are smaller on ranges which have been too heavily grazed. If the better forage plants are gone, stock will eat more poisonous plants and losses will become greater. The stock from some of the better ranges is shipped to market as "grass-fat" or "range-fat" and commands a better price than stock from the poorer ranges, which is shipped as "feeders." Finally, if a range is grazed hard enough and long enough, the vegetation may become so sparse that wind or rains start erosion, carrying away the soil itself so that most of the value of the range is lost for many years to come.

Most Forage Lands Privately Owned.

The larger portion of the grazing lands in the United States is in private ownership. These pastures are grazed by the stock of the owners or

they may be leased to other stockmen. However, there are millions of acres of national forest range, lands of the public domain, and Indian reservations, as well as lands owned by the various States. Grazing on these public lands is vitally important to the livestock industry. The surrounding farms and ranches produce hay and other crops which are fed to livestock during the winter. Many of the western ranches are located in high mountain valleys where hay is the only crop which can be grown or so far from railroads or markets that crops cannot be shipped but must be fed to livestock and marketed "on the hoof." Summer grazing is cheaper than feeding, and stock thrive better on open forage than on dry feed. Thus, public ranges provide means for maintaining farms and homes which could not otherwise exist.

Marketing products on the hoof.

Public Ranges Help Maintain Farms and Homes.

HISTORY OF THE RANGE

Public Lands Once Open.

The history of grazing in the United States, especially in the West, records many struggles between stockmen. The public domain (unreserved, unappropriated Federal lands) was once open to grazing without regulation. Cattlemen could graze their stock on free range without restriction. Small herds grew into large ones, and more and more stockmen put herds on the range. Large companies were organized in the East and in Europe, hoping to "clean up" in the cattle business. Good range became scarce. Scarcity of water was another problem. Conflicts arose, which grew into private wars, and the power of the six-shooter was often the law.

Overgrazing strips land of vegetation.

Driving the "Dogies."

The country was unfenced, and the cowboy rode the range, preventing straying to a certain extent and rounding up the stock for branding or shipping. For a time tremendous movements of livestock took place, as when Texas cattle were taken to northern grass in Wyoming, Montana, and other States over the famous cattle trails.

Sheep were introduced, and the bands soon increased by the thousands. Because sheep were closely herded they could be held on any part of

Range Wars.

the range until the forage was entirely consumed. Clashes between sheepmen and cattlemen developed over "free range" and water rights, and some bloody battles resulted.

Such a state of affairs demanded and led to an orderly settlement of the problems and eventually resulted in the beginnings of range management. On the national forests, separate ranges were laid out for sheep and cattle, and individual herds were allotted definite areas. Forest officers, among their duties, assumed the supervision of range use. Gradually numbers of stock and seasons were fixed and certain methods of handling the animals were required of the owners. Fees were collected and permits issued. As other lands came into the ownership of States, they were leased to individuals, companies, or associations. Ordinarily, the management of these areas is left to the judgment of the stockmen, and numbers and seasons are not specified. Finally, through the Taylor Act, provision was made for the orderly use of the public domain.

Range Management Begun.

Orderly Use of Ranges.

Range Information Valuable.

There is need for more information regarding proper methods of handling stock and lands, and this problem has been taken up by various State and Federal agricultural experiment stations. Much of the knowledge concerning proper range management has been made available by these experiment stations and is obtainable in books and bulletins.

PRINCIPLES OF RANGE MANAGEMENT

Range Management may be stated briefly as the best use of forage resources, through practice of the following principles:

Eight Principles of Range Management.

1. Restoring and maintaining satisfactory growth of good forage plants.
2. Use by the proper class of stocks.
3. Seasonal use.
4. Regulation of number of stock grazed.
5. Proper distribution of stock.
6. Improvement of the range.
7. Specialized handling to meet local conditions.
8. The correct balance between grazing and other uses such as watershed protection, timber growing, recreation, and wildlife.

RESTORING AND MAINTAINING FORAGE

Poor management makes good range bad.

Where the better grasses and forage plants have been weakened or killed out through poor grazing practices, the range cannot furnish good feed. Consequently, it becomes necessary to manage the range in such a manner that the valuable plants can reestablish themselves.

In order to obtain an idea of the quality and quantity of forage, it is well to estimate the *density* or the amount of ground covered by the plants on the range. Ranges in which plants are small and sparse and in which there are many areas of bare ground may be compared with ranges which have been properly grazed or with nearby areas where grazing has not taken place, as in fence corners, along railroad rights-of-way and similar protected plots of ground. If the forage stand becomes thin, it is an indication that some changes in the system of managing the range must be made to allow the better plants to come back.

Keep Good Plants Growing.

Livestock will eat certain plants and leave others. If a range is closely or improperly grazed, the better plants which stock prefer will eventually be weakened or killed out, leaving the less valuable plants more space in which to grow and spread over the range. Under such conditions the ground may be covered with plants, but they are not the plants which livestock prefer to eat. Stock which is forced to graze them does not thrive.

Larkspur, low, (Delphinium menziesia).

This *composition* of forage, or the relative amount of good and poor forage plants on a range, may be compared with properly grazed range or with protected plots, in the same way as density is compared.

PREVENTING FIRE

Fire Ruins Forage.

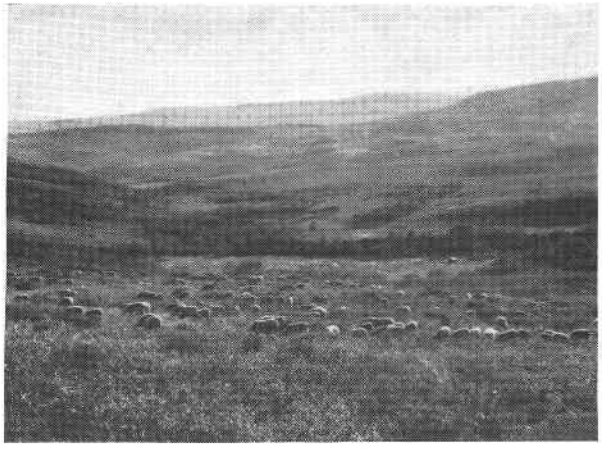
Fire destroys not only growing plants, but also seeds and humus. Forest fire can kill all herbage and undercover, and in dry seasons grass fires can likewise consume forage on open land. Limited grazing helps to prevent fire. Plants which would grow up and die, thus causing fire hazards in the fall, are grazed down during the summer.

Safety practices to prevent fires will do much to prevent depletion of forage and consequent erosion.

PROPER CLASS OF STOCK

Cattle Prefer Grass.

Cattle prefer grass, but on browse ranges they will eat shrubby plants. They do not, however, care for most weeds. They prefer flat or rolling range with plenty of water and shade. Steep or rocky hillsides are usually not grazed if feed is available along creeks or in meadows.



Sheep graze in open forest lands.

Sheep Like Weeds.

Sheep, on the other hand, prefer weeds in spring and summer, grass in the fall, and on the winter ranges eat brushy plants or browse, such as sage and shadscale. Although sheep prefer water daily, they can go for extended periods without drinking. Even in the summer, if the forage is good and there is plenty of shade on the range, they may not drink for several days or weeks. During this time their moisture requirements are supplied by the herbage and by the dew on plants which they consume in grazing. Sheep do better on rough, mountainous range than cattle and make better use of the forage in dense timber.

Horses prefer open, grassy ridges. They travel long distances from water and make use of many semidesert areas. They prefer grasses to most weeds.

Goats are frequently grazed to good advantage on rough and rocky range, as in the Southwest.

They prefer browse or shrubs to other classes of forage. Where they are held too long on one range they frequently damage young trees by eating the twigs and branches and by gnawing bark.

Hogs make use of ordinary forage only to a limited extent. However, in the East, South, and Southwest where beech or oak is found, hogs are turned into the forest or brush ranges to fatten on the mast (acorns, nuts, and seeds).

These habits and preferences of grazing animals must be considered if a range is to be utilized properly. Grazing cattle on a rugged area usually results in overgrazing of creek bottoms. Sheep, on the other hand, often make little use of forage in wet, marshy meadows where cattle can be grazed to good advantage.

Yarrow (Achillea lanulosa), common weed used for forage.

Certain poisonous plants may determine which class of stock should be grazed. Sheep may be grazed on ranges where tall larkspur, which is particularly poisonous to cattle, is found.

Economic factors frequently determine the class of stock to be placed on a range. In many sections of the West, sheep are held on low spring ranges until after shearing and lambing is completed, and about July 1 are placed on the high mountain meadows, which are then ready to be used as summer range. Cattle, which are often held in fields in the spring, must be moved to summer range earlier, to permit the raising of crops. Consequently, cattle summer ranges are quite often found in the foothills and low mountains, while sheep go to the higher country.

Cattle Use Low Range, Sheep the High Range.

SEASONAL USE

It has been found that if ranges are grazed as soon as plant growth begins in the spring the forage is weakened and the carrying capacity of the range is reduced. Range investigators, therefore, recommend that stock be held off the range until plants have made sufficient growth. Certain early grasses, such as bluegrass, should have flower stalks. The average grasses should be at least 6 inches in height. The date when grazing may safely begin naturally varies according to

Flower of larkspur. The characteristic spur on the flowers identifies larkspur.

Kentucky bluegrass (Poa pratensis). Bluegrass should seed before heavy grazing.

The cowboy controls the movement of herds.

altitudes. Vegetation develops later on north slopes than on south slopes.

Livestock, especially cattle, have a tendency to graze the higher ranges as soon as the snow melts and often before the forage has made sufficient growth. This can be prevented by "riding" or by fencing and confining the stock to the lower areas, reserving the higher ranges for summer use. On most high sheep ranges there is an abundance of weeds early in the summer. Later these weeds dry up or are killed by early frosts and sheep must eat grass. On such ranges, management plans often include grazing the band twice over the same area—the first time fairly rapidly, to make use of tbe weeds, and the second time to secure the grass forage. Certain plants, such as lupines (poisonous) should not be grazed by sheep until they are rendered less barmful by frost.

If plants are closely grazed they cannot produce good seed crops, and eventually those good plants which reproduce through seed only, disappear from the range. This fact must be taken into consideration in connection with spring grazing. By keeping animals off the ranges, through fencing or riding, until seed have developed, natural seeding is provided and the quality and quantity of forage is assured. Under another system the range is divided into several units or pastures. Stock are grazed early in a certain pasture for one or more seasons, the forage in the other pastures being permitted to grow and develop seed. Then the order is changed. One of the other areas is used early for a season or two and the originally grazed area is allowed to rest and develop seed during the spring months. This is known as *deferred* or *rotation grazing.*

Providing Natural Seeding.

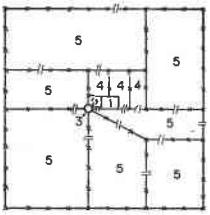
REGULATION OF NUMBER OF STOCK

Damage Through Overstocking.

Much damage is done through overstocking (crowding more animals onto a range than it can support). Some stockmen believe that by placing greater numbers of stock on a range, the cost of production per pound of beef or mutton is decreased. Experiments have shown that tbis is not true. More money is made from animals

How Does Overstocking Affect Production Costs?

in a conservatively stocked pasture than from those on an overstocked range. Stock take on additional weight on a moderately grazed range; better calves, lambs, and wool crops are secured; losses are smaller; and there is less need for supplemental feed, such as hay. These gains more than offset the higher pasture cost of grazing fewer stock.



A section fenced for deferred grazing: (1) Sheds, (2) corrals, (3) deep well, (4) feeding lots, (5) hay and pasture land.

Overgrazing may be recognized by several signs. As is the case when too early grazing is practiced, many of the better species of good range plants disappear and poor or harmful species take their place. Where overgrazing has not progressed very far, this change may consist in the gradual increase of the poorer or poisonous plants. Later, under continued destructive grazing, the range plants may consist almost entirely of weeds or shrubs, which are of no value to livestock.

Overgrazing may result also in damage to tree reproduction. While this is especially true on sheep and goat ranges, a certain amount of damage will occur also on cattle ranges.

Tree Damage Through Overgrazing.

The better shrubs are usually closely grazed and where overgrazing is severe, only dead shoots remain. Finally erosion sets in and barren spots appear where the fertile topsoil has been carried away by wind or water. Gullies begin to appear on the hillsides and deeply worn stock trails are seen where the plant cover has been thinned out. A good stand of grasses and other plants holds back the water after heavy rains and aids the absorption of this water by the soil. It also prevents the carrying away of the soil. When these plants are destroyed, erosion sets in rapidly.

A Good Rule.

A good rule advocated by the United States Forest Service is to leave from 15 percent to 25 percent of the better forage on the ground when stock are taken off the range. This assures sufficient cover to prevent erosion, permits seeds to ripen, and prevents extermination of good forage species.

PROPER DISTRIBUTION OF STOCK

On many large ranges some areas are closely grazed or overgrazed and others are not grazed as

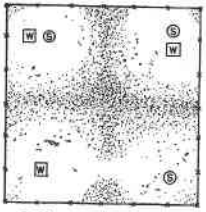
Overgrazing strips the ground of vegetation and ruins potential forest crops.

The ultimate result of overgrazing.

heavily as they should be. On cattle ranges, creek bottoms and meadows are frequently overgrazed while the steeper hills are very lightly used. Ranges which are at some distance from water often are ungrazed. When grazing sheep are brought back to a central bed ground night after night, the forage around the bed ground is gradually destroyed while range at a distance is left untouched or lightly grazed.

Such a condition not only tends to waste a part of the forage but ultimately leads to the destruction of the most desirable range areas. This is especially true if the range is heavily stocked, since the more accessible and desirable portions carry an increased number of animals and destruction is rapid.

Forage Wasted by Uneven Grazing.



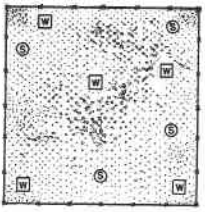
When salt grounds and watering places are not properly located, uneven grazing results.

How Can Good Distribution Be Secured?

On cattle ranges better distribution can be secured through various improvements. These include: Fencing to hold stock on certain areas; developing water sources to make possible the use of ranges which cannot now be grazed because of lack of stock water; and constructing trails into areas which stock cannot otherwise reach. Better distribution of cattle on a range is obtained through riding. In this way stock may be moved from heavily grazed areas to undergrazed areas.

One way of securing good distribution of stock is the proper use of salt on the range. Salt grounds are located in undergrazed areas where possible, usually at some distance from water.

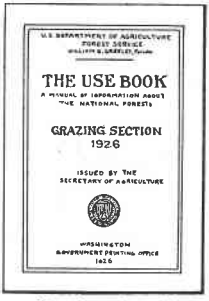
Cattle will travel from water to the salt and back again. They will, therefore, naturally graze the range around the salt grounds, thus using the forage more evenly. Salting is necessary on nearly all ranges to keep the animals in good health. Cattle which do not get enough salt become restless and are hard to handle. They develop perverted appetites and may eat harmful and poisonous plants. Stock on green feed in the spring require more salt than they do later when the forage has dried.



Proper location of watering places and salt grounds gives more even grazing.

Sheep Are Herded to Obtain Even Grazing.

Since sheep are constantly herded, at least under western range conditions, their management is considerably different from that of cattle. Sheep may be herded away from water to the lightly grazed ranges. Salting or fencing is not necessary to secure even use. Salt is necessary for the health of the sheep but is fed to them on the range, usually on the bed ground. The main point to keep in mind in the use of sheep ranges is to have all parts of the range used evenly. Pockets of good feed should not be completely grazed out and other areas left untouched. Drifting the band slowly over the range and bedding where night overtakes them is the best method. This is advocated on all national forest ranges. Only in rare instances, where bed-ground sites are scarce, as in dense timber, should the band be brought back to the same bed ground, and then not for more than three nights in succession.



Grazing is well regulated on National Forest ranges.

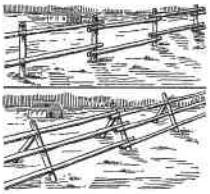
IMPROVEMENT OF THE RANGE

How Can Ranges Be Improved?

The improvement of the forage through proper grazing practices has already been discussed. Range improvements ordinarily mean physical improvements such as fences, reservoirs, spring developments, wells, artificial reseeding, and the destruction of poisonous plants and range-destroying rodents.

FENCES

On ranges fences are of great importance in controlling the movements of stock, especially cattle and horses. Boundary fences are necessary



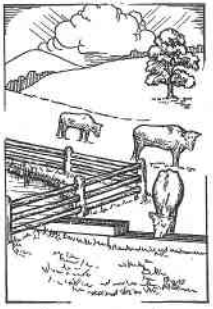
Where poles are available, wood fences are used.

to prevent unwanted stock from grazing the range. Division fences are used to divide the range into smaller blocks in order to prevent overgrazing of certain areas and to control the movements of stock. They are frequently used to divide spring, summer, and fall ranges. In some instances fences are built to prevent cattle from grazing areas of poisonous plants, and in still other cases the ranges of different breeds of cattle are separated by fences.

Concrete dam for water storage.

WATER DEVELOPMENTS

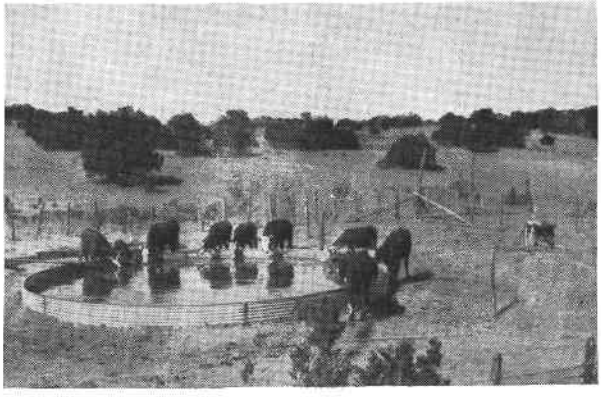
Reservoirs are usually constructed where water is scarce and where suitable springs cannot be developed. The commonest form of reservoir is an earth dam across a favorable coulee or gulch. When rains occur, a large pond is formed behind the dam which serves cattle for weeks or months later. Reservoirs permit the use of range which is so far from water that it is otherwise not possible for stock to use the forage.



A seep may be developed to form a spring.

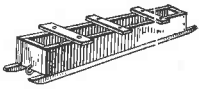
Springs and seeps which, in their natural state, furnish insufficient water for livestock can very often be developed by fencing and digging out the source of the water. The water is then piped into tanks or troughs where it is held for use as needed by stock. A spring which fills a 600-gallon tank in 24 hours provides adequate water for 50 to 60 cattle. On sheep ranges low troughs, set in series so that they all fill, are used most frequently.

Wells and windmills are often necessary to supply stock water in certain locations where



Natural seeps are improved to provide adequate water for stock.

neither spring development nor reservoirs are feasible.



SALTING EQUIPMENT

Sack crystal salt, rock crystal, or block salt may be used, and on cattle range should be put in containers. Salt left on the ground deteriorates rapidly and becomes mixed with earth which is consumed by the animals. Salt troughs may be made from logs or from heavy lumber. Strong boxes secured to posts or stakes also make good containers. Troughs or boxes should be strong enough to withstand rough treatment by herds, but light enough to be moved easily to various parts of the range

RESEEDING

In order to bring back desirable vegetation on ranges which have been seriously damaged, or which are threatened with erosion it is often necessary to reseed. Crested wheatgrass, bluegrass, and brome grass have given good results where conditions are favorable and moisture is adequate. Artificial reseeding is expensive, however, and the results often are disappointing. Consequently, range should be so managed through deferred grazing, seasonal use, and limitation of the number of stock that the native grasses and plants will not be damaged and reseeding will be unnecessary.

"Brushing in" grass seed.

POISONOUS PLANT CONTROL

Poison Plants.

Medical treatment for poisoning is impractical and expensive and the animals may be dead before such treatment can be administered. It is necessary therefore that poisonous plants be eradicated or that the stock be kept off dangerous areas. The eradication of poisonous plants, like artificial reseeding, is expensive work. Many species, such as low larkspur, loco, death camas, and western sneezeweed, cover large areas and the plants may be so scattered and so numerous that control is virtually impossible. In the case of water hemlock, which is extremely poisonous, and which is nearly always found in patches

Wooly Loco (Astragalus mollissimus).

along creek or ditch banks, it is a relatively easy matter to dig up the plants or to fence dangerous areas. Tall larkspur is often found on limited areas and may be controlled by grubbing to a depth of 6 or 7 inches. The area must be gone over again the following year to remove plants which were missed the year before. At best, however, the grubbing of tall larkspur is temporary in effect and the plant has a tendency to come back after a number of years.

Method of Eradication.

Prairie Dogs.

RODENT CONTROL

Rodents are responsible for a large amount of range damage. In the plains region, prairie dogs denude areas around their towns. Where these animals are numerous and the towns large, the amount of forage on the range is seriously reduced.

Gophers.

In mountain parks and meadows pocket gophers cause range deterioration. These animals tunnel underground and eat the roots and bulbs of various plants such as onion grass, wild celery, and others. In addition, they store large quantities of roots in their burrows. Besides these three, other rodents such as jack rabbits, if numerous, consume much forage.

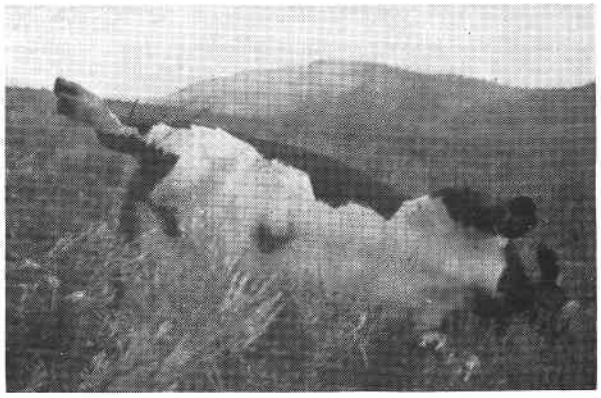
Control Methods.

Prairie dogs and ground squirrels can be controlled through the use of poisoned grain which is dropped in small amounts near the mouths of the animals' burrows. Pocket gophers may be controlled by the use of special gopher traps, which kill these animals in their burrows, or by inserting a piece of poisoned carrot or other root in the tunnel.

HANDLING TO MEET LOCAL CONDITIONS

Special Handling to Meet Weather Conditions.

Frequently, the principles of range management must be modified to meet local problems such as arise when sheep are placed on timbered range during periods of hot weather or on certain dry areas after rains. High water, which makes streams impassable to stock at times, may necessitate a change in the method of handling. There are many other problems peculiar to each range. The most common local problem is that of poisonous plants.



Larkspur kills 6,000 cattle a year.

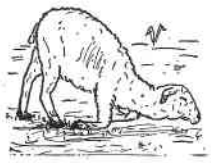
Larkspur, tall (Delphinium barbeyi).

Handling Stock to Prevent Poisoning.

Poisonous plants cause large losses of livestock on western ranges. On the higher mountain ranges tall larkspur is the most harmful of these plants and annually causes the death of thousands of cattle. It seldom causes losses among sheep. Frequently, a change from cattle to sheep will eliminate losses by poisoning. Where this is not possible, it is a good practice to exclude cattle from larkspur range until the middle of summer since this plant loses some of its poisonous qualities after blooming. In some instances the amount of tall larkspur on a range has been decreased through sheep grazing.

When Do Animals Eat Poison Plants?

Low larkspur is also poisonous but does not often cause large stock losses. It is most frequently eaten where the range is overgrazed and good forage sparse. Sometimes a late spring snow storm covers up the better range plants, only the low larkspur extending above the snow. Under such circumstances, losses from this plant may be very heavy. Because of its abundance on certain ranges it is usually best to keep animals off such range until the better plants have grown sufficiently to furnish adequate feed.



A locoed sheep.

