

FIRE PREVENTION AND CONTROL ON THE NATIONAL FORESTS.

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THE IMPORTANCE OF FIRE PROTECTION.

No plan of forest management produces results unless it has as its essential feature an adequate system of fire protection; this is fundamental. Fire can wipe out in an hour or two the work of many decades, and it is obvious that the forester, who must wait on an average about one hundred years for results, would be advocating an impracticable policy unless results were reasonably certain. If the crop is to be harvested it must be protected from fire during the time of its growth. It is worse than useless to devise plans to assure future growth if this future growth is to be burned up. The establishment of nurseries for the production of young trees to be planted in the forests and also the reseedling of cut-over areas to insure reproduction would be manifestly fruitless operations if, when the young growth was secured, it were to be destroyed by fires that would necessitate repetitions of the work.

That the fire menace is a real one needs no emphasis. The records of the great Hinckley fire of 1894 in Minnesota, the Fernie fire of 1908 in British Columbia, and the great fires which have recently swept the western United States, are but a very small part of forest-fire history; but they show the possibilities under a combination of bad conditions. The forester can read from old burnt-over areas the history of the past fires and can trace their effects. The record shows a periodic recurrence of bad fires, which seem to come at intervals of from fifteen to twenty years. It is a simple proposition, if timber is to be raised, and if it takes from seventy-five to one hundred and twenty-five years to secure the crop, some adequate method must be found to prevent the periodic recurrence of severe fires. Success or failure in meeting this problem means success or failure in the application of practical forestry.

THE CHARACTER OF THE REGION TO BE PROTECTED.

To appreciate the problem one must have a clear conception of the type of country in the National Forests, and also some idea of their extent. Except for small areas in Florida, Minnesota, Michigan, Kansas, and the Dakotas, the National Forests include the great mountain watersheds of the West. They lie along the crest of the main divides of the Rockies, the Cascades, and the Coast ranges.

The country is therefore rough and mountainous, cut by gorges and canyons, and broken by almost impassable ranges and unscalable peaks. There are two general forest types—open park areas with timber confined to the north slopes and densely forested regions where timber grows on both exposures. In the main the park country is east of the principal divides and the very heavily timbered regions are to the west. (Pl. XXVII, fig. 2; Pl. XXVIII, fig. 1; Pl. XXXII, fig. 2.)

The work of fire prevention and control, although theoretically the same for both types, differs essentially in practical application. Each National Forest, the unit of administration, contains from 1,000,000 to 2,000,000 acres. This is equivalent to an area from 30 to 50 miles wide and from 40 to 60 miles long. To protect such an area from fire, especially with the difficulties of transportation and communication, is exceedingly difficult.

ECONOMIC LOSSES.

In the National Forests, exclusive of Alaska and Porto Rico, there is estimated to be 530,000,000,000 board feet of timber, valued at approximately \$1,060,000,000, exclusive of its protective value, which is great. Fire has exacted its toll in timber each year to the amount of approximately \$200,000, while the loss outside the Forests has amounted to \$50,000,000 annually. In very dry years, such as the season of 1910, the loss runs very much higher.

The burning of the timber means not only a loss in stumpage, but a community loss in wages of approximately \$10 for every thousand board feet destroyed. When it is realized that it is not uncommon for the timber to run from 50,000 to 100,000 board feet per acre in the dense forests of the Pacific Northwest, it is clear that it does not take very many burned acres to run the figures up to six or seven places. For example, during the 1910 fires in western Montana and northern Idaho the loss was 6,000,000,000 feet board measure, with an estimated value of \$20,000,000. Aside from the value of the timber the danger to lives and to town property from these large fires is a very real one. The fate of Wallace, Idaho; of Fernie, British Columbia; of Chisholm, Minn., and of many other towns emphasizes this. (Pl. XXX, fig. 2.)

CAUSES OF FIRES.

Always the first question asked when the fires are mentioned is: "How do all these fires get started?" The causes are many, but practically all can be classified as preventable. The usual causes in the order of their frequency are: Railroad engines; lightning; careless campers, fishermen, and hunters; settlers burning brush to clear land for cultivation; logging engines and sawmills; malicious incendiaries.

FIRES STARTED BY LOCOMOTIVE SPARKS.

The detailed reports of the Forest Service for 1909 placed the railroads first as being the most common cause of fires on the National Forests. Out of 3,138 fires reported, 1,186 were caused by locomotives, and their setting was due to three principal reasons—the use of coal as fuel, the lack of proper clearing of the right of way, and the non-use or misuse of spark arresters.

The railroad's right of way is usually from 100 to 200 feet wide; in many places within the National Forests the brush and debris has never been properly cleared up on the right of way after the larger timber has been removed, and dry punk logs and debris form the most inflammable kind of material for ignition by a spark from the engine. Furthermore, the heavy grades in the mountains require a full and forced exhaust on the engines in order that sufficient steam may be kept up. Most of the spark arresters now in use interfere with the draft and, as a result, the wire screen must be knocked out or opened up so that the engine may get up the difficult grades. The more modern and larger locomotives have a return draft by which the larger cinders are forced back to the fire box before being emitted through the stack. Despite the improvement, both in engines and spark arresters, the railroads still hold first place as a cause of forest fires.

FIRES CAUSED BY LIGHTNING.

The second great cause of fires, and the only one which can be classed as nonpreventable, is lightning. During dry seasons many electrical storms occur over mountain regions and set numerous small fires when lightning strikes a tree and starts a fire in the debris and humus on the ground below. The scarred trunks of old trees with a straight or spiral scar through the bark, from top to root, show the effects of lightning. These lightning-scarred trees are readily found in any large body of timber. During the dry season of 1910 there were many electrical storms, and innumerable small fires were found immediately afterwards. If the storm is accompanied by rain there is, of course, little or no danger; but it is more usual for these mountain electrical storms to be unaccompanied by rain. In 1909 there were reported 294 fires originating from this cause.

LACK OF CARE BY CAMPERS.

Approximately 407,000 people go to the National Forests for recreation each year. Many of these people are out for a week or two at a time to hunt or fish or just to enjoy outdoor life in the hills. Unfortunately, many of the campers either are careless or are ignorant of the proper handling of camp fires. The carelessness takes the form of leaving the fires unextinguished, or in throwing about cigar

or cigarette stumps or knocking out pipes. The usual Turkish cigarette is a slow fuse that burns continuously to the end. The ignorance is shown in the failure to keep camp fires small and in not building them in fairly open spaces and away from punk logs and débris. Frequently a large fire is built when a little one would serve the purpose better and be safer. Everyone who has been in the hills has run across the skeletons of old tepees that mark the Indian camping grounds. The fireplace gives the impression of having been used for generations. It is simply a depression in the ground about 2 feet square, surrounded by a cleared space about 10 feet in diameter. Their example might well be followed.

CLEARING LAND FOR SETTLEMENT.

The clearing of timbered lands for cultivation by settlers contributes materially to the fire danger each season. The débris must be burned and, in many cases, for lack of market, even the logs themselves are thus disposed of, in order to clean up the land. Not long ago little thought was given to the man who set fire to brush on his own land. If the fire got away and damage was done, civil action was sometimes taken through the courts, but more often nothing was done. Here, again, what is wanted is not legal reprisal for damage, but a prevention of the damage itself. Recognizing that fire is a common danger, many States have taken the stand that anyone burning brush must conform to certain well-defined rules as to time and attendance, the violation of which means the infliction of a severe penalty. Briefly, these rules require that no burning shall be done during the danger season from June 1 to October 1, though in order not to impose a hardship provision is made whereby the settler may procure a special permit from the fire warden; that the brush shall be in small, compact piles, so that the fire is always under control; that contiguous bodies of timber shall be made safe by cutting small fire lines where necessary; and that there should be on hand at all times a sufficient number of men to control the fires which are set out. There will, of course, always be some danger from these fires, but it can be reduced to a minimum if the rules are carried out. The settler himself is coming to realize that the danger is a common one and that it is just as much to his interest to exercise the greatest care as it is to his neighbor's. In 1908 sixty-eight fires were reported on the National Forests as starting from this source; in 1909 there were one hundred and eighty-one.

THE DANGER IN LOGGING OPERATIONS.

The increasing use of donkey engines in logging operations has brought about a corresponding increase in fires, and logging locomotives passing through cut-over areas are almost sure to give



FIG. 1.—A RANGER STATION IN THE TIMBER.
[Small patch cleared to afford pasturage for horses.]



FIG. 2.—WHERE THE TIMBER LIES ON BOTH SLOPES HEAVY AND DENSE.
[Fuel for the fires unless protected by trails, telephones, and patrol.]