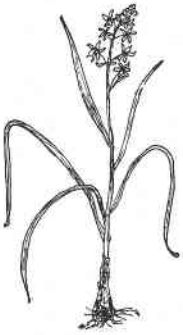
Loco weed, one of the plants belonging to the pea family, is another very poisonous plant on western ranges. Eating loco becomes a habit with stock, especially horses. Like low larkspur, loco is difficult to control. It pays to use the range properly since with the elimination of the grasses, loco has a tendency to become more abundant. Locoed animals seem to teach other

Water hemlock (Cicuta occidentalis).

stock to eat this plant. It is recommended, therefore, that those animals which have acquired the loco habit be taken out of the herd.

The most poisonous individual plant is the water hemlock (Cicuta). This plant, also known as wild parsnip, snake weed, spotted parsley, and muskrat weed, grows along creek banks and ditches. Fortunately it is not usually found in large quantity and can be dug out and destroyed.

Another plant which causes losses, especially among sheep, is the death camas (locally called soap plant, hog's potato, mystery grass, and poison sego), an onionlike plant with white or yellowish flowers. It seldom lasts beyond July and losses are most frequently confined to spring and early summer sheep ranges. The best method of avoiding losses from this plant is to keep sheep off ranges infested with death camas until other forage becomes sufficiently abundant and stock are not forced to eat the camas.



Death Camas (Zygadenus venenosus).

Occasionally, lupine (blue peas, blue beans, old maid's bonnet or Indian bean) causes heavy losses. Under range conditions these losses are limited almost entirely to sheep. Eaten in moderate quantities, lupine is regarded as a valuable forage plant, but if sheep are very hungry when turned on the range, they often eat excessive quantities of this plant. The best means of preventing losses from lupine is to see that the sheep are well fed before going on lupine range. Protection against overgrazing is essential on such ranges. With an abundance of other plants available, there is little danger of lupine poisoning.

Lupine (Lupinus alpestris).

Other poisonous plants which cause stock losses are milkweeds, oak or shinnery, chokecherry, Pingue or Colorado rubber weed, western sneezeweed, woody aster, brackern fern, and several laurels. Losses from these plants are nearly always the result of a lack of good forage plants. Overgrazing and the stunting or killing of the better forage forces stock to turn to these poisonous species.

In addition to the poisonous plants, there are others which cause mechanical injuries. Barley grass and squirreltail grass, some of the needle

grasses, also known as porcupine grass or needle-and-thread, and the three-awn grass come within this class. The awns (the sharp-pointed needle-like seeds) work into an animal's mouth, nose, eyes, or body. Festering sores are produced and animals often are blinded. Animals do not eat these plants from choice after the seeds are formed. Where the plants exist, it may be necessary to graze the range before the awns become stiff and hard. Later in the season stock should be kept off such areas. These plants also affect game animals and cause losses among deer and elk.

Mechanical Injury From Plants.

Squirreltail (Hordeum jubatum).

COORDINATION WITH OTHER LAND USES

Watershed Protection.

Watershed protection is an important item which must be considered when a range is grazed. Unregulated grazing eventually results in the destruction of the plant cover. As explained previously, this results in erosion, rapid run-off of water, smaller water reserves in the soil, and alternate floods and drying up of streams. The amount of water for irrigation and for use by cities and towns is made uncertain by overgrazing. Furthermore, the soil which is carried off the watershed through erosion will fill up irrigation reservoirs and ditches. Often the value of a watershed is greater than the value of the range, and it must be protected through proper grazing practices.

Erosion Control.

"Light Burning" Damages Ranges.

Improper use of the forest for grazing results in the destruction of timber reproduction. Cattle damage young growth and small trees may be eaten by sheep or goats. Central bed grounds on sheep ranges and poor salting and overstocking on cattle ranges lead to the killing out of reproduction through trampling. Careless smoking or unsafe campfires, often result in the destruction of both range and timber. Similarly, burning the range with the idea of improving it usually causes complete destruction of small trees, and damage to the larger ones. Tests have shown that it leads eventually to the weakening of the forage plants, and decreases the value and carrying capacity of the range.

Forest reproduction fails on overgrazed land.

Overgrazing of forest areas results in deformed trees.

Reserving Recreational Areas.

Each year larger numbers of people use the forests and ranges for recreational purposes such as picknicking, camping, hunting, and fishing. It has become necessary, therefore, to leave some recreational areas ungrazed. Stock is controlled by herding or fencing the animals away from the favored areas.

Big Game Animals Must Have Range.

Big game animals, such as deer, elk, and antelope must be provided for in range management plans, where these wild animals use the same range as domestic stock. On most western ranges, especially on the national forests, there is usually enough forage during the summer for both livestock and game. In the rough canyons and ridges many pockets of feed not used by cattle and sheep form ideal game range. However, when deep snow forces game animals from the hills in the winter, frequently the only area available to them is a narrow strip of range between the valley ranches and the mountains. If this range is overgrazed by stock, game animals may starve, or they may invade the ranchers' fields and attack the haystacks. Sheep eat very much the same forage as deer and antelope. In order to provide for game, care must be exercised to see that winter range is not overgrazed. On properly used winter ranges, however, there is usually sufficient feed for both game and stock. Heavily grazed areas are not suitable for recreational purposes, and campers do not prefer to share their campground with a herd of range cattle.

Saving Forage for Wildlife.

SUMMARY

Grazing Economically Important.

Grazing is vitally important to many parts of the United States, especially to the West. Public ranges contribute materially to the welfare of many ranches. In order that ranges may continue to be productive, they must be properly managed.

Sustained Yield of Forage.

Range management must provide for the continued maintenance of a satisfactory stand of forage plants. Where these plants have been destroyed through misuse, the range should be so managed that these plants can reestablish themselves, and crowd out the undesirable species.

Proper Class of Stock for Every Range.

The proper class of stock should be grazed on the range. In general, the less rugged, well watered, grass ranges are best suited for cattle. Sheep make better use of weed forage and utilize rough range better than do cattle. Also, sheep can get along with less water. The general habits of the different classes of livestock must be known as well as the type of range on which they are to be grazed. Occasionally the presence on a range of poisonous plants which affect only one class of stock, may make it desirable to run stock which is not subject to poisoning from those plants.

Seasonal Use.

The range should not be used too early. Plants should have a chance to produce seed; otherwise they will be destroyed. Stock should be held on the lower ranges until the forage on the higher areas has had an opportunity to develop. Ranges may be improved through deferred and rotation grazing, whereby a series of pastures are rested in rotation during the early part of the grazing season.

Carrying Capacity.

The number of stock turned out to graze should be limited to the carrying capacity of the range. Grazing too many stock does not pay. It destroys the range and eventually reduces the profit to be made.

Even Distribution of Stock on Range.

Livestock should be distributed so that all parts of the range are evenly grazed. Water development helps. Also, on cattle range, salt should be so placed as to draw stock to the under-utilized areas. Sheep should be allowed to graze slowly

over the range and bed down where night overtakes them. Returning the band each night to a central bed ground destroys range.

Range Improvements.

Construction of fences aids in securing proper use, especially on cattle ranges. The construction of reservoirs, the piping of water from small springs and seeps into tanks, and the drilling of wells and the installation of pumping equipment are necessary to provide water on certain ranges. Artificial reseeding may be necessary when good forage plants cannot be reestablished through proper grazing practice.

Management to Prevent Poisoning.

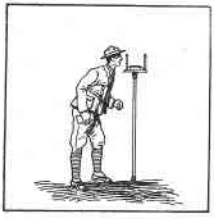
On ranges infested with poisonous plants proper handling of stock is necessary. Too early grazing and overgrazing have a tendency to increase both poisonous plants and stock losses.

Relating Forest Range Use to Other Forest Use.

Other values must be recognized. The destruction of forage on watersheds results in erosion, floods, short water supply, and silting of irrigation ditches and reservoirs. Too heavy grazing often injures timber reproduction. Careless use of fire destroys timber as well as range. Certain areas which have a high value for recreation should not be grazed by livestock or should, at least, not be grazed to the extent that recreation values will be destroyed. Similarly, grazing of game animals should be so regulated that sufficient forage is left, especially on winter game ranges.

Chapter XII

FOREST ENGINEERING



ENGINEERING plays an important role in forest administration. From the beginning of forest development work, land purchase or acquisition, the services of men trained in engineering are necessary. Surveys, roads and trails, bridges, water developments, logging plans, towers, telephone lines, radio communications, and the developments in forests for recreational use—all require engineering knowledge.

Why Is Forest Engineering Necessary?

Forest engineering is a combination of many engineering branches. As forestry develops and more complete and abundant use of forest values becomes more universal, additional types of engineering operations will be adapted to forest administration.

A Summary of Engineering.

Handbooks of the United States Forest Service and the various State services comprise a large library of forest engineering. In this chapter is contained a brief summary of the fundamentals of engineering as they apply to making surveys and constructing roads and trails, bridges, communication facilities, and lookout towers.

INSTRUMENTS

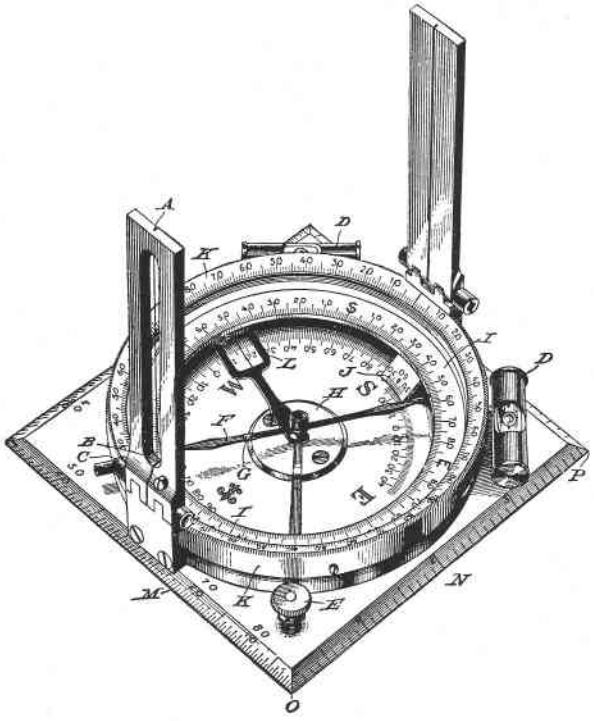
THE COMPASS

Most forest surveys are made with the Forest Service compass, an instrument that resembles the simple box compass sold in 10-cent stores, and which may be compared with the mariner's compass used on ships.

Two Main Parts of the Compass.

The Forest Service compass consists of two main parts: (1) A magnetized steel needle, swinging freely, but always pointing to the north magnetic pole; and (2) a pair of sights to enable the surveyor to determine an accurate line across the compass to a given distant point. The compass circle is divided into 360 degrees or

A—Front sight.
B—Sighting wire.
C—Declination set screw.
D—Spirit level.
E—Needle lock screw.
F—Needle.
G—Wire weight.
H—Needle lock plate.
I—Degree scale (True North).
J—Declination guide.
K—Degree scale (Magnetic North).
L—Clinometer.
M–O—Protractor scale
N–P—Inch scale.



The Compass Circle.

parts; and the four quadrants or quarters of the circle (¼ of 360 degrees equals 90 degrees) are marked North, South, East, and West. North and South are indicated by zero (0) and the letters "N" and "S", and from these points, in both directions, the degrees are numbered up to 90 (the positions of East, "E", and West, "W").

The Quadrants.

Reading a Compass.

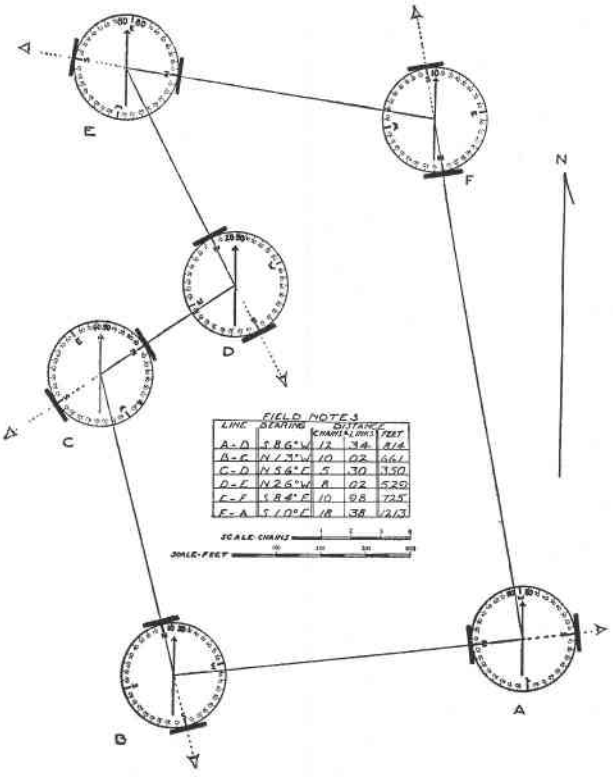
On an ordinary compass the positions of the four cardinal points run in clockwise succession—North, East, South, and West—but on the Forest Service compass the positions of East and West are reversed, so that clockwise they read North, West, South, and East. This reversal is made to facilitate reading the bearing (the direction from the compass to any point). Although readings are taken from the North end of the needle, the direction obtained is that of a line of sight from the observer to the point in question. Hence a true reading is obtained only by reversing the natural positions of East and West.

Why Reverse the Positions?

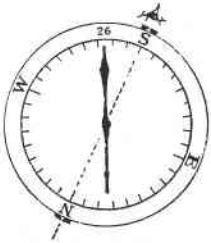
Leveling.

A pair of spirit bubbles attached to the apron surrounding the compass plate aid in leveling the

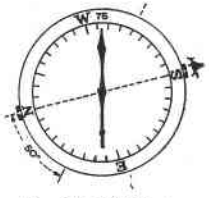
instrument. A lock screw on the base of the instrument may be tightened when the compass is not being used. This prevents wearing of the pivot, upon which the needle rests.



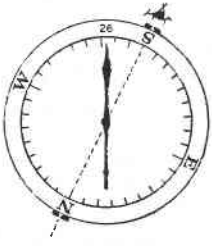
Using the compass.



South 26° West.



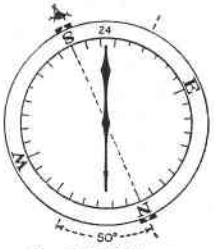
South 76° West.



South 26° West.

USING THE COMPASS

To establish a line to form a given angle with another line, the readings must be determined beforehand. For instance, if a line is to form an angle of 50° with another given line, the compass is set up at the point on the given line from which the angle is to be turned. Suppose, for example, that a reading is taken along this given line and found to be South 26 West. To offset an angle of 50° to the West, the compass is turned 50° to a position where the needle reads South 76 West (26° +50°), and a stake is driven at a point along the line of sight. If, instead of a point 50° to the West, a point 50° to the East of the South 26 West



South 24° East.

or given line is desired, the compass is set up as before at the point on the given line from which the angle is to be turned, and a sight (South 26 West) is taken along this given line (to reestablish the base line). The compass is then turned 50° to the East to a point where it reads South 24 East (26° from S 26 W to S plus 24° to S 24 E, equals 50°), and the stake is set along that line.

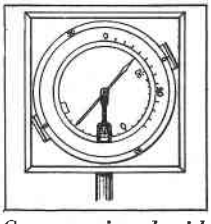
MEASURING ELEVATION

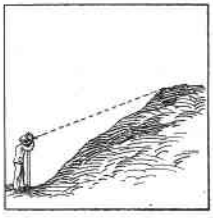
Measuring Vertical Angles.

The Forest Service compass has an attachment that serves as a clinometer, or instrument to measure angles of elevation. It is possible, for instance, to measure the angle formed by a line from the observer to the base of a tree and a similar line from the observer to the top of the tree, or to measure the slope of a hill.

What is a Clinometer?

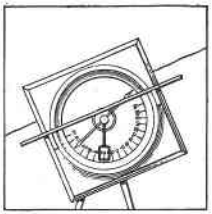
The clinometer consists of a free swinging bar attached to the pivot below the needle. When the compass is tipped edgewise to a vertical position this bar swings pendulum-fashion and comes to rest pointing straight down. Just as a plumb bob points downward regardless of the angle of its support, so the bar maintains a vertical position regardless of the position of the sights and compass plate. When the sights are absolutely level, the pointer on the bar coincides with the zero position on the plate floor. However, if the compassman is sighting at the top of a tree, the front sight is higher than the rear sight—the scale moves forward and upward as the instrument is tilted upward, but the plumb bar remains vertically suspended so that it coincides with an angular mark on the scale. When the instrument is tilted to sight downhill the scale moves rearward, and the plumb bar rests at an angular reading on the other half of the scale.


Compass tipped with clinometer reading 30°.


Measuring slopes with compass clinometer.

Slopes of distant hills may be read by tipping the instrument edgewise to face the observer; a straight edge is laid across the sighting bar, and the instrument turned up or down on the swivel so that the straight edge parallels the edge of the distant slope. Angles are read on the clinometer scale as before.

THE ABNEY LEVEL



Compass clinometer and straight-edge to read distant slope.

Like the clinometer on the compass, the Abney level is used to measure angles of elevation. It is based upon a spirit level and a graduated scale mounted on a sighting tube. The sighting tube is fitted at one end with an eye piece through which the user looks to the other end where a horizontal hair line, or wire, cuts the field of view in two. The hair line and the peep sight, or eye piece, correspond to the sights on the compass.

Rigidly attached to the tube is a scale similar to the degree scale on the compass clinometer. A pointer, pivoted above the scale so that its point may be moved along the scale, has a small spirit level fixed to it. When the sights are level and the spirit bubble centered, the pointer indicates zero on the scale. When the user sights with the instrument at an object that is not level with his eye, the bubble moves away from the center. Holding this sight, the operator tilts the spirit level until the bubble is centered. By tilting the spirit level, he also swings the pointer bar to an angular reading on the scale. This reading is the angle formed by the line of sight and the horizontal plane of the spirit level, or the angle of elevation of the object at which the instrument is being sighted. To facilitate alining the bubble, at the same time that the operator sights at his objective, a mirror has been set in the sighting tube to reflect the image of the bubble.

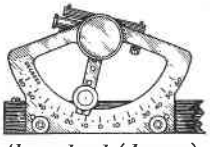
Zero Reading.

Reading the Angles.

Alining the Bubble.

Scales on the Abney level may be graduated in degrees, as on the compass clinometer, or in percent, to indicate the amount of rise or fall in 100 feet of horizontal distance, or in topographic units to indicate the rise or fall in 66 feet (66 feet is the common length of the surveyor's chain).

Abney level (percent).

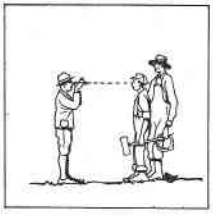


Abney level (degrees).

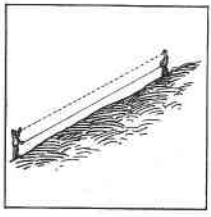
Degree of slope may be changed to percent of slope by multiplying the tangent of the degree by 100. Tangent tables are included in most engineers' handbooks; they express the relationship between the length of the horizontal and vertical legs of any right-angled triangle. For instance, the tangent of 30° is .5774 (found in

Abney level (topographic).

Measuring distant slope with Abney.



Choosing a target.



Using the target.

the table) and the slope is 57.74 percent (.5774 × 100); the tangent of 45° is 1, and the percent of slope, 100. To change percent to degrees, the process is reversed. If the grade percent is 10.5, that figure divided by 100 gives .105; and the nearest tangent number in the table is .10510, the tangent of 6°.

Distant slopes may be measured with the Abney by holding the sighting tube parallel with the slope (just as is done when distant slope readings are taken with the compass clinometer), and with the instrument in this position the bubble is leveled, thus moving the pointing bar to the angle of the slope.

In using the Abney level one should always remember that the instrument is held at the height of the user's eye. To obtain a true reading of ground slopes, the line of sight should be to a height above the ground equal to the height of the instrument. A rod with the height of instrument marked on it may be held at the desired point by an assistant, or some feature of the assistant should be used as a target. (For information on height measurement of trees, etc., see chapter on Forest Mensuration, pp. 170–171.)

When a given grade is to be established, as on a road or trail, the pointer bar may be set at the desired reading. Then by centering the leveling bubble by sighting up or down, the surveyor may direct the placing of stakes. In this manner trails in mountainous country may be located at the rate of one or two miles per hour.

CHAINS AND TAPES

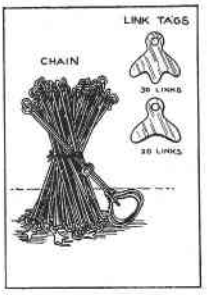
A Unit or an Instrument.

In forest surveying a "chain" may be either a unit of distance (66 feet) or an instrument for measuring distance. The chain, as a unit of length, facilitates the measurement of acreage—a strip 10 chains (660 feet) long, and 1 chain wide equals 1 acre. In measuring distance, 80 chains equal 1 mile.

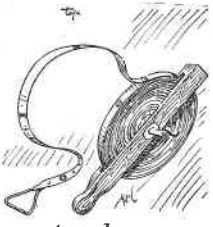
The instrument known as the chain is composed of 100 links, each 0.66 foot in length. The 66-foot chain is often too long for woods work, and a

shorter one of 33 feet, or 50 links is used. Every tenth link on the chain is fitted with a brass tag on the edge of which are indentations or teeth to indicate its position. The first tag has one tooth, the second, two, etc. A handle, one link long, is attached to each end of the chain, so that a 66-foot chain has 98 links and 2 one link handles.

Steel tapes also are used for measuring distances. They are lighter and less bulky than chains, but are more likely to break with rough usage. Often they are of the same length as chains (66 or 33 feet) and marked at each link length. Commonly, however, two-chain tapes (132 feet) or five-chain tapes (330 feet) are used. Other tapes may be 100 feet or 50 feet long, graduated in inches or tenths of feet. In practice, it is common to call the instrument of measurement (whether tape or chain) a chain.



Surveyor's chain and link tags.



A steel tape.

MAKING CHAIN MEASUREMENT

Two men usually are employed to make chain measurements. To mark and tally distances, 11 pins are used. These pins are made of heavy iron or steel wire, about one-eighth to one-fourth inch thick and 15 inches long, pointed at one end and bent into a ring at the other. Strips of white or red cloth are sometimes tied to the rings to aid in finding the pins in underbrush.

Chaining distances.

Use of Pins.

In chaining distances, one pin is placed at the starting point and the front chainman, retaining 10 pins, measures off one chain length and marks his position with the first chain pin. The rear chainman then picks up the starting pin and goes forward to this first chain pin, while the front man drags the chain another length to set the second chain pin. By this procedure 10 chains may be measured without stopping to tally each one. When the tenth chain has been measured, the rear man has 10 pins in his possession. The eleventh pin marks the final point. If the end of the line has been reached before the front man's 10 pins have been played out, the rear man's collection of pins indicates the chained length. Fractions of chains are read from the chain itself, the link tags marking links in multiples of 10.

Use of pins in chaining.

Watch the Pins!

Horizontal distances rather than slope distances are chained.

On level ground the chain may be stretched along the surface, but in hilly country it must be kept level by raising the downhill end and lowering the uphill end. When hills are very steep it is often necessary to "break chain," or measure in half chain lengths in order to get the true horizontal distance. Short chains (33 feet), one-half the length of a regular chain, may be used to advantage.

Slope Chains.

Slope chains are often used to enable chainmen to measure along the slope instead of breaking chain. These chains usually are 2½ chains long, the first two chain lengths being standard (132 feet) and the extra length ("trailer") graduated to offset the influence of the slope. With an Abney level fitted with a topographic scale a slope reading is taken. The reading on the topographic scale shows the difference in elevation between the two points measured. On the trailer are marks corresponding to the reading of the topographic scale. Thus, a chain stretched 132 feet along a slope that rises 38 feet in one chain must be extended 20.42 feet to give the true horizontal distance of two chains. When the man using the Abney reads a 38-foot rise on the topographic scale, the chainmen extend the trailer to a point marked "38" (20.42 feet from the end of the two-chain mark).

What is a Trailer?

How to Measure Slopes.

MAPS

Providing Details for Maps.

To make plans for any forest engineering project maps are necessary. For almost all areas in the United States some sort of maps are available. Often, however, these maps must be checked or details not included in the original survey must be added. Compass and chain mapping, with Abney readings for slopes and elevations, is adequate for most forest surveys.

Use of "Topo" Maps.

When topographic maps are available, trails can be located on these maps before field observations are made. Topographic maps show the differences in elevation, at regular intervals, by means of contour lines. These lines are drawn connecting points of a given elevation. If, for instance, contour lines (lines, all points on which

What Are Contour Lines?

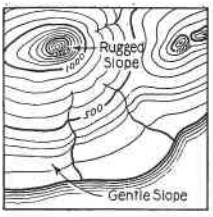
are at the same elevation above sea level) of 20-foot intervals were actually drawn on the surface of a section of hilly land, one would cross four lines in walking from a 100-foot elevation to a point 200 feet high. On uneven ground, starting at the 100-foot contour line and walking uphill one would cross the 120-foot line, then the 140-foot line; and if he then descended into a hollow, he would recross the 120-foot line and possibly the 100-foot line before ascending the other side of the hollow to recross the 120-foot line.

A Section of Land in a Tank of Water.

The position of contour lines may be indicated by imagining a section of land in a huge tank of water, with the water just at sea level. If the water is raised to a depth of 20 feet, a new water line (contour line) appears; all the land higher than 20 feet is above the water, and all less than 20 feet is submerged. As the water is raised in 20-foot levels, new contour lines appear. Looking straight down, as on a map, the lines on steep slopes appear close together, and on gentle slopes, farther apart.

Look Straight Down.

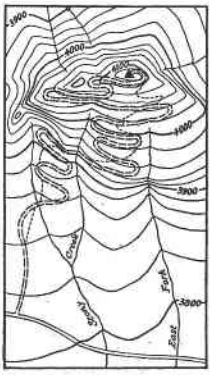
The United States Geological Survey has made topographic maps of large areas, and the areas not already mapped are in process of survey. On maps of rugged country, the contour intervals are 50 feet or even 100 feet apart, but in flatter areas 10- or 5-foot intervals are used. The spacing of the lines on a map indicate the topography of the country. A comparatively level stretch will be indicated with contour lines far apart; a steep mountain with crowded lines; and a gentle slope with contour spacing somewhere between that for level and rugged land.



The contour intervals indicate topography.

How to Lay Out a Trail With Contour Map.

To lay out a trail on a topographic map one must know the contour interval (distance between contour lines) and the map scale. These are marked on the map legend. To locate a trail, as for instance from a road intersection to a tower on a ridge, divide the allowable grade into the contour interval to obtain the least number of feet of horizontal distance permissible between contour changes. For example, if the allowable grade is 10 percent and the contour interval is 20 feet, then, according to the rule, it is necessary to divide 0.10



Another Use for "Topo" Maps.

into 20 which gives 200, the least horizontal distance permissible between contour lines. By the same principle a map with a scale of 400 feet to the inch would show a trail of at least one-half inch (200 feet) between contour lines. If the scale were 800 feet to the inch, the trail line would run at least one-quarter inch between contours. When the figure for the trail has thus been obtained it may then be sketched on the map. When a number of trails are sketched, the shortest or most adequate one may be chosen for construction.

Contour maps may be used also in estimating the area of land to be flooded by a dam or stream change, and the necessary cuts and fills in trail construction.

TRUCK TRAILS

Why Trails Are Necessary.

To obtain the maximum use from forests, and to give them adequate protection against fire, it is necessary to provide means of access for men and machinery. Truck trails and other trails permit the development of areas that were formerly inaccessible and facilitate transportation of men and equipment.

Forest trails increase forest values.

High service forest trails demand high construction standards.

Three classes of truck trails are recognized by the United States Forest Service. This classification has been adopted by some States and has been used as standard for Emergency Conservation Work projects.

Classes of Truck Trails.

Low Service truck trails are constructed where speeds up to 15 miles per hour are enough for all activities, such as on little used roads to lookout and guard stations, and short spur roads into camps.

For Speeds Less Than 15 m. p. h.

Medium Service truck trails are adequate where a speed of 16 to 25 miles per hour is desirable. They are used where low service roads are inadequate such as for connecting headquarters and ranger stations, for areas of high fire hazard, for long hauls of timber, products, fire fighters or livestock, and to serve popular recreational areas and small towns.

For Speeds of 16 to 25 m. p. h.

High Service truck trails will permit speeds exceeding 25 miles per hour, and are important as main travel routes for protection and administration, or for through travel.

For Speeds Exceeding 25 m. p. h.

TRUCK TRAIL LOCATION

In laying out a truck trail or other type of trail there are a number of elements to be considered.

(1) *Purposes:* Truck trails should be so located and constructed as to serve all forest needs. If a truck trail is to be used for timber operations, it should be made accessible to timber sale areas; if for protection, it should provide for getting personnel into hazardous areas and possibly serve also as a fire break; if for recreation, it should reach into sites of recreational value. All these

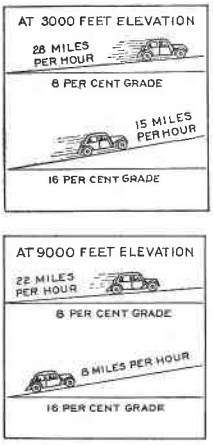
Trails Must Fulfill Their Needs.

uses should be considered before finally deciding upon the location for a truck trail.

Beauty of Location Is Worth Considering.

(2) *Esthetic value:* Road beautification should be considered in planning the project. Even if the truck trail is not intended primarily for recreational or tourist travel, it may eventually be used for such purpose. Although picturesque truck trails may have no greater utility than ugly ones, care should be given to esthetic values. Particular attention should be given to roadside cleanup, such as the disposal of timber and debris incident to construction.

Roadside Cleanup.



Determining the Grade.

(3) *Grade:* Maximum grades have been established for the various truck trail classes and for various elevations. A car or truck loses 3½ percent of its power with each 1,000 feet rise in elevation. For a low service truck trail at 3,000 feet above sea level, therefore, the maximum grade is 15 percent but at 9,000 feet, 11 percent is maximum. Since most modern motor vehicles can climb steep grades, it is often possible to reduce construction costs by increasing the grade. A much shorter truck trail may be built if a few steep grades are included instead of winding the location around hills. Grades steep enough to cause excessive erosion and rutting should not be permitted. The purpose of the truck trail will govern the allowable grade. Heavy logging trucks, for instance, may not be able to negotiate steep hills. Speed is reduced on any up-hill grade, and it is often necessary to travel down hill at slow speeds. Grades that shorten the route but require greater traveling time ordinarily are to be avoided.

Purpose of Truck Trail Determines Allowable Grade.

Eliminating Curves in Trails.

(4) *Alinement:* Truck trails should be located with as few sharp curves as possible, considering allowable cost. Straight stretches or long sweeping curves do not slow up travel as do short turns, nor are they as dangerous. On side-hill location it is often practicable to eliminate short curves by cutting or filling.

Keep Trails Narrow for Low Costs.

(5) *Width:* Truck trails are usually constructed of single-track width. Where the amount of traffic justifies it, a double-track width may be used. Wide roads necessitate greater cuts and fills than do narrow ones. On steep side hills

construction costs increase tremendously with the width of road.

Consider Soil Types in Locating Trails.

(6) *Type of soil:* The difficulties and expense of construction are influenced largely by the type of soil through which a truck trail passes. Spongy and boggy ground or soil types subject to heavy erosion should be avoided. It is more difficult to secure drainage on clays than on sands or rocks, but loose sands and rocks should be avoided in side-hill locations.

Clearing Right-of-Way Costly.

(7) *Clearing:* Unimportant truck trails may be shifted higher or lower on slopes to avoid large trees and clumps of trees that involve excessive clearing. On level lands such sites may be avoided by long curves that will not add to road costs. Medium service and high service truck trails should ordinarily not be shifted much to avoid clearing, unless this can be done without affecting the service value of the trail.

Locate to Avoid High Clearing Costs.

Cuts and Fills.

(8) *Excavation:* Cuts and fills increase initial cost and often make maintenance expensive. Alinement and speed requirements will determine the amount of excavation and fill. Where possible, excavated material should be used for fills.

Take Advantage of Natural Drainage.

(9) *Drainage:* To a great extent the life of any road depends upon drainage conditions. Advantage should be taken of natural drainage. Level roads require more drainage than do roads with reasonable gradient. Adequate drainage should always be provided.

Try to Locate Trails to Avoid Necessity for Bridges.

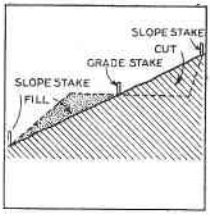
(10) *Bridges:* Before bridges are planned for any road or trail their necessity should be definitely determined. Often it is possible to avoid stream crossings or to reduce the number of crossings by following one side of the stream. When all other conditions are equal, roads with bridges cost more to build and to maintain than do roads without them; hence, the road engineer should weigh carefully the cost and utility of a number of possible routes before his final decision is reached. When bridges are necessary, either a straight stretch or a long curve should constitute the approach. Knowledge of high- and low-water levels, stream-bank conditions, and

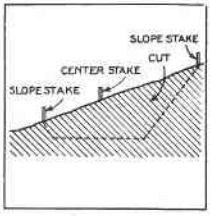
Avoid Short Curves at Bridge Approaches.

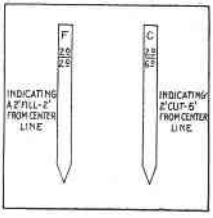
possibilities of good foundation will aid in bridge location. The course of unimportant shallow streams may be changed in some instances, to decrease bridge building.

Available Right-of-Way Essential in Locating Trails.

(11) *Ownership of land:* When private land must be traversed, sufficient right-of-way should be obtained to enable future improvements to be made without entailing more problems of ownership. Scanty right-of-way may not allow width for future enlargement or permit enough trees to remain, if private owners start cutting, to add esthetic value to the truck trail.







Instructions are given on slope stakes.

SURVEYS

Before construction work starts on a forest truck trail, a location survey is necessary. The use of the truck trail and possible improvements such as greater width and better alinement for future needs should be considered.

For most forest purposes, surveys with Abney level, compass, and tape are adequate. All curves, cuts, and fills should be located on the map, and the necessary construction work involved should be computed so that it may be compared with that of alternate routes.

When the route has been definitely determined, it is staked out with center stakes or grade stakes, ordinarily placed at 100-foot intervals. On curves and over rough topography, center stakes may be set closer than 100 feet if necessary.

Slope stakes, in addition to center stakes are needed: (a) To indicate how far to cut into a bank, (b) to guide workers in making cuts, blasting, and clearing, and (c) to mark the "toes" or lower edges of fills, and to indicate height of fill. Slope stakes are set opposite center line stakes, at right angles to the road line.

CONSTRUCTION

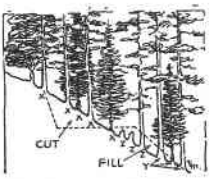
The Four Processes of Forest Road Construction.

There are four major activities in forest road construction: (a) Clearing, (b) excavation, (c) drainage, (d) finishing.

CLEARING

Removal of trees should be limited to those on the proposed truck trail site, and those injured in

construction. Trees on steep slopes, whose main roots have been cut, and other dead or dying trees that may fall across the truck trail should be removed. Stumps allowed to remain should be at least one foot below the finished road. All others should be blasted or pulled.



X—Remove both tree and stump.
Y—Do not remove tree.
Z—Cut tree, do not pull stump.

Clearing for Sunlight.

Where snow is likely to remain on the truck trail, wider clearings may be made to permit the entrance of sunlight. Such clearing is done on the sunny side, and only when the cost of clearing and the timber value are less than that of surfacing or drainage. On curves, thinning and pruning may be necessary to increase visibility. Large groups of trees, however, should not be removed for this purpose. Where the truck trail passes through cleared areas, a screen of trees on both sides may be planted to keep snow from drifting on to the truck trail.

And Visibility.

Planting for Snow Protection.

Brush disposal should be provided for, where much clearing is necessary. This may mean that clearing must be done a season in advance of the rest of the construction job. Brush, particularly along trails which will be open to public use, should be burned or carried out of sight into the woods. Stumps likewise should be removed from the trail side.

Brush-strewn trails are ugly fire hazards.

The sawing and chopping gangs should work in advance of the tractors and trail builders, or "bulldozers." Large logs, if cut into lengths of 16 feet or less, may be pushed aside with the trail builder. Small trees and brush need not be cut if it is possible for tractors and trail builders to push them over. Larger trees may be pulled with tractors and cables. It is often possible for trail builders to undermine stumps on side hills by gouging out the slope beneath them.

Clearing Out Timber.

Some trees may be blasted out more economically than they can be cut or pulled, and it is often necessary to blast stumps. In most cases it is better to split or loosen a stump with dynamite, so that it can be removed with a tractor or trail builder, than to attempt to blast it out of the ground.

Use of Explosives in Clearing.

Use should be found for the timber that is cut, rather than to allow it to remain along the right-

Wildlife Shelter.

of-way. Shelter and cover for wildlife should be considered in roadside cleanup. Small patches of brush which do not constitute fire hazards but which add to roadside beauty and form game shelter should be permitted to remain.

EXCAVATION

Moving Stone by Machinery.

When large quantities of rock must be moved, plans should be made beforehand, and the most economical method chosen. Trail builders, tractors, rippers, and other mechanical devices should be used, when possible, to loosen rock or to move it after it has been blasted loose.

Blasting.

Under many conditions, the use of dynamite or blasting powder is necessary to remove large rocks or to open up frozen soil. In all cases, blasting operations should be sufficiently in advance of succeeding construction that it will not conflict with or hold up progress.

Only Experienced "Powder Men" Should Be in Charge.

Only experienced, qualified men should be permitted to place and discharge powder or dynamite. Experience in handling explosives is necessary to obtain safe and efficient use. The amount of powder or dynamite and the number of shots to be used will be determined by the amount and character of the rock excavations. If too little dynamite is used, expenses are increased through the necessity of reloading and refiring. On the other hand, too liberal use of explosives is a wasteful process that should be avoided. Material that can be used for fills, or that will stick to the slope on the lower side of the road should be loosened but not blasted out of reach.

Safety First, Blasting Second.

What Quantities of Dynamite Are Necessary?

Disposing of Blasted Rock.

When rocks and boulders have been sufficiently reduced by blasting, the trail builder or bulldozer is usually the most efficient machine for moving them from the road. With the blade at an angle facing the lower side of the slope, the trail builder is capable of pushing large rocks over the side. It is often possible to use the trail builder to direct the rock into holes and hollows and to build the lower side up to grade. Tractors with hoists or chains are sometimes necessary when the job is too big for the trail builder.

By Bulldozer.

By Hoists.

For side-hill excavation, the trail builder should

Bulldozers speed up trail construction.

be used only to open a way for the tractor and grader. It constructs a rough road over which a tractor-drawn grader may work to obtain the desired width and grade. On most truck trail projects, the ripper precedes the grader. The ripper, or scarifier is a machine fitted with heavy steel teeth that dig up the ground, loosening it so the grader can spread it out or scrape it off to grade.

Use of Trail Builder or Bulldozer.

How to Use Rippers on Truck Trails.

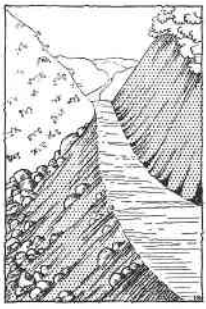
Through cuts often may have to be dug with picks and shovels, or blasted out, if much rock is encountered. The material taken from cuts should be used for nearby fills.

The Tractor and Grader versus the Bulldozer.

Although the persistent rapidity of motion of the bulldozer or trail builder may seem at first to make it superior to the tractor and grader as a dirt mover, dirt can actually be moved cheaper with the tractor and grader where they can be used. The grader should always be used as soon as the trail builder has roughed out a sufficient trail. A finished job requires the use of the grader. Banks which are not excessively rocky may be gouged out with the grader, while the bulldozer goes ahead to tackle the harder jobs. When not employed in opening up a trail for the grader, the bulldozer may be used to make fills or to pare off the tops of small humps and ridges.

"End-Haul."

Fills may be made by end-haul or from borrow pits. End-hauling consists of removing earth from the higher spots near the fill and depositing it in the low spots. When earth and small rock must



Earth from cuts is "end-hauled" to fills.

Awell-drained trail.

Water will flow over an out-sloped trail.

A break to carry water across trail.

be end-hauled more than 100 feet to fills, the tractor-scraper is more efficient than the bull-dozer. Borrow pits are areas along the side of the road from which earth is taken to fill the low spots. Large borrow pits are ugly features and should be located out of sight of the truck trail whenever possible. Small borrow pits should be dug in places where extra width is desired.

Roots and rocks should be removed from the truck trail to provide an evenly wearing surface that can be maintained by tractor and grader. Root and rock removal is usually done by a crew following the grader.

DRAINAGE

Proper drainage will reduce maintenance costs, prolong the life, and increase the efficiency of the truck trail. Three types of drainage are common to all roads: (a) Surface drainage, (b) cross drainage, (c) subsurface drainage.

Surface drainage: Surface drainage is the disposition of water from the surface of the trail. Water, permitted to lie on the truck trail or to move over its surface, induces ruts and natural water channels which cause excessive erosion and make poor traveling conditions. This problem may be handled by: (1) Out-slope, (2) grade breaks, (3) dips, (4) in-slope and cross drains, (5) open-top culverts, (6) intercepting ditches, and (7) water bars.

Out-slope: Where trail material will not become slippery in wet weather, and where small quantities of water may flow over the shoulder without wearing away the lower bank, out-sloping will provide surface drainage. A slope of one-fourth to one-half inch per foot of width is sufficient for most truck trail projects (a 12-foot road would be from 3 to 6 inches higher on the inside edge than on the outside).

Grade breaks: To prevent run-off from attaining destructive speed and accumulating volume on long grades, the slope may be broken into short level sections or slight upgrades. Grade breaks should be made where the truck trail can be out-sloped to act as a spillway.

Dips: Dips of not less than 30 feet in length may be installed to take care of excess run-off. These, like grade breaks, should be out-sloped and placed at points where erosion will not result.

In-slopes and cross drains: Truck-trail surfaces which become slippery when wet or fill banks which erode rapidly are poor sites for out-sloped drainage. In such cases in-sloping may be used to direct run-off to the inside ditches. In-sloping usually requires culvert construction to conduct the water under the trail to the lower side. Because of this added expense, in-sloping is not used where other methods prove adequate.

Open-top culverts: Open-top culverts may be constructed on little-used truck trails where wheel rut wash is likely to do damage. Such culverts usually are from 3 to 8 inches deep, depending upon the amount of water to be carried, and are constructed of heavy durable timber, corrugated iron, or other heavy material. When the fill bank upon which the culvert discharges is not composed of rocks, it must be protected with stone riprap or pipe.

Intercepting ditches: Intercepting ditches may be built above the trail to direct run-off from steep slopes into streams or culverts. This relieves the water burden in the ditches and prevents accumulation of earth and debris.

Water bars: Water bars of earth or logs may be installed on little-used truck trails to direct the flow of trail water from the surface. They usually are only temporary in character, as they produce an uneven surface that will not stand heavy or continuous traffic.

Turnpikes are a combination of in-slope and out-slope, usually resulting in a crown. Run-off goes to either side of the crown and into paralleling ditches. Simple turnpikes may be built with low crowns and broad, shallow ditches so that the entire roadway may be traveled.

Cross drainage: When water must cross the truck trail, cross drainage is necessary. Depending upon the amount of water and the trail conditions, cross drainage is handled by: (1) Bridges

Dips help drain low service roads.

Culverts are necessary on in-sloped trails.

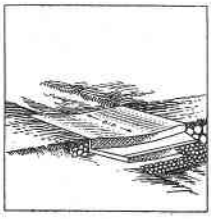
An open-top culvert.

Intercepting ditches keep water off road (note cross-section).

Water bars are used as temporary drainage structures.

Turnpikes carry the water to either side.

Drainage Structures Must Accommodate Highest Water Flow.



Concrete dip permits stream to cross trail.

Finishing a log culvert.

A stone culvert.

Corrugated Iron Pipe.

(see pp. 274 to 277), (2) fords or dips, and (3) culverts. The amount of water to be carried in drainage structures may be determined by measuring the channels of streams and observing high-water marks, or by checking the adequacy of other structures, under similar conditions, on truck trails already built. Run-off tables, based on area, slope, and precipitation, are useful guides to planning cross drainage. Where heavy floods or cloudbursts are common, the drainage structure should be large enough to accommodate high-water flow.

In building dips or fords in the truck trail so that streams may cross over the surface, it is important to have cut-off walls deep enough to prevent water from gouging out under the trail. Cut-off walls are built on the side from which the stream approaches. Concrete or stone should be used for both walls and dips. Pipes may extend through the dip to transport ordinary flow, in which case the dip would be called upon only to carry the burden of high water.

In locating culverts, natural water courses should be used when possible, both for inlets and outlets. The earth material at each end should be firm and not subject to excessive erosion. When it is necessary to discharge culverts on soil which erodes readily, rock or other paved spillways should be laid.

Culverts may be built of timber, stone, metal, or concrete. Wood for culverts must be durable and strong. Large, heavy planks or round timbers may be used. If large rocks, which will stand the weight of traffic and not disintegrate under wet conditions, are available, they may be used for culverts. Often when suitable cover rocks cannot be found, the culverts may be built up of stone and capped with wooden or metal covers.

Probably the most common culvert material is corrugated iron pipe, which comes in various lengths that can be joined with collars to meet any truck trail width. In laying corrugated pipe it is important that the galvanized surface (protection against rust) be not chipped or scratched.

Cast-iron or concrete culverts are very durable. They should be used where their added expense is justified.

Culverts should cross the trail in the direction the water would take if permitted to flow naturally. The slope should not be less than 3 percent nor more than 8 percent. Slopes less than 3 percent cause culverts to fill with debris and earth; those more than 8 percent permit too rapid water movement and induce scouring. Ditch or stream water should not be slowed up before it enters culverts, as this causes depositing of soil and muck at the inlet.

Direction of Flow and Amount of Slope Are Important.

All pipe culverts must be at least 1 foot beneath the surface of the truck trail. The depth of cover for a large pipe should be at least one-half its diameter. Culvert pipes are extended not less than 1½ feet beyond the shoulder of the truck trail and a lead-in ditch of at least 10 feet in length is dug to transport the flow from the road ditch to the inlet. Lead-in ditches often are paved with stone or walled to prevent erosion and the extending ends of the culvert pipe are protected with stone walls (see illustration).

Head wall of culvert.

Subsurface drainage: Truck trails running through marshes or near water where seepage creates boggy or wet spots on or below the surface, present drainage problems that cannot adequately be handled by surface or cross drainage. Underground springs may be uncovered by grading, or water from a rising water table may saturate the trail.

End wall for culvert.

Surfacing over such water sources is wasteful as, at best, it results in but temporary relief. The best plan is to cut off the water supply. When the source of water is not in the truck trail itself, deep ditches between the source and the trail will serve as intercepting barriers. If deep paralleling ditches create hazardous conditions they may be filled loosely with rock. A wide berm, or strip of unworked earth, left between the ditch and the truck trail will reduce travel hazard and seepage of water from the ditch.

Intercepting ditches separate road bed from water source.

Corduroy or Rock.

Corduroy bases often are necessary in swampy land. Heavy, durable logs are best for corduroy, but usually rock fills are cheaper and more efficient.

Porous Pipes.

Springs and water pockets in the truck trail may be drained from beneath by use of perforated iron pipe that will direct the water to side ditches.

SURFACING

Good Surfacing Increases Utility.

Although perfect smoothness of trail surface is desirable, it cannot always be obtained. Surface conditions greatly affect travel speed and utility. Ruts, stones, bumps, and loose surface slow up traffic and cause rapid wear. The best forest truck trails have settled, compact, hard surfaces which are reasonably smooth. Holes are filled in, protruding rocks are removed, and the surface is kept in uniform shape.

Surfaced sections, when completed, are level with the unsurfaced shoulders. To obtain this finished level, the subgrade must be trenched out to receive surfacing material. The depth of the trench depends upon the thickness of surfacing material to be applied.

Surface Must Be Stable.

Hard rocks, such as trap rocks, limestone, and granite, are better for surfacing than such soft material as schist, sandstone, and slate. Roads which are too sandy may be improved by adding clay. Soils with too much clay may be thinned with sand. Clay or sand, whichever is needed, may be spread over the surface, worked to proper depth with harrow or scarifier, and then compacted by traffic.

Surfacing Material Must Pass Inspection.

Gravel or stone may be taken from the pit or bank and applied directly to the truck trail. When this plan is followed the only selective process involved is in choosing a good source and raking away lumps and stones more than 3 inches in diameter. Finer gravel may be obtained by screening or crushing. A good surface may be spoiled by adding too much gravel, especially if no binding material such as clay is used.

The United States Forest Service has adopted three standard classes of surfacing:

CLASS A

Double-Track Trails.

(1) For double-track truck trails (20 to 22 feet wide) surfacing is placed in trench 16 feet wide—3 inches of 1½ to 3-inch stone, overlaid with 3 inches of ¾- to 1½-inch stone, capped with 2 inches of ¾-inch stone and smaller.

Single-Track Trails.

(2) For single-track truck trails (13 to 15 feet wide) surfacing is laid in trench 9 feet wide—base of 1½ to 3-inch stone (3 inches deep at outer edges, less in center); next, a layer of ¾- to 1½-inch stone (2 inches deep at center, 3 at outer edges), capped with uniform layer of ¾-inch stone and less, 2 inches deep.

CLASS B

Minor Trails.

For any truck trail not requiring class A surfacing—one course of ¾- to 1½-inch stone, 2 or 3 inches deep, topped with 2 inches of ¾-inch stone or less.

CLASS C

For any truck trail of low surfacing requirements—2 inches of ¾-inch stone and finer material, spread evenly in trench 8 feet wide.

Shoulders, after they become compacted are treated with 1 inch of fine material, up to ¾-inch stone, to bring them up to grade.

Surface Must Be Compact.

The thicknesses given in the Forest Service classification are those of loose material; the thickness of the finished job will depend upon the amount of compacting done. Stone and gravel are spread with dump trucks and distributed to the required depths with shovels and rakes. Each layer should be compacted before an overtopping layer is added.

MAINTENANCE

Trail Must Be Kept in Good Condition.

After the truck trail is completed, its life and utility will depend upon efficient maintenance. The frequency of maintenance operations varies with the type and the use of the trail. Intensive going over once in 2 years may be sufficient for low service trails, but high service trails may demand continuous maintenance.

In maintaining truck trails, all points of the projects should be inspected and repaired or improved, if necessary. Shovels, scrapers, and graders comprise the equipment generally used.

Drainage Must Be Perfect.

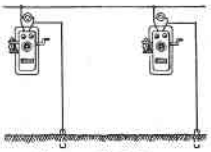
Ditches, culverts, outlets, and inlets are cleaned of all debris and vegetation. Head walls are repaired and erosion is checked on spillways. Culverts that are not working because of improper setting are taken up and reset. Additional culverts or larger ones are placed where drainage has proved inadequate.

Surface Is Made Smooth.

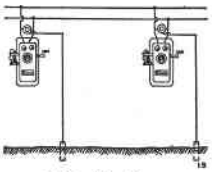
Ruts and holes are filled and shoulders are built up to grade; the surface is reshaped to conform to standards. Rocks which have been jarred loose by traffic, and those which have descended in slides are removed along with brush or fallen trees that impede travel. Bridges and fill sections are given special care.

In short, the work of maintenance is to keep the truck trail "as good as new" or better.

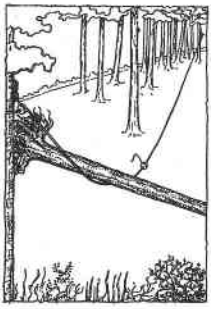
TELEPHONE LINE CONSTRUCTION



Grounded line.



Metallic line.



Split insulators and loose ties prevent line breakage.

For effective fire control and efficient administration of forest areas of any appreciable size the telephone is an indispensable instrument of communication. Forest areas usually are remote from established telephone systems, or are situated in areas where delays occasioned by "party line" interference decrease their effectiveness. It is necessary, therefore, that forest administrators build their own telephone lines to towers, ranger stations, and guard camps.

Two types of telephones are used in the forest—the metallic line and the grounded line. In the metallic line, the current travels outward on one wire and returns on another; but in the grounded line the current travels outward over a single wire and returns through the ground.

Construction and maintenance costs of grounded lines are much less than those of metallic lines, and both types of line are equally satisfactory for Forest Service purposes. Grounded lines are used, therefore, wherever practicable in the forest.

The simplest grounded line system utilizes trees instead of poles. It consists of a slack wire strung in freely swinging insulators through which the wire may slide in either direction. In the forest where heavy snows, falling branches,

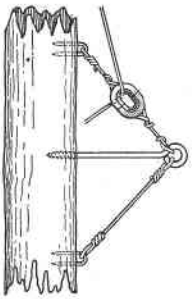
or falling trees would break a tightly tied wire, the slack of the tree line permits it to be borne to the ground without breakage, and since communication must be uninterrupted on lines used for reporting fires, it is all-important that the line be nonbreakable.

Although the tree line allows sufficient slack to take care of the burden of falling trees and snow, the line should be located, if possible, to avoid such hazards. Exposed sites where high winds are likely to occur, and hillsides subject to landslides or snowslides should also be avoided. For maintenance purposes the line is usually strung along roads or trails so that inspection may be carried out easily. The line should run along the lower sides of roads and railroad tracks to keep broken wire from falling across traffic; and main highways or railroads should not be crossed unless such crossings are unavoidable.

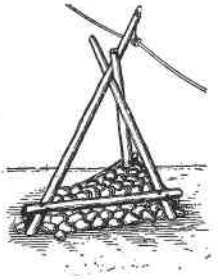
Clearing of right-of-way should be at least partially done before the wire is strung. All branches which will come in contact with the line should be removed, including such branches on the tie tree and adjacent trees which may bear on the wire when snow laden. Small trees, beneath the line, which will grow upward to touch the wire are also chopped out.

In selecting tie trees (those to which the wire is to be attached) it is important to avoid sharp angles, as these increase the pull on the wire and often cause breakage. To avoid grounding the circuit, the wire should pull away from, rather than toward, the tree. Spans between tie trees vary from 125 to 140 feet, but may be more or less, depending upon the amount of snowfall, kind of topography, and the roads or railways crossed. In any event the span lengths should be equalized as nearly as possible so that the weight of wire in each span will be about the same. Large trees which are difficult to climb are seldom chosen, and species which sprout vigorously are avoided when possible.

The wire is strung to a height of about 18 feet at the hanger, but at its lowest point it should not have less than 12-feet ground clearance. The



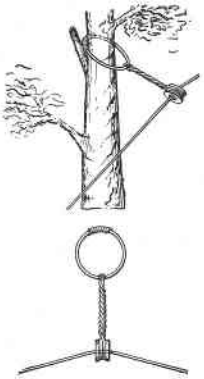
Split insulators permit movement of wire.



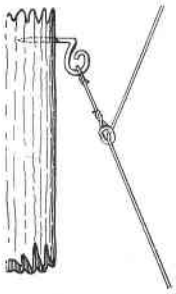
Tripods are used on treeless areas.

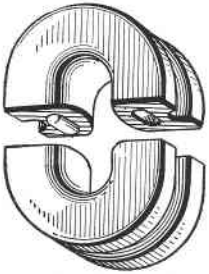
Telephone right-of-way is cleared to avoid contact with trees and branches.

Corners must not be sharp.

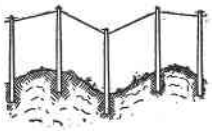


Methods of fastening wire.

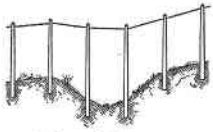




A split tree insulator.



The wrong way.



The right way.

wire should clear the level of the deepest snow, so that it will not be snowed under.

Light ladders ordinarily are better than tree climbers, as more uniform and faster work can be done with them. Tree climbers should be included in the field equipment, however, as they are handy for miscellaneous work.

Staples, rings, or hooks are used to secure hangers to the trees. Hooks have a special use in keeping the wire from touching the tree when pulling the line toward the tree cannot be avoided.

The wire is strung through split insulators with sufficient slack between spans so that the wire may be pulled to the ground with a weight of 75 to 90 pounds. Ties are made strong enough to support the wire under ordinary conditions, but weak enough to break under a 400-pound pull. Thus a falling tree will pull the tie loose and bear the line to the ground rather than break it.

On steep slopes the slack is apt to creep downhill if it is not anchored by an occasional solid tie, or "stay tie."

In pole lines, 25-foot poles, set about 175 feet apart, are used for straight stretches; but at curves, corners, and other places of unusual strain they may be set as close as conditions warrant. At crossings longer poles may be used to elevate the wire, but such changes of elevation should be gradual. Different length poles should be used to maintain a fairly level line elevation over uneven ground.

Poles should be not less than 6 inches in diameter at the top, and of medium taper. The tops are roofed with a half pitch cut to shed water. On poles which bear cross arms the roof ridge is set parallel with the wire line; but on poles which bear brackets, and on which it is not planned to put cross arms later, the roof ridge is placed at right angles to the line. The water shed from the pole roof should not be permitted to soak into the wood near the brackets or cross-arm attachments, as this will hasten decay.

In setting out a pole line, the course is staked out so that the line is as straight as possible. Poles are carried out by truck or horse (if good

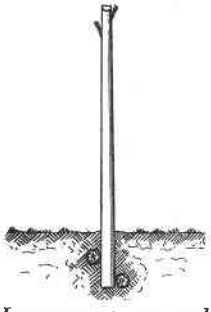
durable poles cannot be found near the proposed site) and are laid near the stakes. Usually the crew is divided into axmen, hole diggers, pole setters, and linemen. The axmen clear a temporary right-of-way which helps mark the line and which facilitates the other operations. With shovels, steel digging bars, or picks, the hole diggers make holes 2½ to 6 feet deep, depending upon the size of the poles and the type of earth. Hole digging and pole setting are made easier if a small trench is dug into the hole, but for small poles this is not necessary. The holes should be large enough, however, to permit tamping the earth around the pole.

When the pole is set in the hole, earth is filled in around it and tamped tight. Three tampers, with iron tamping bars, to each shoveller, constitute the usual organization. The earth is tamped until it is solid enough to hold the pole in position.

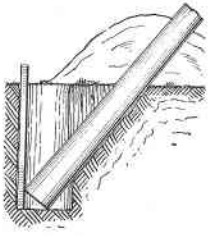
On curves and corners the poles should be given enough "rake" to offset the pull of the line. "Raking" a pole is leaning it away from the line pull. The distance from the top of the pole to a vertical line drawn from its base is the rake. For pulls less than 5 feet (see diagram) the rake should be about 10 inches; 5- to 10-foot pulls require 15-inch rake; and pulls over 10 feet, 25-inch rake.

When the pull exceeds 30 feet bracing or guying is necessary. Bracing or guying is also used at road and railroad crossings, on long spans, on steep slopes, in windy sections, on loose or swampy

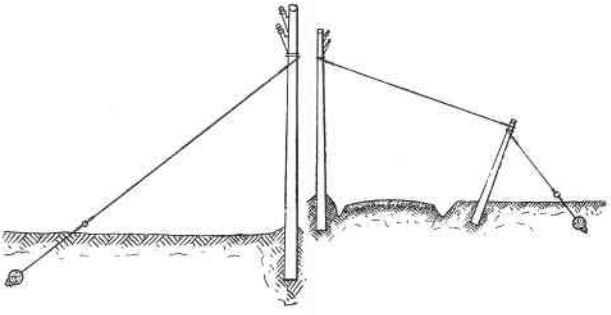
Poles are roofed to shed water away from brackets.



Log supports are used in boggy land.

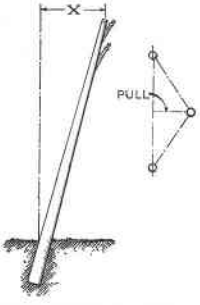


Setting a pole.

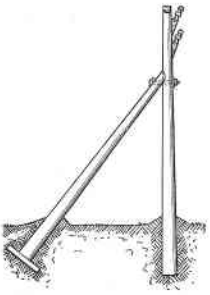


Guyed against the pull.

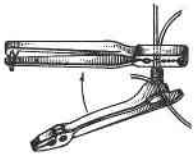
Guying across road.



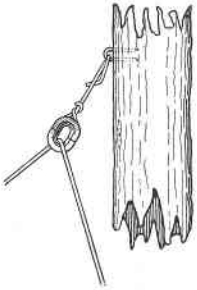
Pole raked to offset pull.



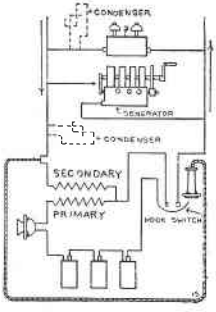
Braced against the pull.



Splicing tools and completed splice.



Weak tie made to break under stress.



ground, when the line crosses a high tension wire, and on the first and last poles of the line.

After the poles have been set, the linemen stretch out a half-mile of wire on the ground along the line. They then carry the wire up the poles and place it between the bracket and the pole. Two or three linemen stay on poles along the line while the wire is tightened with a block and special wire grips which do not cut or injure the wire. After the men on the poles signal to the stretcher that the wire is tight enough, they wait a few minutes for the line to adjust itself to an evenly distributed tautness before making a permanent tie. The amount of slack left in the line depends upon the length of the span and the temperature at which the line is strung. Wire expands or contracts with changes of temperature. For instance, if no. 9 galvanized iron wire is strung in a 75-foot span on a hot day (temperature about 100° F.), a sag of about 4½ inches must be left in the span so that the wire will not tighten and break in colder weather. If much slack is left in cold weather the wire will sag too much when the temperature rises.

Ties are made of the same size wire as the line wire. (See fig.)

THE TELEPHONE INSTRUMENT

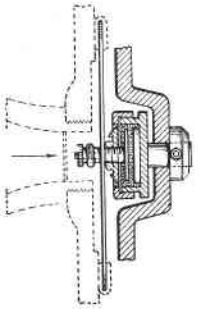
To understand why a telephone works, one must have an understanding of the fundamental laws of electricity and magnetism. This discussion is not intended to give the student a complete course in either of those subjects. It is an attempt to explain how, not why, the telephone operates.

The best laboratory equipment for studying the telephone is the instrument itself. If possible the student should take a telephone apart to examine: (1) The transmitter, (2) the induction coils, (3) the receiver, (4) the generator, and (5) the bell; and to trace the wiring which connects these parts.

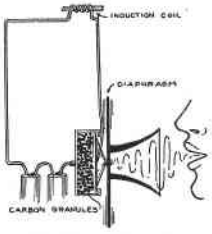
THE TRANSMITTER

When the pressure on two conducting bodies (carbon granules in the transmitter) is increased,

more of their surfaces are brought into direct contact, and their combined resistance to current is diminished; and when the pressure is decreased, less of their surfaces are in contact and their combined resistance is increased. The telephone transmitter is based on this principle. The conducting bodies are the carbon granules in the carbon button or capsule behind the diaphragm. Voice tones, when spoken into the transmitter, strike against the diaphragm (a nonmagnetic disk) with sufficient force to apply pressure to the carbon granules and thus increase or decrease their resistance to the electric current flowing from the battery and through the induction coil or "step-up" transformer. These changes in resistance regulate the amount of current through the primary of the induction coil and the "induced" current in the secondary that flows from the sending telephone to the receiver at the other end of the line. It is these changing currents that cause a corresponding movement of the receiver diaphragm at the other end, reproducing the voice tones of the sender.



Changing voice tones to electric charges.



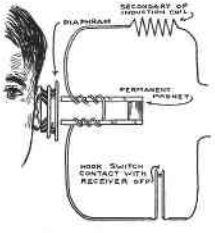
Sending the voice along the wire.

THE INDUCTION COIL

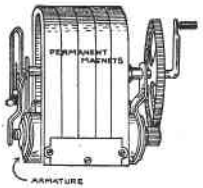
From the transmitter the current flows to the induction coil, which acts in a manner similar to that of the transformers on the poles of commercial electrical lines. It "steps up" the current through the magnetic action of the primary on the secondary of the induction coil. It is this induced current of higher voltage which flows to the receiver on the other end of the line.

THE RECEIVER

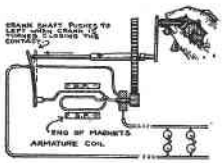
The induced current, arriving at the receiver, passes through the coils around its horseshoe magnet and causes a change in the magnetic field. This change, which might be likened to raising and lowering its magnetic properties, causes the magnet to draw the receiver diaphragm closer to it or to drive it away. The movements of the receiver diaphragm correspond to those of the transmitter diaphragm, and since the air in contact with the receiver diaphragm is moved, sound is produced,



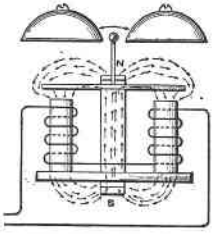
Changing electric charges to voice tones.



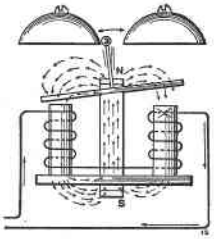
The generator.



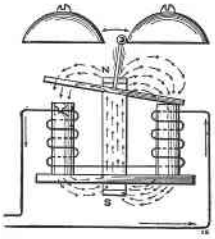
The ringer circuit.



The bell at rest.



The generated current pulls the clapper to one side.



The current alternates and pulls the clapper to the other side.

and the words spoken into the transmitter again become audible in the receiver. The receiver diaphragm is made of soft iron, which responds to magnetic lines of force from the receiver magnets.

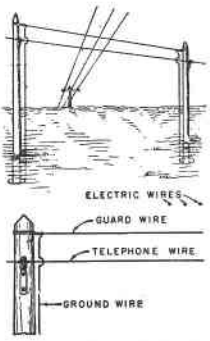
THE GENERATOR

Most rural telephones and those used in the forest are remote from electrically operated lines, and the current for ringing the bell must be generated by a hand crank. The crank turns an armature (a soft-iron core, wound with many turns of fine copper wire) between the poles of a series of three to five horseshoe permanent magnets. The magnets are arranged so that all north poles are on one side, and all south poles are on the other. When the armature is turned the wires cut across the magnetic field between the north and south poles, and an alternating current is set up in the armature wires of sufficient voltage or pressure to ring the bell at the other end of the line.

THE BELL

The mechanism that causes the bell to ring consists of a permanent magnet, and an electric magnet. The clapper is rigidly attached to the center of an armature, pivoted on the north end of a permanent magnet. Thus the lines of force from the magnet enter the armature at its center and travel to each end of the armature. Each end of the armature has the properties of a north pole. Beneath the north poles of the armature is a soft iron core, wound with wire. The north poles set up by the armature ends are attracted to these iron cores. If one end of the armature is pressed against one pole of the cores, the armature will stay in that position, since the magnetic field at the other pole has been widened and the attraction thus decreased. When the armature is in this position the clapper rests against one of the bells. The soft iron cores are connected to the generator wires. When the generator is turned, an alternating current is set up which produces a magnet in the coils surrounding the cores, making first a north pole at the right-hand coil and a south pole at the left-hand coil, and then reversing

to make a south pole at the right-hand coil and a north pole at the left-hand coil. Changing the polar designation alternately, about 25 times per second, causes the armature to be pulled down first at one end and then at the other, as the south pole on first one coil and then on the other, is alternately strengthened and weakened. This movement of the armature moves the clapper back and forth from one bell to the other.



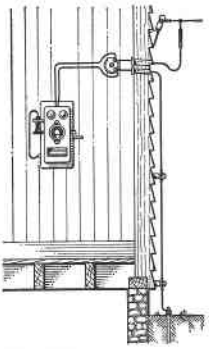
Guarding against high-tension charges.

TELEPHONE CURRENTS

The voice current flowing over the line is so slight that it cannot be felt; and there is no danger of shock from that source. The bell, or ringing, current can be felt, but it, too, does not reach dangerous strength.

There are two charges, however, which can reach dangerous proportions and which should be eliminated. One is the electricity which flows along the line when the wire contacts a high tension line. Avoidance of high-tension lines when the telephone line is constructed will eliminate this trouble. Where they cannot be avoided, the proper placing of guard wires will minimize the danger.

The other cause of damage to telephone systems is lightning. In regions where lightning storms are prevalent, the line should be protected with a lightning rod and a ground wire on every tenth pole. Arresters of sufficient capacity should be installed at each instrument to prevent lightning from damaging the telephone.



The lightning arrester protects the instrument.

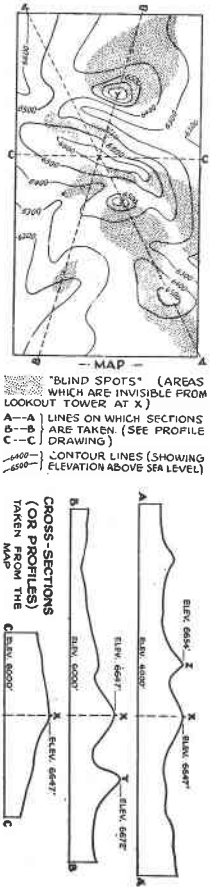
LOOKOUT TOWERS

In selecting tower sites, the object is to attain the greatest visibility of the land to be protected. Usually the greatest visibility is attained from the highest peak or ridge. Often, however, the position of the tower on the ridge or peak will determine the view. One end of a long flat ridge may overlook a wider area than does the other end; or the middle of the ridge may combine the advantages of both ends.

Towers are not necessary on some sites.

Topographic maps may be used to determine the relative advantages of various proposed sites. Elevation profiles may be drawn, radiating from

See next page.



the site, as shown in the accompanying sketch. Blind spots (areas not visible from the tower) may be found by drawing a line of sight from the tower's height, over the ridge tops of the profile.

Towers are not necessary when the desired visibility can be attained without them. High peaks, or ridges, where the view is not obstructed by trees, may serve as lookout stations, in which case a cabin or other suitable shelter can be erected much more cheaply than a fire tower.

STEEL TOWERS

For any tower, the placing of anchors or bases is of prime importance. These are the foundations upon which the stability of the tower depends. The piers in which anchor posts are set should be of masonry, concrete, or brick, and should rest firmly upon rock or solid ground. They should be heavy enough to prevent overturning of the tower, and should be at or slightly above the ground level. (See diagram.)

The tops of the piers and the anchor rods must be level to prevent a twist in the tower. Perfectly adjusted instruments (levels and transit) and a competent engineer are necessary if a perfect job is expected. Steel towers are manufactured to

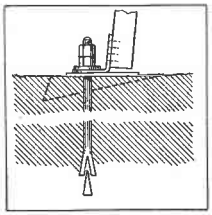
Nuts and bolts should be checked and tightened as part of tower maintenance.

fit specifications, and bolt holes are drilled so that connecting members fit perfectly without forcing or reaming. Directions for erecting steel towers, and specifications for foundations and guying usually are supplied by the manufacturer.

The tower is built up from the foundation, one piece at a time, each horizontal section being completed before the next one is started. After the tower has been completed, it is checked over within a week or two, and all bolts and connections are made tight.

Towers over 30 feet in height are sometimes guyed to add greater stability and to prevent toppling. When guy wires are used, they are fastened to each corner at the topmost horizontal member of the tower frame. They are then run through turnbuckles and anchored solidly at least one-half the tower's height away from the tower base.

A Firm Foundation Is Necessary.

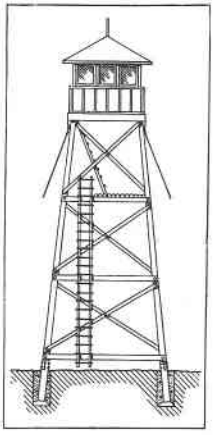


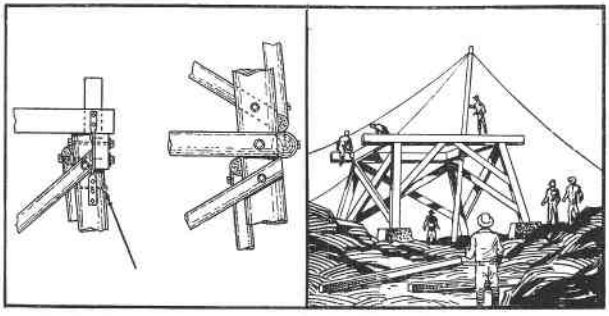
Anchor base set in solid rock. The dotted line section is concrete.

WOODEN TOWERS

When durable native material can be found, towers may be built of wood. Designs for wooden and steel towers do not differ essentially; and the development of modern connectors for wooden members has increased the safe height to which wood towers may be erected. Radio Station WEBC (Superior, Wis.) has constructed a 350-foot broadcasting tower of which 120 feet is wood. In Meuhlacker, Germany, a wooden tower 625 feet high supports 1,320 pounds of radio antenna.

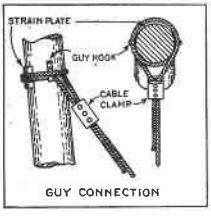
The accompanying illustrations show the construction of log fire towers.





Methods of making bolt connections.

Wooden tower under construction.



A short span log bridge.

Short span bridges often may be avoided by the installation of adequate culverts, and culverts provide a smooth, continuous surface, greatly reducing costs. The use to which the truck trail will be put will determine whether fords or bridges will be installed. Future use, when it can be predicted, should be considered in planning bridge construction.

Except in cases of unusually large and expensive bridges or very unimportant roads, the bridge should be wherever the road location line crosses the stream, and the bridge should be located to conform with the alinement and grade of the road.

The transit is used for the most accurate measurement.

Curving routes may eliminate bridge construction.

Bridges Must Clear High Water.

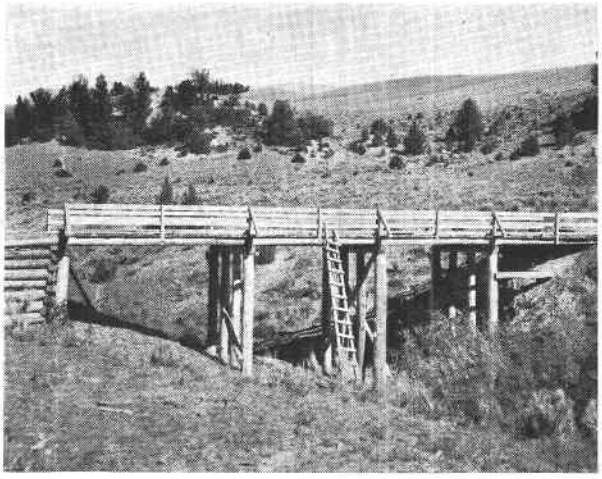
On high-service truck trails, however, bridges should be located on straight stretches, but if these are not obtainable a long radius curve is permissible. Abrupt changes of grade are to be avoided, and the bridge floor should be level. Changes of grade, if unavoidable, should be made far enough away from the bridge to allow an even approach surface.

Ordinarily, bridges are constructed with at least 5 feet of clearance above high-water level. This allows logs and uprooted trees to pass under the bridge. Where shallow, sluggish streams are likely to flood, low-water bridges may be built over which the stream may flow in flood seasons.

If the downstream side of such bridges is higher than the upstream side the weight of water passing over the bridge tends to hold it to the bottom and reduce the danger of its being washed out.

Piers and abutments for bridges may be built of stone, concrete, timber, or a combination of stone and timber known as the stone crib. Often when natural rocky ledges border both sides of the stream, much of the work and cost of building abutments is avoided. Ledges should be inspected thoroughly, however, to see that they have not been undermined or cut away by the water at their bases.

Low-water bridges are sloped—permitting high water to flow over the decking.



Truck trail bridges combine low cost with high utility.

ABUTMENTS

STONE ABUTMENTS

Dry-stone abutments are not stable enough to bear heavy, rapidly moving traffic, but they may be used for short low little-used spans. Sometimes what may appear to be dry-stone abutments are, in effect, protective walls to reduce scouring of natural banks.

Stone Must Be Carefully Selected.

In building stone abutments the bank should be cut away to allow a wall to be erected at least one half as thick at the base as it is high. Stones must be selected carefully and projecting points must be removed from the tops and bottoms. To prevent the wall washing out from below, the pier must be based well below the stream bed and preferably on natural bedrock.

Wet masonry (that bound together with mortar), is more stable than unbound stone, and piers and abutments of this type may be built up to any necessary height.

It is important in laying masonry to establish bond (overlapping of the stones). A series of consecutive vertical joints causes a weak spot in the wall.

Cut Stone for Fine Construction.

Square-cut stone, known to engineers as *ashlar*, is used in fine construction work. Ordinarily, however, such expensive construction is not justified in building forest bridges. Unsquared stones, or *rubble*, is commonly used. Rubble falls into two classes—coursed rubble or that laid in definite layers, and uncoursed rubble or that laid with no attempt to maintain regular courses. In either method the stones are at least rough cut, that is the projecting points and unevennesses are smoothed off to allow as great a bearing surface as possible.

Coursed Rubble Sufficient for Most Forest Bridges.

In laying stone:

Five Points to Remember.

1. Use the largest stones in the foundation and reduce the size gradually toward the top.
2. Place the broad faces down.
3. Overlap all joints.
4. Moisten porous stones before imbedding them in mortar (to keep them from absorbing moisture from the mortar).
5. Fill all spaces between stones with mortar.

CRIBBING

Building a timber crib bridge.

A combination of wood and stone, known as stone crib, is often used for piers and abutments. It consists of a log frame filled with rocks to give it added weight and stability. Bridges supported in this manner are common in eastern logging sections where low streams must be crossed by ogging roads. Such bridges can be constructed cheaply and quickly. When built of strong, durable logs, wooden logging bridges may be serviceable for many years.

TRESTLES

The supporting members of a trestle are known as bents. When *properly constructed*, a bent will support a load of 600 pounds for each square inch

of average cross-sectional area of the piling. For instance, if the average diameter of the piling is 10 inches, the cross-sectional area is 78.5 inches, and the allowable load is 47,000 pounds (600 by 78.5).

A timber trestle bridge partially completed.

WOOD FOR BRIDGES

The life of wooden bridges depends largely upon the kind of wood of which they are constructed. In all common native trees, the heartwood is more decay resistant than the sapwood. For stringers, floor beams, and flooring, untreated timber should be at least 80 percent heartwood on any girth; but for caps, sills and posts the timber should contain at least 75 percent heartwood on each of the four sides. (For more detailed descriptions of forest bridges, see The Forest Truck Trail Handbook, structures section.)[1] The Forest Service has classified woods for bridge construction in the following groups:

Heartwood Is Best.

Woods for Bridge Construction.

Durable	*Intermediate*
Chestnut.	Douglas fir.
Southern cypress.	Chestnut oak.
Black locust.	Southern yellow pine.
Redwood.	Western larch.
Cedar.	Tamarack.
Semidurable	*Semilow resistant*
Dense Douglas fir.	Beech.
Dense Southern pine.	Birch.
White oak.	Hemlock.
	Sugar maple.
	Red oak.
	Spruce.
	Yellow poplar.

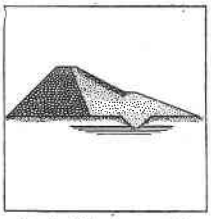
DAMS

Uses of Dams in the Forest.

In forestry work dams are constructed to fulfill one or more of the following purposes:

A. Recreation.
B. Fish and game management.
C. Water supply.
D. Water conservation.
E. Irrigation and power for forest use.
F. Flood control.

[1] U. S. Forest Service, Washington, D. C.

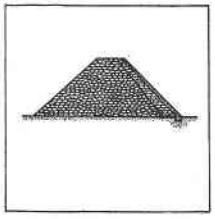


Rock-fill dam with heavy earth facing (cross-section).

For large dams, or those which in case of failure would cause loss of life or property, the services of a competent geologist, as well as those of engineers, are necessary to make certain that the ground formations and soil conditions are stable and sufficiently sound to answer the purpose of the proposed dam. The selection of site and the construction of even small dams, except those for erosion prevention, usually require engineering knowledge.

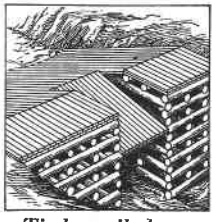
Fundamental Principles.

There are certain fundamental principles, however, that apply to all forest dams, and with which the forester should be acquainted. The purpose for which the dam is being constructed will be a determining factor in its location and specifications. Recreational dams, for instance, should provide swimming, boating, and fishing in accessible areas where adequate space is available for camping or picnicking. Possible sources of pollution must be obviated or avoided if the water is to be used for swimming or domestic purposes. Dams to provide breeding places and shelter for game and fish must be so situated that they form a part of the game-management plan. Water conserved for irrigation or domestic use should not be too far away from its final point of consumption.



Rock-fill dam with concrete facing (cross-section).

Surveys are necessary to coordinate topography with use and construction. Often a good site will not provide an adequate basin, or an adequate basin will not have a good location for the dam. This may be discovered by field inspection, but the surest method is to couple field inspection with a topographic survey of the area.



Timber crib dam.

The handbook, Design and Construction of Forest Service Dams, prepared by the United States Forest Service contains detailed information on specifications and construction of spillways and outlets, earth dams, rock-fill dams, concrete and masonry dams, and timber dams.

Chapter XIII

FOREST RECREATION

FREQUENT reference has heretofore been made to the recreational values of forests. The growth of forest recreation since 1916 has in some sections placed it at the top of the list as a forest value. In 1916, 237,357 persons visited the national parks, and in 1931, 2,999,451. Records of visitors in the national forests in 1917 showed a total of 3,132,000, whereas the 1931 reports showed a total of 32,288,613. In 1935 the forest service recorded 41,725,000 visitors. The following tabulation from "A National Plan for American Forestry" [1] shows the popularity of these natural playgrounds and resting places during the year 1931:

Forest recreational use is growing.

Class of forest land	*Number of visitors*
National parks	3, 000, 000
National monuments	400, 000
National forests	32, 000, 000
Other Federal lands	1, 500, 000
State parks and forests	50, 000, 000
County and municipal parks	60, 000, 000
Private lands	100, 000, 000
Total	246, 900, 000

246,900,000 Man-Days in the Forests.

These figures, of course, contain many duplications. Many people visited two or more areas and some spent only an hour in the forests. Others, however, spent weeks or even the entire summer in camps and summer homes. It is safe to assume that an average of 1 day each was spent in the forests by the 246,900,000 persons who visited them in 1931.

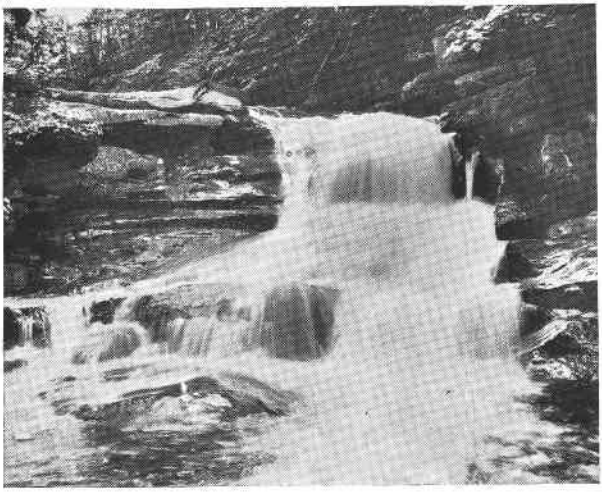
Increased population and increased leisure time undoubtedly have been important factors in raising the popularity of forest recreation. Probably the most significant factor has been the almost universal use of the automobile as a means of

[1] Senate Document 12, 1933.

New trails mean new recreational opportunities.

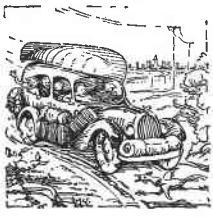
transportation. Coupled with these factors has been the activity of the CCC in recent years, in making the forest more accessible to the motorist and the hiker, in improving recreation and scenic values, as well as in increasing the utility of the forest as a producer of wood.

Numerous attempts have been made to evaluate forest recreation in terms of dollars and cents. Probably the most easily understood figures are those of Robert Marshall: Assuming that a day spent in the forest has a recreational value equal to that of a 25-cent motion-picture show (and many recreationists deem this comparison unfair to the forest), the man-days spent in forest recreation (approximately 250 million) have a value of 62½ million dollars. In spite of the conservative value placed on a day in the woods by this authority, the final figure is high.



Man's artistic developments seem insignificant when compared to natural beauty.

The value of forest recreation to industry has been placed at $1,750,000,000—1 billion dollars for motor travel, one-half billion for hunting and fishing equipment, and one-quarter billion for summer homes, resorts, and hiking equipment.



TYPES OF RECREATIONAL AREAS

Seven types of areas have been recognized in "A National Plan for American Forestry" to fill the requirements of as many classes of recreationists.

Superlative areas: Unique and outstanding scenic, scientific, or historical values characterize certain localities. Grand Canyon, Crater Lake, the volcanic regions of Yellowstone National Park, and the big tree and redwood forests of California are "superlative areas." Most of such areas have been set aside for recreational use and study in national parks, national monuments, national forests, and State parks, although a number of them are privately owned. The size of a superlative area depends upon the superlative characteristic itself and upon the number of people that visit it.

Superlative beauty.

Primeval areas: From a scientific standpoint, the preservation of "primeval areas" or "natural areas" is of major importance in studying the laws of nature as applied to forest growth. These areas of virgin timber have also a great recreational value particularly to people who wish to escape from the artificialities of modern life to the quietude of the forest primeval.

To satisfy both scientific study and recreational relaxation such areas should be at least 5,000 acres in extent. Smaller areas of about 1,000 acres may be adequate for research and study.

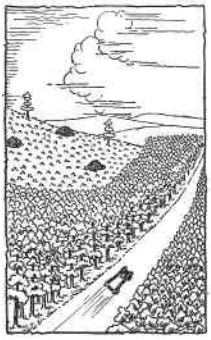
The forest primeval.

Wilderness areas: Tracts of forest land, with no permanent inhabitants, no roads for automobile traffic, and large enough to enable a person to spend a week or more of travel in them without back-tracking, are designated as "wilderness areas." Such areas should be at least 200,000 acres in extent, and should be free from the marks of civilization, except where improvements such as telephone lines and towers are necessary for fire protection.

Wilderness conditions may still be found in extensive areas of the West and in a few sections of the East. The problem of establishing wilderness areas is not one of development, but of retarding or restraining the encroachment of civilization.

No roads, no inhabitants, plenty of space.

Roadside areas: Strips of timbered land left uncut along highways and important roads are known as "roadside areas." Ranging from 125 to 250 feet in width, these strips help beautify



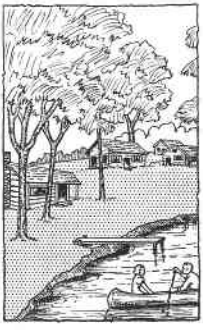
Hiding cut-over land.

automobile travel. Similar strips left along the shores of waterways and lakes add to the pleasure of boat travel.

Camp-site areas: Camping is one of the major activities of forest recreationists. This activity has been recognized in the setting aside and development of areas for campers. Their location is governed largely by accessibility and water supply, and they may range in size from one-quarter acre to an area large enough to accommodate more than a thousand camps.

The forest provides quiet atmosphere for summer cottages.

Residence areas: In 1931, 493,235 summer home sites were rented on the national forests and many State and private land holders also supplied sites for summer homes, hotels, stores, sanitaria, and other special uses. The tracts of land for these activities vary greatly; probably one-quarter acre is the minimum size.



Summer cottages in the forests.

Outing areas: The recreationist who desires a spot away from the noise and dust of the highway, which although used for timber production and equipped with administrative roads and trails, has not been injured scenically, finds "outing areas" suited to his need. These areas may be only 4 or 5 acres or many thousands of acres in extent. Outing areas adjacent to superlative or primeval areas provide camping facilities without marring natural beauty.

CAMPGROUND IMPROVEMENTS

To obtain the maximum use of forest recreational areas and to protect them against destructive use, it is necessary to establish improvements.

With the exception of camp-site areas very little is needed to provide adequate recreational opportunities. At camp sites, however, people are likely to congregate in great numbers, and planning and development are necessary.

In developing a recreational area, the natural beauty of the spot must not be lost through the building of facilities which do not blend well with the landscape. Each camp site presents a problem that is best solved on the site itself. There are, however, fundamental developments which are part of any well-planned camping area.

A tourist haven.

Improvements and structures increase recreational utility.

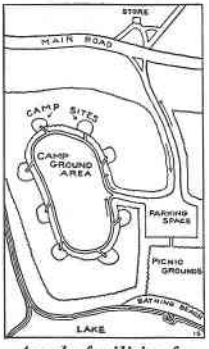
Camp-site improvements vary widely throughout the country. Each region, each State, in fact each recreational area has its own peculiarities of design. The great diversity of campground planning is accounted for by the fact that this is a new phase of forest administration. Definite plans have been developed by some Forest Service regions and by a few of the States. They are becoming coordinated as time and public use prove their worth.

LOCATION OF CAMP SITES

The most important factor in the location of a camp site, for the average tourist or week-end

Combining Comfort, Accessibility, and Outdoor Ruggedness.

visitor, is its accessibility. Camp sites are developed to supply a recreational demand—the demand of the camper who does not wish for too great exertion. Campers of the rugged woodsman type usually spurn the refinements of prepared camp sites, and choose isolated spots far from traveled roads. For the city dweller who takes his family on a week-end camping trip, the campground planner must combine scenic values with easy access and must temper the ruggedness of the outdoors with facilities for comfort and rest.



Ample facilities for camper and picnicker.

To be accessible a camp does not have to be situated on the shoulder of a main highway or on the outskirts of a large town. It should be so located, however, that campers may approach within easy walking distance by automobile. One-way, loop roads from the main highway to the camp area will provide this access and will tend to limit the travel of noncampers through the area.

Pure Water Supply and Good Drainage Are Necessary.

The campground should be on level ground—steep slopes are undesirable. Although scenic beauty is pleasing and should be a part of every camp-site area, it is not as important to the camping area as pure water supply, good drainage, and comfort. Swampy ground, rockslides, old stream beds, low flats which may be flooded in high water, and extremely windy areas should be avoided.

CLEARING

Campers are attracted to the forest by the trees and other natural vegetation. Unnecessary removal of trees and shrubs, therefore, defeats the purpose of the campsite. Only such vegetation should be removed as interferes with the safety and comfort of the campers.

Remove Dead and Dying Trees.

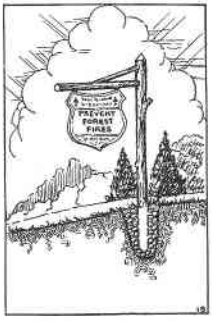
Brush and undergrowth and fallen trees which constitute fire hazard should be cleared away, and dead or dying trees which are likely to fall across the camp site should be cut down. Sufficient clearing and cleaning must be done to accommodate tents, shelters, and other facilities, but this clearing must not be overdone. When in doubt as to whether a tree or clump of brush should be cut, it is wise to let it remain.

The fire demon can change beautiful recreational areas to ugly wastes.

SIGNS AND POSTS

Like billboards on public highways, campground and trail signs may be unnecessary eyesores if they do not blend in with their surroundings. Picturesque, rustic signs, if they are not too numerous or conspicuous, tend to make the public conscious of the forest and instill a desire to keep the campground clean.

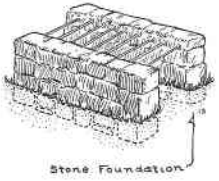
Signs should be simple in their construction and design, and should be built of native material of durable character. Native shrubs form a good background.



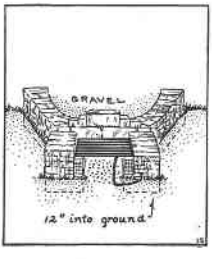
Well-anchored, picturesque, rustic signs.

CAMP STOVES AND FIREPLACES

When visitors are permitted to build fires at will in a campsite area, the spot soon becomes a mess of ash heaps. These ash heaps, besides being unsightly, have a poisonous effect on plant growth. Rain beating down on them washes lye into the soil so that in a relatively short time all nearby vegetation is seriously damaged or killed.



Permanent stone or brick fireplaces offer better cooking facilities than do open fires, and campers will take advantage of them if they are conveniently placed. Besides reducing the number of ash heaps, stone fireplaces reduce fire hazard.



Native stone is used for fireplace construction, but often it must be lined with firebrick to prevent

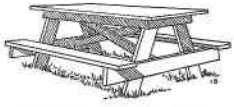
A campfire ring.

it from cracking and crumbling. The simpler fireplaces are short parallel walls of stones but the more elaborate ones have chimneys and are equipped with cast-iron grates or steel plates to hold utensils for cooking.

A ring of native stone filled with gravel to form an elevated hearth can be used for campfires or bonfires. Such an arrangement will attract the campers and will tend to limit the size of the fire.

Improved camp areas offer healthful outdoor recreation.

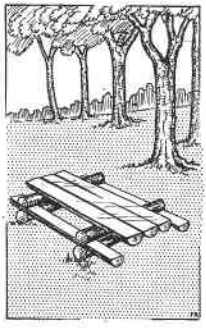
TABLES AND BENCHES



Sturdy enough for rough usage.

Two-inch planks may be used for table tops and bench tops and 4 by 6 material may be used for legs. Furniture of lighter material will not stand the rough camp usage, and is too easily moved from place to place.

Attractive tables and benches may be constructed of 12-inch peeled logs with their top surfaces hewed flat. These are spiked together to form table and bench combinations as shown in the sketch.



Built of 12-inch peeled logs.

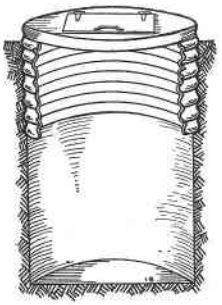
Rustic picnic tables may be built of peeled, stained, native cedar logs about 4 inches in diameter with 2-inch planks for seats and table tops.

GARBAGE PITS

The indiscriminate disposal of garbage at popular camp sites results in a messy area uninviting except to scavengers and flies. Campers will use

garbage pits if the pits are well placed, and if they are inspected frequently. When the pits are filled to within about eight inches of the top, new ones should be dug, and the old ones should be covered with rocks and earth. If garbage is permitted to pile up near the ground surface, animals may uncover old pits.

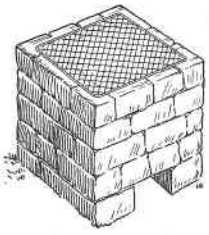
Pits are dug not less than 4 feet in depth, and the sides are lined with rock or supported by corrugated pipe. Standard tops, with hinged lids, either of galvanized iron or wood may be removed from old pits and placed on new ones.



Cross-section of garbage pit with removable top.

INCINERATORS

For burning trash, stone incinerators may be built of native material topped with a screen lid to prevent the escape of large sparks and burning material. Draft openings are made at the ground level on opposite sides of the incinerator.



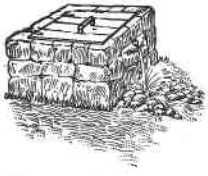
A safe place to burn trash.

WATER SUPPLY

Campsite areas must have a supply of fresh, pure water, and springs must be improved to meet this demand. Although one or two campers may use a natural unimproved spring without spoiling it, a number of visitors over a long period of time can make a muddy swamp of a small free-flowing spring.

Too Many Users Can Spoil a Spring.

Protecting boxes for springs may be of many types, but concrete or stone have proved most satisfactory and permanent. Before a spring box is built, the spring must be cleaned out and all impediments to flow must be removed. The box is then built to enclose the spring completely. Suitable, tight-fitting covers are necessary to keep out leaves, earth, and insects, and to prevent pollution by animals. Springs from a height outside the camping area may be piped to a faucet in camp.



Improved for greater use.

Adequate drainage for overflow must be provided. Paving with gravel or stone will prevent the area around the spring or faucet from becoming muddy.

The development of springs and water lines is explained in the Forest Service publication

Manual for Small Water Developments.[2] The services of an engineer and campground planner are usually necessary in laying out pumps, hydrants, pipes, and other water facilities. Water requirements are computed according to the number of people using the area and the type of water-using facilities installed. For camps not provided with flush toilets, about 5 gallons per person per day fills all demands; but for the more elaborate camps, equipped with cabins, flush toilets, baths, and lavatories, from 25 to 50 gallons of water per person per day may be necessary.

The Number of Visitors Determines the Extent of Water Facilities.

LATRINES

Water Supply Must Not Be Contaminated.

The location of latrines, with reference to other camp-site facilities, is very important. They should be no closer than 100 feet from streams and water supply, and should be no farther away than 300 feet from the camp spot. The number of latrines will be determined by the number of people who use the camp-site area. One unit may be expected to serve for three camp spots (about 15 people).

Of the three common types (pit, chemical, and flush) the pit latrine is the cheapest. In small camps this type is adequate, but it is more difficult to keep sanitary than are the more elaborate types.

Large Camps Demand Greater Sanitation.

Flush latrines should be installed in camp areas serving a large number of people and where adequate water supply and good drainage can be provided without contaminating springs and drinking water. In porous soil where the drainage is not near the water supply cesspools may be used, but septic tanks are far better.

Chemical latrines are safe near water supplies as they sterilize and liquefy the sewage. These, however, demand constant care and supervision.

MISCELLANEOUS IMPROVEMENTS

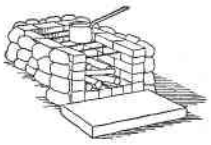
A Facility for Every Fancy.

A camp site may have a number of other facilities, depending upon its use. Near streams and lakes, boat landings, diving boards, beaches,

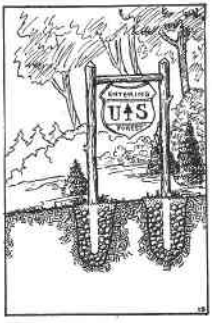
[2] U. S. Forest Service, Washington, D. C.

wading pools for children, and bath houses are provided. Some of the larger camps are equipped with laundries, shower baths, playgrounds, pavilions, and recreation halls. As recreational use continues to grow, more and varied facilities will be demanded.

SUMMARY



Although forest recreation is still in its infancy as a phase of forest administration, it is growing rapidly. Its growth has been due to a number of developments in modern civilization—increased population, shorter working hours, raised standards of living, ease of transportation, and increased nervous strain and pressure of business life. These developments are increasing in influence and a corresponding increase in demand for recreational areas may be expected. No plan for development of recreational areas should be too limited or too rigid to allow for future expansion.



Natural Conditions, Recreation, and Utility Are Coordinated.

Structural improvements vary in the regions and States; new ideas and new facilities characterize the development of each new area. The interchange of plans between the agencies responsible for recreational development will bring about the greatest recreational use of each area.

In planning recreational developments it is important to preserve natural conditions and natural beauty. Other forest uses may be coordinated with recreation. Clear cutting usually leaves an area unattractive to vacationists. Where forest land is demanded for recreational use, a system of selection cutting will provide for timber harvest and will not seriously harm its hiking, hunting, fishing, and outing possibilities.

Units of Use—Recreation, Timber Recreation, Timber Culture.

Many forest areas have been separated into units of use—units where recreation is of major importance, units where it is of equal standing with timber harvest, and units where timber harvest is of major importance. In the first units, no cutting is done if it will interfere with recreational use; in the second, both uses are coordinated; and in the third, recreational use is not permitted to interfere with timber culture or

Timber and recreational values may be derived from the same forest area.

harvest. Flexibility in the designation of these units is necessary to meet the requirements of changing forest uses.

Forests offer inexpensive recreational opportunities which appeal to rich and poor alike. Low priced automobiles and good roads have made the forest accessible to thousands of American workers. It is possible, however, to extend forest recreation to many more city dwellers by establishing picnic and outing areas near cities and towns or by providing transportation at reduced rates for those who otherwise would not have an opportunity to spend an occasional "day in the woods."

Chapter XIV

THE WORK OF FORESTRY

THE NATURE OF FOREST WORK

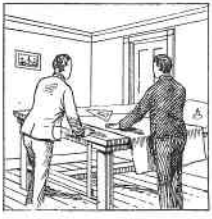
The Forester's Work Has Changed.

EARLY forestry methods were crude, and foresters were no more than woods policemen or wardens. Practically all their work was out of doors and of a rough nature. Today, although much of the work is still in the woods, added duties have been assigned to foresters so that most of the unskilled work is done by local laborers, supervised by foresters.

The forester supervises woods work.

SCOPE OF FORESTRY

A forester is not necessarily a man who wears a regulation uniform and climbs lookout towers looking for fires. He may be a business man working in a modern office. He may be a supervisor who drives an automobile over forest roads inspecting the woods work. He may be a teacher in a college, a writer, a lumberman, or a manufacturer of wood products. A forester may be far from cities in isolated mountain regions where he works on his projects and protects the forest assigned to his care. He is a man who knows about forest problems and how to meet them. He knows the value of trees and what they mean to man. A forester who was asked to define the term, gave the following definition: "A forester is a combination business man, diplomat, evangelist, technician, and laborer who knows plenty about trees and doesn't object to hard work."



The forester may be a draftsman.

STANDARDS OF FOREST WORK

Forest work is wide in scope and the standards of work are high. Professional foresters try to do their work efficiently, and have earned, and been given, praise for rendering unselfish service.

Because of the varied work required of foresters they should possess rather positive characteristics.

What Characteristics Should a Forester Possess?

A forester should be physically strong, an outdoors man, and willing to endure hardships. He should be intelligent, mentally resourceful, and congenial. He should be a nature lover, and should be willing to make personal sacrifices for his work.

Forestry work often means long periods on the trail.

TRAINING OF FOREST WORKERS

FOR NONSKILLED WORK

How Foresters Choose Laborers.

There are various degrees of training necessary for forest workers. Many men are needed to carry on the labor of the forests such as logging, making roads and bridges, fighting fires, and planting trees. Foresters choose laborers who want to do good work, know how to do it, and will be interested in their jobs.

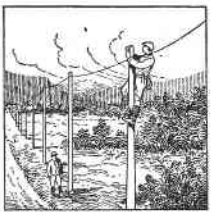
Forest laborers must know how to work and must be strong enough to do rather heavy labor. They should have personal initiative, be willing and able to carry out directions of supervisors, and should be satisfied to do only the best grade of work.

Forest laborers at work.

FOR SKILLED WORK

The training for skilled workers must be sufficient to give them a greater degree of proficiency than is required of general laborers. Many jobs, such as construction of towers, trails, bridges, and telephone lines, demand precision in techniques

and skills. Operating tractors, steam shovels, sawmills, and doing concrete and steel work are jobs requiring expert services. These skills may be obtained in trade or technical schools, or through practical experience.



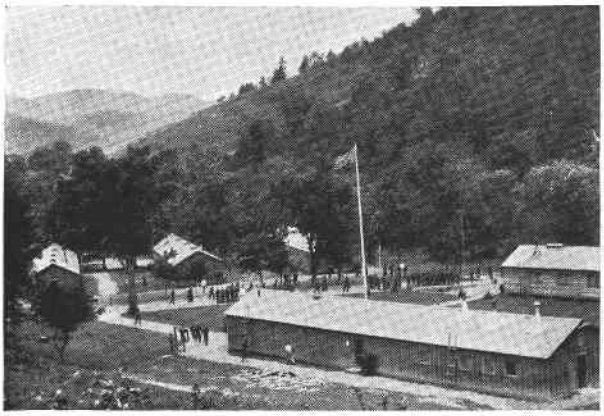
Telephone work requires skill.

Jobs Requiring High Type of Ability.

There are some jobs in forestry requiring administrative ability and a general knowledge of forestry as well as ability to do hard labor and skilled work. Rangers of the United States Forest Service fill these jobs. Formerly the Forest Service selected rangers by examination, from among skilled woodsmen, and practical experience was an important qualification. But today the ranger must be more than an intelligent woodsman. He must have a background of basic forestry knowledge. With rare exceptions, ranger applicants must have studied in an approved forest school before being eligible for examination and appointment.

Qualifications for Rangers.

Similar training and abilities are required of foremen in the Civilian Conservation Corps. The Civil Service Commission has given examinations to enrollees who desire advancements to the technical staff. Knowledge of the work, ability to direct men, and a basic understanding of forestry and conservation are requisites of a good forest-



The CCC has increased forest employment.

work foreman. Candidates for this position should apply themselves to their work and take advantage of the technical education opportunities offered in the camp.

Training for Skilled Workers.

A Long "Grind."

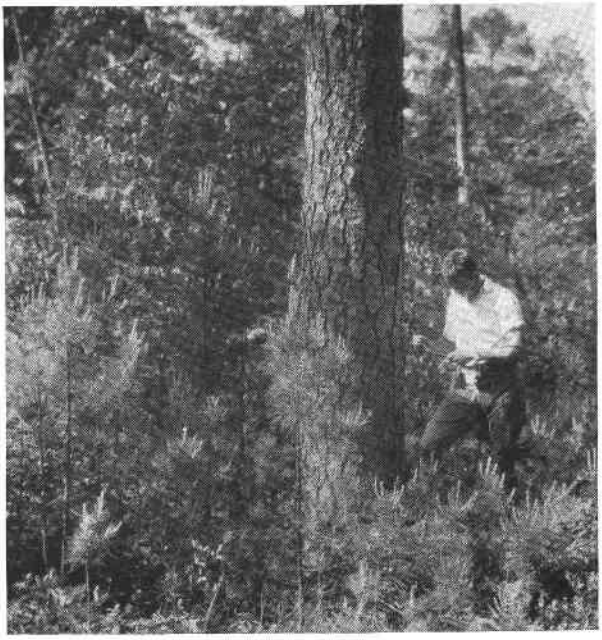
Study is necessary.

Costly Too.

Young men who wish to prepare themselves for professional forestry work must undergo a long period of study and training. To begin with, they should make a personal evaluation of their own characteristics, to determine whether they possess the essential qualities required for the forestry profession. They should also make a study of the field of employment and their chances to find jobs after they have prepared themselves. Finally, they must decide whether they have or can obtain the money required for the 4 or 5 years of collegiate study. The cost of a 4-year course in forestry varies from about $2,000 for the thrifty student in a school where expenses are low, to about $5,000 for the average student in more expensive schools.

How Professional Foresters Are Trained.

The training of foresters begins with the fundamentals of the work. Classroom study is combined with actual field work where students learn to use forest tools. They learn forest principles, and methods of applying them. After fundamental knowledge is acquired, forest students usually specialize in a particular phase of forestry.



Forest students learn practical as well as theoretical forestry.

College Degrees.

Upon completion of their standard course, many students specialize in study for an additional advanced degree. The 4-year course prepares students for the bachelor degree in science or forestry, the 5- or 6-year course for the degree of master of forestry (or science).

The following subjects generally are studied by forest students:

What Forestry Students Study.

1. Preparatory subjects

Economics	Botany
English composition	Chemistry
History	Geology
Literature	Mathematics
Political science	Physics
Public speaking	Zoology

2. Technical subjects

Forest management	Forest administration
Forest protection	Forest mensuration
Forest utilization	Forest finance
Silviculture	Forest pathology
Forest recreation	Forest entomology
Wildlife management	Forest economics
Range management	History of forestry

3. Allied subjects

Dendrology	Surveying
Soil ecology	Drawing
Plant ecology	Wood technology
Logging	Accounting
Timber marketing	Telephony

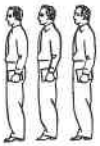
Many of these subjects overlap and many are not studied in detail except by students specializing in them. There are many other allied subjects which may be used to advantage by foresters.

Location of forest schools of United States.

There are 25 schools in the United States offering degrees in forestry. Some of these schools offer a very high type of instruction, while others have poorer facilities and have not been so well developed.

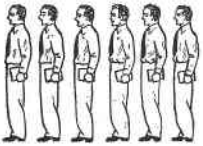
In addition to the forest schools many colleges and universities offer courses in forestry not leading to a degree. These general courses lead to further study, and fit men for work in fields allied to professional forestry.

Forest schools in the United States



Represents forest school enrollment, 1933.

1. University of California.
2. University of Michigan.
3. New York State, Syracuse University.
4. Yale University.[1]
5. Cornell University.
6. Harvard University.[1]
7. University of Idaho.
8. Iowa State College.
9. University of Minnesota.
10. Oregon State Agriculture College.
11. Pennsylvania State College.
12. State University of Montana.
13. Michigan State College.
14. University of Washington.
15. Duke University.[1]
16. University of Georgia.
17. Louisiana State University.
18. University of Maine.
19. North Carolina State College.
20. Purdue University.
21. Colorado State College.
22. Connecticut State College.
23. University of New Hampshire.
24. Utah State College.
25. Washington State Colleges.



Forest school enrollment has doubled since 1933.

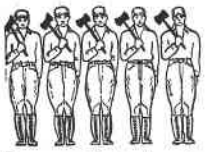
POSSIBILITIES FOR EMPLOYMENT

Emergency Employment.

Many phases in the field of forestry must be considered before one can predict future employment possibilities. Before CCC emergency employment, made necessary by the depression, there were five or six thousand foresters. These are now all employed. Forest schools in 1934 graduated over 400 foresters, and enrollments increased 68 percent in 1935. At present nearly 4,000 students are enrolled.

Representing forestry employment before the CCC was created.

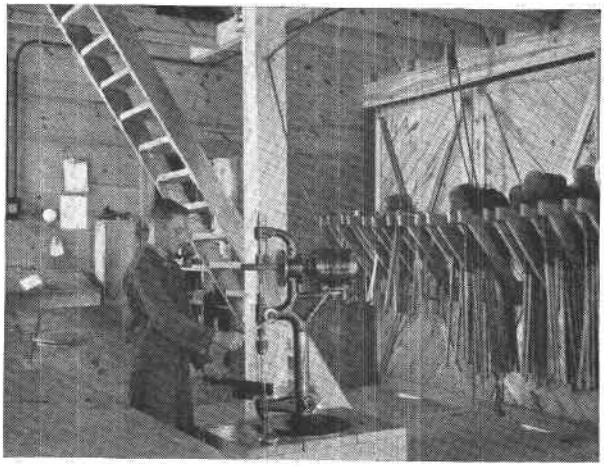
If this increase continues, many graduate foresters may be unable to find employment of the type they desire. They may find it necessary to take labor jobs, and to do the work formerly done by untrained men.



Representing forestry employment since the CCC was created.

Forest schools give a broad training which enables the forester to adapt himself readily to allied scientific and public service occupations. Many foresters enter educational fields as professors of science, botany, forestry, and similar subjects.

[1] Graduate schools only.



The work of the forester is not always confined to the woods.

Others establish businesses as nurserymen and landscape architects. The wood-using industries—furniture making, wood distillation, paper manufacture—employ foresters as specialists and technical advisers. All forestry courses include the study of engineering and mathematics which enable graduates to find employment as engineers and surveyors with highway departments.

Ability and Determination Win.

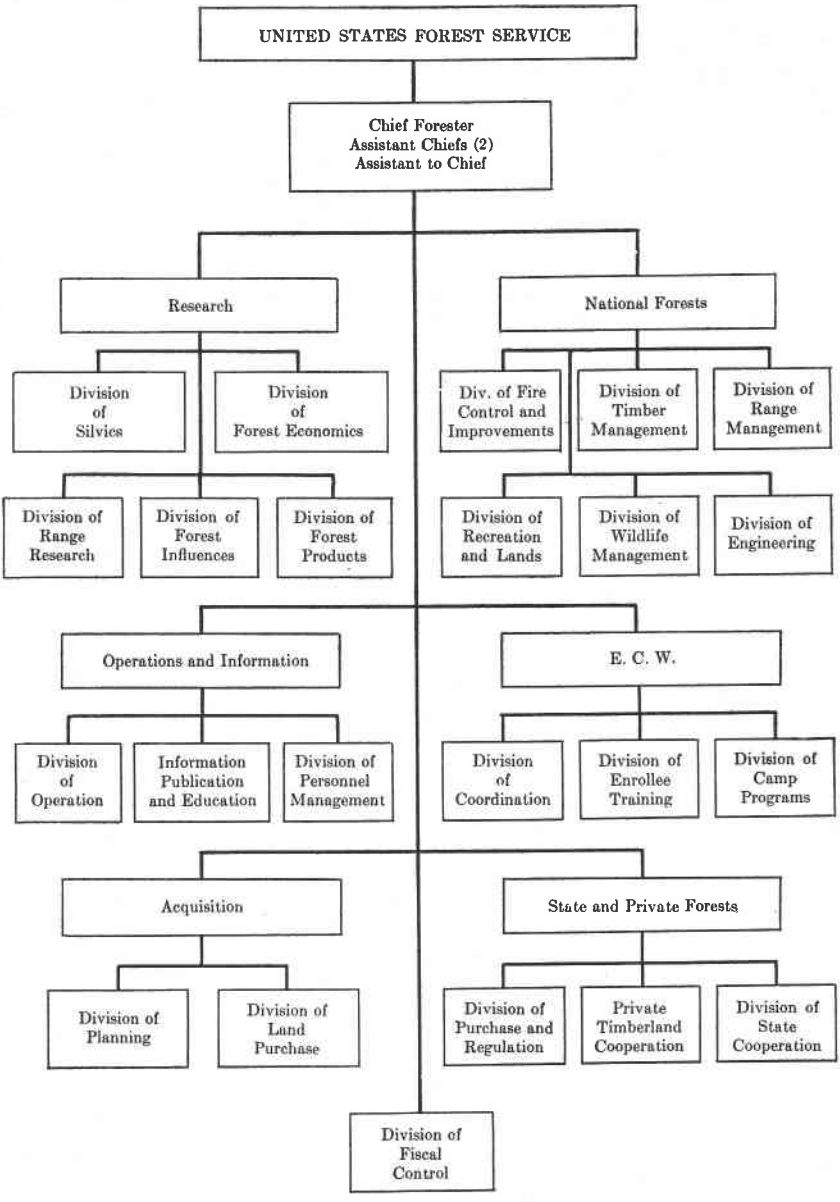
The forestry profession, like industry, is always looking for good men. A young man who has the ability and determination may succeed in spite of numbers. The average young man entering a forest school in 1937 or thereafter should have done considerable thinking, and should not be unduly optimistic regarding his opportunities. He should know what odds are against him.

EMPLOYMENT IN FORESTRY

JOBS IN THE FEDERAL FORESTRY PROGRAM

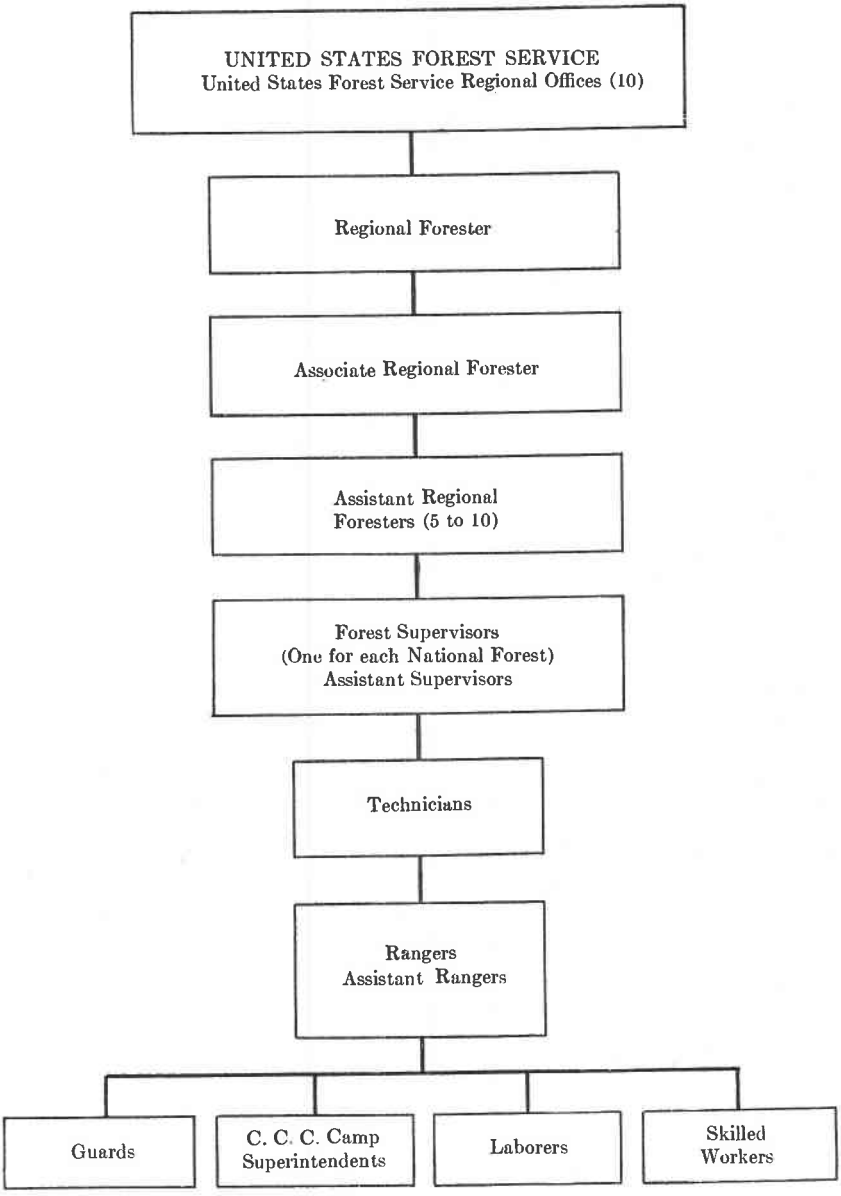
Employment in United States Forest Service.

Employment by the Government is largely, though not entirely, confined to employment in the United States Forest Service. The Forest Service is a bureau of the Department of Agriculture, employing regularly more than 6,000 people. The diagram on the next page shows the organization of the service and the positions held by its employees. It does not show the employment of hundreds of assistants, such as technicians, secretaries, typists, and messengers.



National Forests Administration.

As shown by the chart, most of the employment is on the national forests. The six major functional units of service are each headed by an assistant chief in the Washington office. Each of these branches is related to management of the national forests.



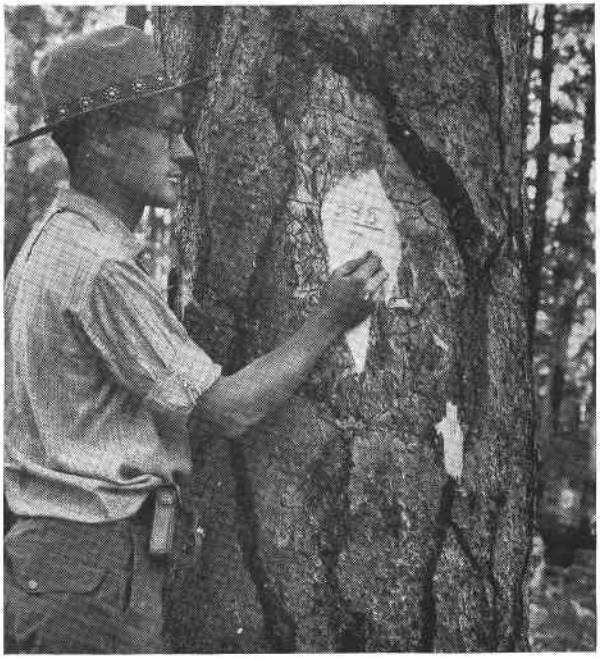
REGIONAL OFFICES

Regional Forests.

Ten regional offices have been established so that the business of the different regions can be handled more efficiently. Each region has its regional forester with his assistants.

Ranger Districts.

The work on the forests located in each region is under the administration of the regional forester. Each national forest (there are 142 of them plus 35 purchase units) has a forest supervisor, whose office is in or near the forest, with office assistants and supervisors. Each forest is divided into two or more ranger districts, and a ranger directly supervises the work of the district. The ranger district may be subdivided, the subdistrict being in charge of an assistant ranger. Much work is done by temporary employees.



A forester at work.

Forest Experiment Stations.

In addition to the 10 forest regions of the Forest Service, employing foresters and rangers, there are 11 Federal forest experiment stations and a forest products laboratory. Foresters and forest workers carry on research in these stations and make experiments relating to the better development and utilization of forest products.

Other Government Agencies Employing Foresters.

Other Government agencies employing foresters are the National Park Service, the Soil Conservation Service, the Biological Survey, and the Bureau of Indian Affairs. Forestry is directly related to these Federal agencies, but all these

together employ regularly only 22 percent as many foresters as the Forest Service alone.

The employment of foresters as here discussed refers to regular employment. Emergency employment will be treated separately.

JOBS IN PRIVATE FORESTRY

The Forester Gains a Place in Private Forestry.

Jobs in private forestry are generally connected with the lumber industry. Lumbermen see the necessity of growing timber crops and managing their forests to provide for sustained yield. Increasing numbers of foresters are being employed by lumber companies, pulp and paper manufacturers, and other industrial forest organizations.

As in Federal and State forestry, the types of work range from labor jobs to high executive positions. Forest labor may include felling and bucking trees, stand improvement, sawmilling, trail building, and fire fighting. Jobs requiring skill include cruising and scaling timber, logging by machinery, treating lumber, inspecting and grading lumber, and other similar work. Higher positions requiring definite abilities are those related to forest management, manufacturing, marketing, and research. Often foresters are executives of large corporations whose operations include forestry and lumbering.

What Is a Consulting Forester?

Consulting foresters are professional men who offer their advice and services to the public and charge fees for service rendered. Few foresters enter the consulting field, as there is little demand at present for consulting foresters. This work may be associated with some other business, such as operating a nursery or landscape architectural service, to form a profitable business.

STATE FORESTRY

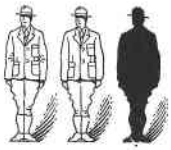
Pennsylvania and New York Leaders in State Forestry.

Although State forestry had its beginnings years ago, very few States had forestry organizations prior to 1920. Today all the States have organizations for forestry work and 40 employ technical foresters. Pennsylvania and New York lead in the employment of foresters and forest workers. The former has 61 foresters and the latter 40.

These two States own more than half of all the State-owned forest land of the United States. The 48 States as a whole employ a total of about 300 full-time foresters (not including emergency projects) and many technicians and part-time workers. Work in State forestry may be classified as follows:

Functions of State Forestry Departments.

a. Protecting and developing State-owned forests and parks.
b. Educating the public in forest conservation and use. Furnishing technical information to private forest owners.
c. Managing forest nurseries to furnish seedlings demanded throughout the State.
d. Cooperating with private owners in protecting their forests from fire and in making forest improvements.
e. Carrying on research in forestry.
f. Planning for and acquiring State forest land.



One-third of the trained foresters are in Federal employment.

EDUCATIONAL WORK

About 1 out of every 10 foresters is employed in a forest school or college. Some of the best foresters of the country have been chosen as teachers. Almost all the forest schools of the country are State-owned. Although States have been rather backward in providing governmental forestry departments, many of them have organized forest schools in their universities.

WHERE FORESTERS WORK

Who Employs the Trained Forester?

The following table shows the distribution of foresters from a total of 1,718 forest school graduates of the years 1900 to 1929:[2]

	Percent
Federal Government	33. 3
State, county, municipal governments	14. 1
Forest industries	29. 2
Educational insitutions and graduate work	12. 5
Private forestry	6. 7
Miscellaneous	4. 2
	100. 0

EMERGENCY EMPLOYMENT

Forests Furnish Field for Emergency Employment.

A large part of the emergency employment incident to the recent economic depression was forestry work. The Civilian Conservation

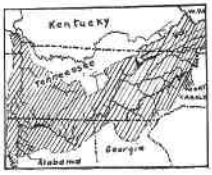
[2] Based on *Forest Education*, Graves and Guise, 1932.

Corps with three to four hundred thousand laborers, working largely in forest improvement and protection, required the services of a great many foresters.

Prior to 1933, approximately 30 percent of the five or six thousand foresters in the country were unemployed. Emergency Conservation Work has absorbed these technically trained men and thousands of men trained in other lines. Engineers, mechanics, woodsmen, executives, and work supervisors have been employed. During the first 3 years of Emergency Conservation Work, more than a million and a half men were given employment, largely in forestry work.

The CCC Cooperative.

The Civilian Conservation Corps has been administered on a cooperative basis. The Director of Emergency Conservation Work has had final authority. The Army has housed, clothed, and fed the workers, the Department of Labor has chosen the enrollees. Supervisors and technical men, under authority of the various work agencies (Forest Service, National Park Service, Soil Conservation Service, etc.) have administered and directed the actual work performed. The CCC is a marked example of splendid cooperation among Government departments.



Areas of the T. V. A.

The Tennessee Valley Authority was set up in 1933. Thousands of workers have found employment in Tennessee Valley Authority forests. Soil conservation and reforestation projects car-

A Forest Officer Making Plaster Cast of Incendiary's Footprint.

ried on in connection with this enterprise have employed many foresters. Forest lands purchased by the Tennessee Valley Authority total 15,000 acres, and 6,000,000 acres of farm woodlands in the Tennessee Valley area will be under cooperative management as a result of this program.

Shelterbelt.

The Shelterbelt project of the Prairie States has given employment to thousands of forest workers. This experiment may lead to wider planting for protection from wind.

PAY FOR FOREST WORK

Salaries of Forest Workers.

The compensation received by forest workers is indicated in the following table:

United States Forest Service

Forest guard	per year	$900
Other temporary employees	do	$900–1, 200
Assistant ranger	do	1, 620–1, 860
Ranger	do	1, 800–2, 040

State forestry departments

Temporary	per month	$30– $100
Assistants	per year	1, 500–2, 000

Private forestry

Laborers	per month	$30– $100
Skilled workers	do	60– 150
Inexperienced foresters	per year	1, 200–1, 500

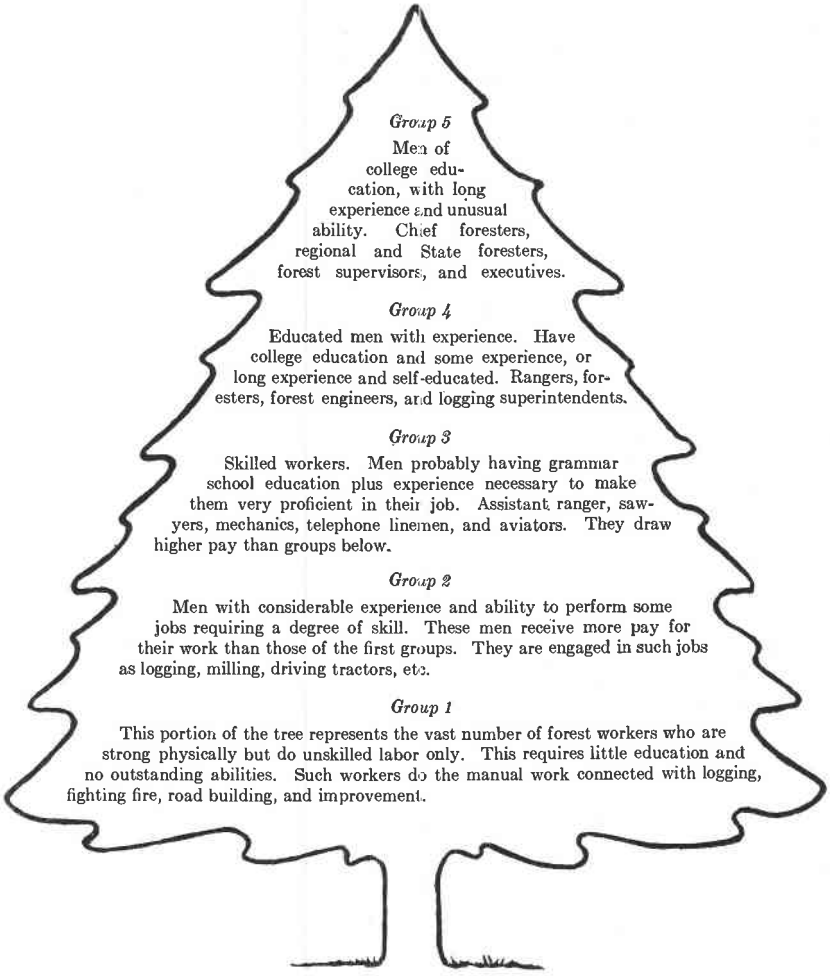
OTHER CONSIDERATIONS

Service to Others.

By devoting spare time to study and research, the forest worker has an opportunity to advance into the higher salary brackets.

Although the forester's work is not wholly altruistic, it is of great service to the people. One who helps to establish, maintain, and protect forests is making a valuable contribution to the well-being of society. The realization that he is making this contribution is one of the satisfactions the forester derives from his profession.

The work of foresters, engaged in outdoor employment, moreover, is conducive to good health and physical development.



THE "FOREST WORK" TREE

APPENDIX

A CROSS-REFERENCE GUIDE

To be used with CCC Vocational Series No. 8

An example of how the cross-reference guide is used: A foreman in a CCC camp is preparing to teach a lesson in forestry. He uses the outline of instruction, CCC Vocational Series No. 8, as a teaching plan, and is working on the second lesson of Unit Course I. Under section III, number 3, he finds that he must lead a discussion on forest influences (see p. 13, outline of instruction). Now, this foreman has a pretty good idea of the influences of forests on civilization, but the word "physical" bothers him a little, and he is not sure about the effects of forests on climate and rainfall. He would like some reference material on the subject so that he can "brush up" a little before meeting his class. Taking a copy of "CCC Forestry" which he keeps within reach, he turns to the cross-reference guide and looks under lesson 2. There he finds: "Sec. III—3....*17* to *27*." He knows that "Sec. III—3" means section III, number 3, of the lesson outline and the "*17* to *27*" refers to pages in "CCC Forestry" which will explain forest influences. Turning to page 17 he finds that it is the beginning of a section on forest influences which will furnish the information he needs.

UNIT COURSE I

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 1	
Sec. II—5	*15 to 34*
Sec. III—8	*1, 2*
9	*40, 41, 45 to 47, 50 to 53*
10	*148 to 150*
Sec. IV—1	*52 to 53, 140 to 144, 153*
2	*52 to 53*
3	*148 to 149*
LESSON 2	
Sec. III—3	*17 to 27*
6	*17 to 18*
7	*18 to 19*
8	*22 to 27*
9	*19 to 21*
10	*21*
Sec. IV—1	*17 to 18*
2	*21*
3	*15*
4	*17*
5	*18 to 19*
6	*8*
LESSON 3	
Sec. III—4	*152 to 163*
6	*160 to 162*
7	*154, 162*
8	*40, 46, 50, 155 to 157*
Sec. IV—2	*156*
3	*148 to 150*
LESSON 4	
Sec. II	*279 to 290, 27 to 31*
Sec. III—1	*16 to 31*
2	*19 to 27*
a	*23 to 27, 232*
b	*22, 40, 63*
c	*25*
d	*23*
3	*28 to 31*
4	*279 to 290*
a	*220*
b	*280 to 282*
c	*283 to 289*
d	*207, 210, 215*
e	*280*

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 4—Contd.	
Sec. IV—3	*23, 63*
4	*63*
7	*64, 216*
8	*22*
LESSON 5	
Sec. II—1	*57 to 59*
3	*38, 57, 60, 63*
Sec. III—2	*35*
3a	*38*
b	*56*
4a, b, c	*39 to 49*
d	*51, 52*
e	*47 to 49*
Sec. IV—1	*162*
2	*37, 38, 162*
4	*55*
LESSON 6	
Sec. II—1	*57 to 85, 303*
Sec. III—1	*57, 63 to 64*
2	*59 to 62*
3a	*64 to 72*
d	*72 to 73*
e	*72 to 80*
f	*80 to 85*
Sec. IV—2	*47 to 49, 59 to 63*
LESSON 7	
Sec. II—1	*57 to 59*
Sec. III—2	*87 to 89*
3	*85, 86*
4	*89*
5	*85 to 87*
6	*89 to 94*
7	*94 to 97*
Sec. IV—1	*95*
2	*95 to 96*
3	*96, 237 to 238*
4	*95, 110, 117*
5	*85 to 89*
6	*89*
7	*57, 58*
8	*89*
9	*86*
10	*86*
11	*89*
12	*91*
13	*92*
LESSON 8	
Sec. II—1	*125 to 128*
3	*221 to 240*

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 8—Contd.	
Sec. III—1	*54, 125, 144 to 145*
2	*125 to 127*
3	*125 to 133*
5a(1)	*127*
(2)	*129*
6	*129*
a	*130 to 132*
b	*133 to 136*
7b	*221, 239*
c(1)	*225*
(2)	*222*
(3)	*232 to 233*
Sec. IV—1	*132*
4	*125*
5	*10*
6	*224*
7	*225, 233*
LESSON 9	
Sec. II—1	*201 to 220*
Sec. III—1	*201, 203*
2a	*205, 214*
b	*32 to 34, 201, 205*
3a	*202, 203*
b	*203 to 205, 210 to 214*
c	*209*
d	*220*
e	*220*
4a	*202, 203*
b(1)	*208, 215, 218, 220*
(2)	*214, 220*
(3)	*204*
Sec. IV	*206 to 209*
LESSON 10	
Sec. II	*35 to 53*
Sec. III—1	*36 to 38*
3a(1)	*39*
(2)	*39*
(3)	*40*
(4)	*40*
b	*40*
c	*41*
d	*40 to 42, 45 to 47, 50 to 53, 140 to 144*
4	*45 to 47*
5	*50 to 53, 140 to 144*
Sec. IV— 3	*40*
6	*296, 297*

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 11	
Sec. II	*298 to 305*
Sec. III— 1	*298, 299, 305*
2	*41, 42, 297 to 300, 304*
3	*291 to 305*
4a(1)	*302, 303*
(2)	*296, 303*
(3)	*40*
(4)	*42, to 45, 300*
b	*45 to 47, 301, 302*
c(1)	*296, 297, 301*
(2)	*301*
(3)	*31 to 33*
d	*302*
e	*298, 300, 301*
LESSON 11—Con.	
Sec. IV— 1	*41, 42, 292*
2	*296*
3	*305*
4	*294, 295*
5	*19 to 22*
6	*19 to 22*
7	*102, 103*
8	*73*
10	*11*
11	*10, 135, 136*
12	*54*
13	*38, 54, 57*
LESSON 12[1]	

[1] This lesson designed for review and to stimulate thought and discussion. Specific references are not practicable.

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 1	
Sec. II—2	*46, 60, 62, 65, 66, 74, 285*
4	*68 to 70*
5	*57, 59 to 64*
Sec. III—2	*64 to 66*
a	*64*
b	*65*
c	*65, 66*
3	*60*
4	*62*
5	*57*
a	*59 to 64*
6	*61, 62, 65, 284, 285*
7	*65*
8a	*68 to 71*
b	*67*
c	*67*
9	*67*
10	*68 to 71*
Sec. IV—5	*70, 71, 250, 251*
LESSON 2	
Sec. II—2	*73 to 80*
Sec. III—1a	*70, 71, 250, 251*
b	*251*
c	*71*
2	*72*
3a	*77 to 79*
b	*79*
4	*80*
5	*77*
Sec. IV—3	*76*
5	*83, 84*
6	*79, 80*
7	*77 to 79*
LESSON 3	
Sec. II	*84*
Sec. III—1	*71*
2	*83, 84*
3	*84*
4	*84*
5	*80 to 85*
6	*81 to 82*
LESSON 4	
Sec. II—1	*241 to 248*
2	*248 to 250*
4	*251, 255, 257 to 262*

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 4—Con.	
Sec. III—1	*250 to 252, 284*
2	*250*
3a	*241 to 244, 246 to 248, 254*
b	*245 to 246*
4(1)	*251*
(2)	*252*
(3)	*252*
(4)	*252*
(5)	*252*
(6)	*253*
(7)	*253*
(8)	*253, 256 to 258*
(9)	*253*
(10)	*253, 258 to 262*
(11)	*253 to 254*
(12)	*254*
5	*254*
6	*262 to 263*
7	*260 to 261*
8	*261*
9	*258 to 261*
Sec. IV—1	*243 to 248*
2	*247 to 248*
4	*251 to 254*
5	*254*
6	*262 to 263*
LESSON 5	
Sec. II—2	*271 to 273*
5	*276, 277*
Sec. III—1	*271, 272*
2	*271 to 273*
3	*273*
4	*274 to 275*
5	*275 to 277*
6	*275 to 277*
8	*277*
9	*277*
Sec. IV—1	*272*
5	*274*
LESSON 6	
Sec. III—2a	*264*
3a	*266 to 268*
b	*264 to 266*
c	*265*
4a	*265*
b	*266 to 268*
6	*271*

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 10—Con.	
Sec. III—4	*283, 285*
5a	*252*
b	*281, 282, 256*
6	*282 to 289*
7	*285 to 288*
8	*62, 65*
Sec. IV—1	*31 to 33, 279*
2	*31 to 33*
4	*289*
LESSON 11	
Sec. II—1	*204, 207, 210 to 213*
2	*207, 210 to 212, 215*
3	*221 to 226*
4	*225, 233, 235, 236*
Sec. III—1	*33, 205, 206*
2	*202, 203, 209, 214, 216*
3a	*207*
b	*216, 217*
c	*207, 213*
4	*136*
5	*203, 214, 220*
6	*226, 227*

Instructional Outline, Vocational Series No. 8	Pages in CCC Forestry
LESSON 11—Con.	
Sec. III—7	*237, 238, 58, 59, 96, 142, 143*
8	*230, 231*
9	*227, 228*
10	*233, 234–237*
Sec. IV—1	*33, 205, 206*
3	*207*
4	*213*
5	*58, 59, 96, 227 to 231*
6	*223, 224*
LESSON 12	
Sec. II—1	*3, 21, 44*
2	*44*
3	*8*
Sec. III—1	*19*
2	*20, 43, 44*
3	*8, 9, 21, 43, 44*
4	*20*
5	*23 to 27*
6	*8, 23 to 27*
Sec. IV—1	*23 to 27*
2	*63*
3	*63*
4	*19 to 20*
5	*22 to 23*

ONE HUNDRED IMPORTANT TREES OF THE UNITED STATES

Common Name	Botanical Name	Range
Alder	*Alnus rhombifolia*	Idaho and Pacific States.
Ash:		
Black	*Fraxinus nigra*	Northeast.
Blue	*Fraxinus quadrangulata*	North Central States.
Green	*Fraxinus pennsylvanica lanceolata.*	Eastern United States and Rocky Mountains.
White	*Fraxinus americana*	Eastern half of United States.
Aspen:		
Eastern	*Populus tremuloides*	Northern United States and Southern Rocky Mountains.
Largetooth	*Populus grandidentata*	Northeast, Appalachian Mountains.
Western	*Populus tremuloides aurea*	All western United States.
Basswood	*Tilia glabra*	North, east of Rocky Mountains.
Beech	*Fagus grandifolia*	Eastern half of United States
Birch:		
Gray	*Betula populifolia*	Northeast.
Paper	*Betula papyrifera*	North, Appalachian Mountains.
Sweet	*Betula lenta*	Northeast, Appalachian Mountains.
Yellow	*Betula lutea*	Do.
Buckeye, yellow	*Aesculus octandra*	Pennsylvania to Illinois, Appalachian Mountains.
Butternut	*Juglans cinerea*	Northeast, southern Appalachian Mountains.
Catalpa	*Catalpa speciosa*	Central Mississippi basin.
Cedar:		
Alaska	*Chamaecyparis nootkatensis*	Oregon and Washington.
Incense	*Librocedrus decurrens*	Oregon and Sierra Nevada Mountains.
Northern white	*Thuja occidentalis*	Northeast, Lake States, Appalachian Mountains.
Port Orford	*Chamaecyparis lawsoniana*	Northwest coast.
Red, eastern	*Juniperus virginiana*	Eastern half of United States.
Red, western	*Thuja plicata*	Northwest coast, northern Rocky Mountains.
Southern white	*Chamaecyparis thyoides*	East and Gulf coasts.
Cherry, black	*Prunus serotina*	Eastern half of United States to Great Plains.
Chestnut	*Castanea dentata*	Northeast, Appalachian Mountains.
Cottonwood:		
Black	*Populus trichocarpa hastata*	Mountains in California.
Eastern	*Populus deltoides*	Eastern half of United States.
Cypress, southern	*Taxodium distichum*	Coastal plain, central Mississippi basin.
Douglas fir	*Pseudotsuga taxifolia*	Western United States, except Nevada.
Elm:		
American	*Ulmus americana*	Eastern half of United States to Great Plains.
Rock	*Ulmus racemosa*	Across Northeastern States to Kansas.

ONE HUNDRED IMPORTANT TREES OF THE UNITED STATES—Contd.

Common Name	Botanical Name	Range
Fir:		
Alpine	*Abies lasiocarpa*	High Rocky Mountains, Washington, and Oregon.
Balsam	*Abies balsamea*	Northeast, Lake States.
Corkbark	*Abies arizonica*	High mountains in Arizona and New Mexico.
Lowland white	*Abies grandis*	Northern Rocky Mountains, northwest coast.
Noble	*Abies nobilis*	Mountains of northwest coast, Cascade Mountains.
Red	*Abies magnifica*	Sierra Nevada Mountains and Cascade Mountains.
Silver	*Abies amabilis*	Northwest coast, Cascade Mountains.
White	*Abies concolor*	Central and southern Rocky Mountains, Sierra Nevada Mountains.
Gum:		
Black	*Nyssa sylvatica*	Eastern half of United States.
Red	*Liquidambar styraciflua*	Southeast and east.
Tupelo	*Nyssa aquatica*	Southeast coastal fresh water swamps.
Hackberry	*Celtis occidentalis*	Northeast.
Hemlock:		
Eastern	*Tsuga canadensis*	Northeast, Lake States, Appalachian Mountains.
Western	*Tsuga heterophylla*	West coast and northern Rocky Mountains.
Hickory:		
Bitternut	*Hicoria cordiformis*	Eastern United States to Great Plains.
Pignut	*Hicoria glabra*	Northeast, Appalachian Mountains.
Shagbark	*Hicoria ovata*	East, except southern coast.
Holly	*Ilex opaca*	Southeast, east coast.
Larch, western	*Larix occidentalis*	Northern Rocky Mountains.
Locust:		
Black	*Robinia pseudoacacia*	Appalachian Mountains.
Honey	*Gleditsia triacanthos*	Central States.
Magnolia, cucumber.	*Magnolia acuminata*	Central and Southern States.
Maple:		
Red	*Acer rubrum*	Eastern United States.
Sugar	*Acer saccharum*	Eastern States to Kansas and Oklahoma.
Oak:		
Black	*Quercus velutina*	Eastern half of United States, except Lake States.
Chestnut	*Quercus montana*	Northeast and Central States.
Live	*Quercus virginiana*	South Atlantic and Gulf Coasts.
Oregon white	*Quercus garryana*	Northwest coast.
Pin	*Quercus palustris*	Eastern United States.
Post	*Quercus stellata*	Central and Southern States.
Red	*Quercus borealis*	Northeast, Appalachian Mountains.
Scarlet	*Quercus coccinea*	Do.
Southern red	*Quercus rubra*	Southeast.
Swamp chestnut	*Quercus prinus*	Central and Southern States.
Swamp white	*Quercus bicolor*	Northeast quarter of United States.
Water	*Quercus nigra*	Southeast.

ONE HUNDRED IMPORTANT TREES OF THE UNITED STATES—Contd.

Common Name	Botanical Name	Range
Oak—Continued.		
White	*Quercus alba*	Eastern half of United States.
Willow	*Quercus phellos*	Atlantic and Gulf coasts.
Pecan	*Hicoria pecan*	Mississippi Valley.
Persimmon	*Diospyros virginiana*	Eastern United States, except in North.
Pine:		
Jack	*Pinus banksiana*	North, Maine to Minnesota.
Jeffrey	*Pinus Jeffreyi*	Southern Oregon and California.
Limber	*Pinus flexilis*	Rocky and Sierra Nevada Mountains.
Loblolly	*Pinus taeda*	Southeast, coastal plain.
Lodgepole	*Pinus contorta*	Northern Rocky Mountains.
Longleaf	*Pinus palustris*	Coastal plain.
Northern or eastern white.	*Pinus strobus*	Northeast, Lake States, Appalachian Mountains.
Norway or red	*Pinus resinosa*	Northeast, Lake States.
Pitch	*Pinus rigida*	Northeast, Middle Atlantic States.
Ponderosa	*Pinus ponderosa*	Rocky Mountains.
Shortleaf	*Pinus echinata*	Middle Atlantic and South.
Slash	*Pinus caribaea*	Coastal plain.
Sugar	*Pinus lambertiana*	Western Oregon, mountains of California.
Western white	*Pinus monticola*	Northwest, Sierra Nevada Mountains.
Poplar:		
Balsam	*Populus balsamifera*	North.
Yellow	*Liriodendron tulipifera*	Northeast, South.
Redwood	*Sequoia sempervirens*	Low mountains of Pacific coast, Oregon and California.
Sequoia (Bigtree)	*Sequoia washingtoniana*	West slope of Sierra Nevada Mountains.
Spruce:		
Black	*Picea mariana*	Northeast, Lake States.
Engelmann	*Picea engelmannii*	Rocky Mountains, Washington and Oregon.
Red	*Picea rubra*	Northeast, high Appalachian Mountains.
Sitka	*Picea sitchensis*	Northwest coast.
White	*Picea glauca*	Northeast, Lake States, northern Rocky Mountains, Washington.
Sycamore	*Platanus occidentalis*	Eastern half of United States.
Tamarack	*Larix laricina*	Northeast, northern Rocky Mountains.
Walnut, black	*Juglans nigra*	Eastern half of United States except South.
Willow, black	*Salix nigra*	Eastern half of United States along streams.
Yew, Pacific	*Taxus brevifolia*	West coast and northwest.

GLOSSARY OF FORESTRY TERMS

AERATION—Supplying or charging water with air.

AERIAL SURVEY—A survey made from an airplane.

AFFORESTATION—The act of creating forests.

ALIDADE—An instrument equipped with sights used to determine a line, or to locate a point, such as a forest fire.

ANNUAL RING—A ring of wood put on each year by a growing tree.

ARBORICULTURE—The art of growing individual trees or shrubs such as ornamentals.

ARTIFICIAL REPRODUCTION—Regeneration of forests by methods other than natural.

BACK FIRE—A fire started some distance before and directed against a fire to be fought, so that when the two fires meet, both go out.

BALL PLANTING—A process of planting trees that have been lifted with a ball of original earth retained on the roots.

BAND SAW—A saw composed of a band of steel, with teeth on either edge, which runs on pullies like a belt. (See p. 197.)

BED A TREE—To pile brush on the ground where a tree which is being cut is to fall. The brush cushions the fall so that the trunk of the tree does not break.

BINDER CHAIN—A chain used to tie logs on truck or wagon, or to build logs together in a raft.

BLAZE—A mark made on a tree by hewing off some of the bark.

BLAZER—(1) A blazing ax. (2) A workman who blazes trees.

B. M.—Abbreviation for "board measure", meaning board feet.

BOARD FOOT—A unit of timber measure equal to a piece of board a foot square and 1 inch thick.

BOARD RULE—A table giving the board-foot contents of boards of different dimensions.

BOLTS—Small logs or sections of larger logs that have been split. A bolt is usually less than 4½ feet long.

BOOM—Floating logs chained together, end to end; used to deflect or hold floating logs.

BREAST HIGH—Four and a half feet high; the point on a tree where diameter measurements are taken.

BROADLEAF TREE—A tree having leaves with broad surfaces (not needles).

BUCK—To saw or chop a tree into logs.

BULLDOZER—A tractor equipped with a blade in front for pushing earth, boulders, etc. Bulldozers are usually used for trail and road construction.

BUNK—Heavy timbers on wagon, truck, or sled to support logs in transportation.

BURL—A knotty protuberance on the trunk or branch of a tree.

BURN—A section of a forest which has been burned over.

BUTT CUT—A log or bolt cut from the butt of a tree.

CALIPER—An instrument, consisting of a scale with one rigid and one movable arm, for measuring the diameters of trees.

CAMBIUM—A sheaf of living cells beneath the bark of a tree; that part of a tree where new wood cells are manufactured.

CANOPY—The leafy crown of trees.

CANT HOOK—A heavy lever fitted at one end with a small iron toe-ring and lip, and a large movable hook; used for handling logs.

CATFACE—A scar on a tree resulting from an old wound or burn.

CHECK DAM—A small dam made of stones, logs, or earth, used to check water flow and erosion.

CIRCLE SAW—A common power saw, with teeth on a steel disk, which turns on an axle.

CLEAR CUT—To cut all the standing timber from an area.

CLINOMETER—An instrument for measuring vertical angles or slopes.

CLOSED CROWN—A full, close, forest canopy which excludes sunlight.

COMPARTMENT—A forest area upon which one definite type of management or cutting is used.

COMPOSITE FOREST—(1) A forest composed of trees of various species and age. (2) The forest as a whole, including soil, floor, undergrowth, and trees.

CONE SHAKER—A machine in which seeds are freed from cones by a shaking and stirring process.

CONIFER—A tree which produces cones.

COOPERAGE—Wood from which barrels and kegs are made.

COPPICE—(1) A thicket. (2) Forest growth produced by sprouts, as coppice forest.

CORE—A slender cylinder of wood taken from a tree by an increment borer. Growth rings are counted on such cores to determine rate of tree growth.

CROP TREE—A tree forming part of the timber harvest; a tree of good form and species which will develop merchantable timber.

CROSS HAUL—A method of loading logs by team or machine. The power is applied across the vehicle upon which the logs are being loaded.

CROTCH—The fork of a tree or branch.

CROWN—The expanse of branches and twigs of a tree; the tree top.

CROWN CLASS—Trees grouped according to the position, shape, and condition of their crowns in the canopy.

CROWN FIRE—A forest fire which extends to and sweeps along in the tops and branches of trees.

CUTTING AREA—A section of woodland upon which timber is being cut or will be cut.

D. B. H.—Abbreviation for "diameter breast high."

DEADHEAD—A tree with a dead top.

DECK—A platform upon which logs are placed before being rolled on the saw carriage; a loading platform.

DECIDUOUS—Term applied to trees which drop their leaves in the fall.

DECIMAL SCALE—A log scale graduated and marked in tenths of board feet.

DENDROMETER—An instrument for measuring tree growth.

DIAMETER LIMIT—A definite size (diameter) to be used as a maximum or minimum in tree-cutting operations.

DIAMETER TAPE—A tape, based on relationship of circumference to diameter, for measuring the diameters of trees directly.

D. I. B.—Abbreviation for "diameter inside the bark."

Dinkey—A small logging locomotive.

Dogger—One who attaches hooks or dogs to a log for skidding or loading.

Dominant—Pertaining to trees which overtop and suppress others.

Donkey—A small engine and boiler used for operating steam winches.

Doty—A term applied to wood which is partially decayed.

Drill—(1) A shallow trench in a nursery bed in which seeds are planted. (2) To plant seeds in drills.

Drill Maker—A roller or marker used in nursery practice for making drills.

Drive—A method of water transportation for logs. (Loose logs are floated down streams.)

Dry Rot—A dry decay occurring in wood.

Duff—Forest ground covering, consisting of leaves, twigs, rotting wood, etc.

Edger—A saw which cuts uneven edges and bark from sawed boards.

Entomology—That branch of biology which treats of insects.

Exotic—Not native, foreign.

Fire Lane or Break—A strip in the forest kept clear of inflammable material as protection against spread of forest fire.

First Growth—Timber stands in which no cutting has been done. Synonyms: Old growth timber, virgin timber.

Fish Ladder—A small spillway built around dams or falls up which fish can ascend.

Flank—(Of a fire) The side.

Flume—A continuous trough of running water for floating logs or timbers.

Flunkey—A handy man or assistant in a logging camp or on a logging job.

Forest—See page 1.

Forest Finance—The business of computing costs and incomes of forest enterprises.

Forest Floor—The covering of the mineral soil of a forest—humus, duff, and litter under forest growth.

Fungus—A plant which derives its nourishment from the organic matter of other plants.

Freeing—Thinning to deliver a stand from suppression.

Germination—The sprouting of a seed.

Girdle—To strip the bark from around trees.

Go-devil—A short, strong sled used in yarding logs.

Grab Hook—A narrow hook that will catch and remain on a single link of a chain.

Grabs—Hooks that grip logs; used in snaking and hauling.

Grade—(1) The slope of a road or trail. (2) To classify logs or lumber.

Ground Cover—The vegetative covering of an area: Grass, brush, trees, etc.

Ground Fire—A forest fire which consumes humus and duff beneath the surface.

Group Method—A method of securing forest reproduction, after cutting, by leaving groups of seed trees.

Gun Stick—An instrument used in felling trees to determine the direction of fall.

HAND LEVEL—A small leveling instrument which is held in the hand while in use rather than being mounted on a tripod.

HARDWOOD—(1) Trees of the broadleaf species. (2) Wood of broadleaf trees.

HEAD WATER—(1) Rapidly flowing water in a stream. Head water is necessary in small streams for log drives and for floating rafts. It may result from natural rises or from water released from splash dams. (2) Small streams tributary to larger, more important ones.

HEARTWOOD—The center of the tree; composed of dead cells; usually darker in color than sap wood.

HEEL IN—To cover the roots of bundled trees with earth; a method of seedling storage.

HIGH LINE—A system of log yarding in which logs are carried on cables high above the ground.

HUMUS—Decayed vegetable matter; black soil rich in vegetable matter.

HYGROMETER—An instrument for measuring moisture content of the air.

HYPSOMETER—An instrument for measuring the height of a tree.

IMPROVEMENT CUT—A cutting operation to improve a stand of timber.

INTOLERANT—Referring to trees which cannot thrive in deep shade, e. g., locust, larch.

IRREGULAR STAND—A stand of trees of different ages and species.

KILN—A drying chamber for seasoning lumber.

KILN-DRY—Lumber seasoned in a kiln.

LANDING—A "yard" where logs are collected; usually beside a road, railroad, or river.

LAYERING—A process of reproducing trees by burying shoots so that they will sprout.

LIFTING—Taking up seedlings or transplants as in nursery practice.

LIMB—To trim the limbs from a tree after it is felled.

LITTER—Leaves, twigs, rotting wood, and duff beneath trees.

LIZARD—A sled made from the crotch of a tree; used to support the front ends of logs.

LOAM—Loose, sandy soil rich in plant food.

LOG—To cut and remove logs from an area.

LOGGER—(1) A man who is engaged in logging operations. (2) Locally, a man who hauls logs to landings or skidways.

LOG RULE—(1) A table indicating the amount of lumber which can be sawed from logs of given sizes. (2) A log scaling stick.

LOG SCALE—A scaling stick for measuring the contents of logs in board feet.

LOP—To cut up a tree top for disposal.

LOW LINE—A method of dragging or snaking logs to yards or landings by means of steel cables and power winches.

LUMBER JACK—One who works on logging operations.

MARKING HATCHET (AX)—A hatchet used for blazing and branding trees and logs.

M. B. M.—Abbreviation for "thousand board feet."

MENSURATION—The science of measuring forest products.

MERCHANTABLE TIMBER—Salable timber.

MILL CHECK—A measure of the quantity of lumber sawed by a mill from logs of known dimensions.

MOTHER TREE—A picturesque name for seed trees left on logging operations.

MULCH—Material such as straw, leaves, or burlap placed on the soil for protection.

"NIGGER"—A steam-driven mechanical arm used in sawmills to adjust and manipulate logs on the saw carriage.

NOTCH—To cut a notch in a tree before sawing, to prevent splitting and binding, and to control the direction of fall.

OPENING CUT—A term applied to shelterwood cutting methods; the first cut in which only a part of the merchantable timber is removed.

PATHOLOGY—That branch of forestry which deals with tree diseases.

PEAVY—A heavy lever fitted at one end with a pike and a large movable hook for handling logs.

PERCOLATION—The process by which water finds its way from the surface to underground channels, springs, and seeps.

PICAROON—A light pole with a spike and a short hook on one end for controlling floating logs, or handling lumber.

PIKEPOLE—A long, light pole with a spike on one end for directing logs in rivers or ponds.

PITCH—The resin of a coniferous tree or a thick tar made from it.

PLANTATION—An area of artificially planted trees.

PLANTING—Setting out seedlings or transplants.

PLANTING BAR—A bar used for making a hole for planting trees.

PLYWOOD—Boards made from three or more thin layers of wood glued together.

POCKET BOOM—A loop boom, used to confine a number of floating logs. (See p. 195.)

POWDER—A term applied to any form of explosive.

POWDER MAN—A man who handles or works with explosives; a blaster.

PREDATOR—An animal which preys upon other animals. Insects which prey upon other insects.

PRESERVATIVE—Any substance applied to timber to prevent decay.

PRIMEVAL AREA—Tract of virgin timber in which human activities have not upset the natural appearance.

PRUNE—To trim the lower branches from trees.

PUDDLE—To dip the roots of young trees in thin mud to prevent drying out.

PURE STAND—A forest area of which at least 80 percent is of one species.

QUARTER SAWED—Lumber which has been sawed radially rather than across the grain. (See p. 162.)

RAKE (A POLE)—Lean given a telephone pole to compensate for pull of wire in opposite direction. (See p. 267.)

RAYS—Thin layers of cells which extend ribbonlike and radially from the pith to the cambium of trees.

REGENERATE—To reproduce new forests.

REMOVAL CUT—A term applied to shelterwood cutting methods; last of the merchantable timber to be removed.

REPRODUCTION—Regeneration; growing new forests.

ROAD MONKEY—A workman who maintains a logging road.

ROOT COLLAR—A swelling at the base of a tree caused by root formation.

ROOT SUCKER—A shoot or new plant from an underground root or stem.

ROTATION—The time required for a tree to develop into a merchantable product.

Run-off—Rain (or snow) water which runs off the surface rather than being absorbed by the earth.

Rule of Thumb—A simple rule for calculating log volume.

Sample Plot—A representative area of forest trees measured to obtain data for use in timber estimation.

Sample Tree—A representative or average-sized tree.

Sanctuary—A protected place for wildlife; especially applied to bird protection.

Sander—A device for spreading sand over seeds in nursery beds.

Sapling—A young tree 2 to 5 inches in diameter.

Sapwood—That section of wood in a tree lying directly inside the cambium. It is usually lighter in color than the heartwood and is composed of living cells.

Scale—(1) To measure logs with a scaling stick. (2) The measured contents of logs. (3) A measuring instrument (scale stick) used to measure the board-foot contents of a log. (See p. 180.)

Second Growth—Forest trees which have reproduced naturally on a cut-over or burned area.

Seed Bed—A nursery bed for germinating seed and growing seedlings.

Seed Cut—A term applied to shelterwood cutting methods; the second removal of timber which is designed to scatter seeds for reproduction.

Seed Dispersal—The scattering of seeds by natural means. (See p. 100.)

Seed Forest—A timber stand reproduced from seed rather than from sprouts and suckers.

Seeding Trough—A trough used in nursery work to facilitate even distribution of seed in drills.

Seed Spot—A spot prepared for direct seed planting.

Seed Tree—A tree left after a cutting operation to supply seed for reproduction. (See Mother tree.)

Seed Year—A year in which forest trees mature heavy seed crops.

Selection Stand—An irregular stand or all-aged stand adaptable to selective cutting.

Shake (Wind)—A crack (or cracks) in timber caused by wind.

Shelterbelt—A continuous strip of trees grown primarily for protection against wind.

Shelterwood—A modified clear-cutting system. The trees are removed in at least three cutting operations. See: Opening, Seed, and Removal Cuts.

Shrub—A woody plant not attaining tree size or form.

Silting—The process by which silt and eroded soil is deposited by flood waters, as in river beds and reservoirs.

Silvics—Science of the growth and habits of forest trees.

Silviculture—The art of producing and managing forests.

Skid—To drag or snake logs.

Skidway—(1) A trail along which logs are skidded. (2) A loading platform or deck.

Slack Water—Water in a stream having no appreciable current, as in sloughs or above dams.

Slash—Debris, such as tree tops and brush, left in forests after cutting operations.

Slide—A track or trough made of timbers, down which logs are snaked.

Sluice—A watertrough used for log transportation, as in a flume or a splash dam.

SMOKE CHASER—A man who investigates the source of smoke in forests. Smoke chasers are dispatched to determine the origin of smoke in the forest, or to extinguish small fires.

SNIPE—To bevel the end of a log to make dragging easier; to "nose" a log.

SNUB—To check the speed of logs on slides, sleds, or other logging equipment, by passing a line around a tree.

SOFTWOOD—Trees of coniferous species or timber from such species.

SPECIES (OF TREES)—Subordinate to a genus; trees having common characteristics. In common language, a kind or variety.

SPLASH DAM—A dam built in a small stream to store water which may be discharged to drive logs downstream.

SPORE—A minute reproductive organism produced by a flowerless plant.

SPOT FIRE—A fire started ahead of an advancing forest fire by flying sparks and embers.

SPROUT—A tree originating from an established stump.

SPUD—A tool for removing bark from logs or trees.

SPURS—(1) Spikes worn on shoes of workmen to facilitate climbing poles or trees; pole climbers or tree climbers. (2) short, auxiliary roads or trails.

SPUR TRACK—A short railroad track branching from a main line to a logging job.

STANDARD—A tree 1 to 2 feet in diameter.

STEAM LOADER—A steam-powered derrick for loading logs and timbers.

STEM WINDER—A small logging locomotive employing gears to transmit power from pistons to drivers (obsolescent).

STRATIFY—To store seeds by alternating layers of them with layers of sand or earth.

STRIP METHOD—A modification of the clear-cutting system in which the trees are removed in strips. (See p. 129.)

STRIP SURVEY—Estimating timber by strips running through the stand.

STUMPAGE—Standing timber, or the value of timber as it stands. Stumpage is often estimated by the acre or thousand board feet.

SUB-COMPARTMENT—A cutting unit on a logging operation. (See p. 133).

SUCKER—A tree originating from an old root.

SUPERLATIVE AREA—An area having unique scenic value and beauty.

SUPPRESSED TREE—A tree hindered in its development by other trees.

SURFACE FIRE—A forest fire confined to the surface of the ground.

SUSTAINED YIELD—Continuous yield of forest products on a given area.

SWAMP—To cut out brush or undergrowth. A trail or a compass line may be swamped out.

SWAMPER—A workman who cuts brush and undergrowth. See Swamp.

SWELL BUTT—A log or bolt cut from the base of a tree which has an enlarged butt.

TALLY—(1) The count of trees, logs, or other products. (2) To count trees, logs, or other products. (3) To record products, distances, etc., as measured.

TALLY BOOK—A book for tallying. See Tally.

TALLYMAN—One who makes a record of units being counted or measured.

TANBARK—Bark, such as oak or hemlock, containing tannic acid in commercial quantities; used in tanning leather.

THINNING—Removing inferior trees from a stand to provide for better development of crop trees.

TIMBER—Standing trees; woodlands; lumber; any piece or pieces of wood of considerable size; a principal beam in a ship's framing.

TOLERANT—A term applied to trees which can thrive in shade.

TOTE ROAD—A road through the forest over which supplies or products are hauled.

TRAILBUILDER—A machine for road and trail building consisting of a tractor and adjustable blade for grading, ditching, etc. See Bulldozer.

TRANSPIRATION—The release of water by a plant.

TRANSPLANT—A young tree that has been lifted from a nursery bed and reset; to reset seedlings.

TRANSPLANT BOARD—A notched board to hold trees while they are being transplanted. (See p. 119.)

TREE COUNTER—A mechanical device for recording the number of units being counted. (See p. 176 for illustration and description.)

TREE INSULATOR—A porcelain telephone line insulator to be stapled or wired to a tree. (See p. 266.)

TRENCH PLANTING—A method of planting trees in trenches or furrows.

TRIMMER—(1) A workman who trims or limbs trees. (2) A saw for cutting boards to given lengths.

T. S. I.—Abbreviation for "timber stand improvement."

TWO-SLED—A logging vehicle made of two sleds chained or bolted together.

TWO-STORIED STAND—A forest containing two stands, one overtopping the other.

UNDERBRUSH—Young trees and shrubs growing under more matured forest growth.

UNDERCUT—A notch cut in felling trees to direct the fall and to prevent splitting and binding.

UNDERPLANT—To plant trees under an existent stand.

UPPER STORY—The taller stand of a two-storied forest.

VETERAN—A tree having a diameter greater than 2 feet.

VENEER—A thin layer of wood glued over other wood of poorer appearance or quality.

VIRGIN FOREST—A forest which has not been cut over. Old growth.

VOLUME TABLE—A tabulation of the quantity of lumber obtainable from logs of given dimensions.

WATERSHED—A drainage area; an area from which the run-off flows into a given stream.

WEDGE A TREE—To drive a wedge into the sawcut in felling a tree; to facilitate sawing and to direct the fall.

WEDGE PLANTING—A method of tree planting in which the roots are spread across a wedge-shaped ridge of earth left in the bottom of the planting hole.

WEED TREE—A tree of undesirable species or form.

WELL SINKER—A machine for driving or sinking a well or well pipe.

WET STORAGE—(1) A method of storing forest tree seed in cold, running water. (2) Storing seedlings under dripping or spraying water. (3) Storing logs in ponds or rivers.

WHIP—A tall, slender sapling which may be blown and whipped by the wind.

WIDOW MAKER.—A large broken limb hanging from a tree.

WILDING.—A young seedling tree reproduced naturally in the forest.

WILDERNESS AREA—A large forest area having no roads or mechanical means of transportation and no permanent inhabitants.

WINDBREAK—A group of trees standing close enough to check the force of wind. Trees for windbreaks are usually planted in rows. (See p. 104.)

WINCH—A power-driven drum upon which ropes or cables are wound, as in line logging; a windlass.

WINDFALL—Forest trees which have been blown down by a windstorm.

WINDFIRM—Descriptive term applied to a tree which is strong enough to withstand strong winds.

WINGWALL—The extended side wall of a culvert or bridge, designed to stabilize the road bed.

WOOD LOT—A farm forest of small area.

WOOD TECHNOLOGY—The science of wood structure, characteristics, and properties.

WORKING CIRCLE—A forest area which is cut or managed according to a definite system.

WORKING PLAN—A management plan for timber harvesting.

YARD—(1) A place where logs or other timbers are collected. (2) To collect logs in a yard, landing, or skidway.

YARDER—Any device used for hauling logs to a yard or skidway; i. e., sled, lizard, cart, or tractor yarder.

YARDING ARCH—A heavy arch mounted on strong wheels, usually equipped with winch. The arch holds the front of the log off the ground and is usually hauled by tractor. (See p. 191.)

YARDING DONKEY—A small engine (usually steam) used to yard logs by one of the line methods.

YIELD—The quantity of lumber or other products furnished by the forest.

YIELD TABLES—Tables covering present or future yields of the forest.

INDEX

84618°—37