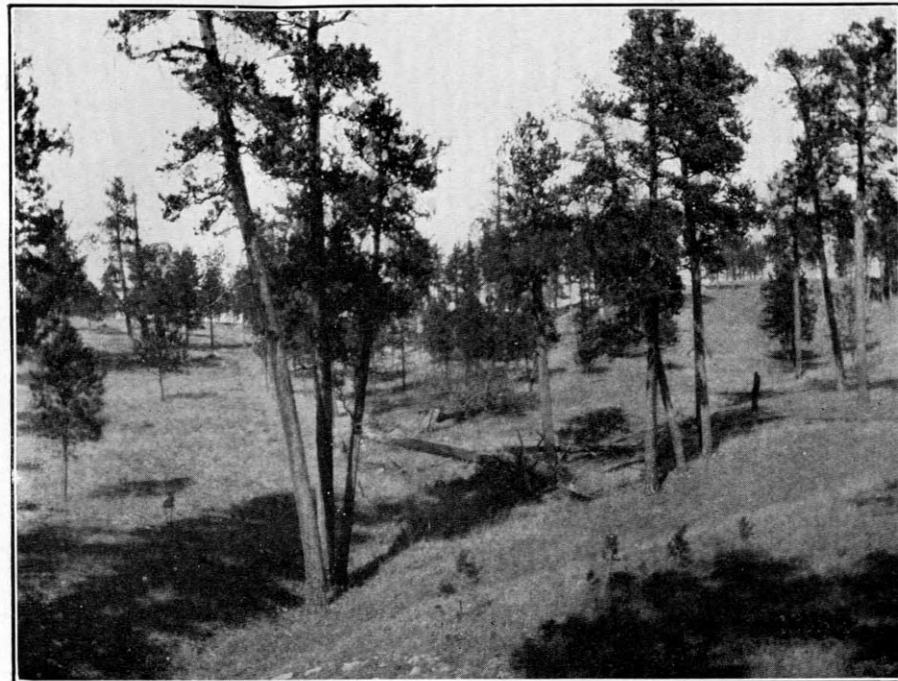


FIG. 1.—THE OPEN YELLOW PINE TYPE, WHERE THE TIMBER HANGS TO THE NORTH SLOPES.

[Easy of access and fire danger small; confined mostly to grass and ground rubbish.]

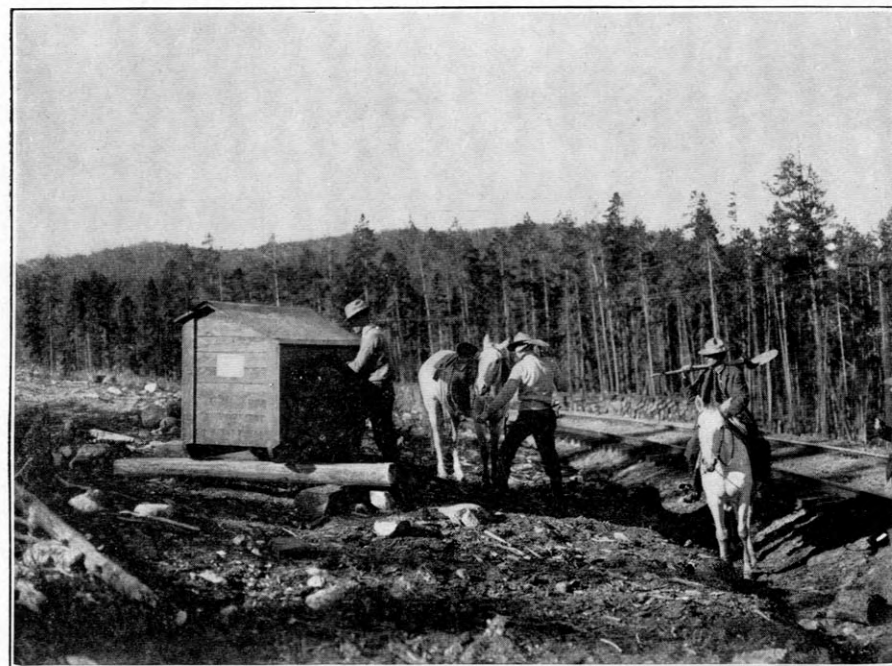


FIG. 2.—RANGERS GETTING FIRE-FIGHTING TOOLS FROM A BOX-CACHE ALONG THE RAILROAD.

[Shovels, mattocks, saws, and axes are kept in readiness. Each ranger keeps a key to the box.]



FIG. 1.—TRENCHING TO MINERAL SOIL TO STOP A GROUND FIRE.

[High winds cause the fire to run in the tops of the trees, rendering trenching valueless; only stopped by back firing.]

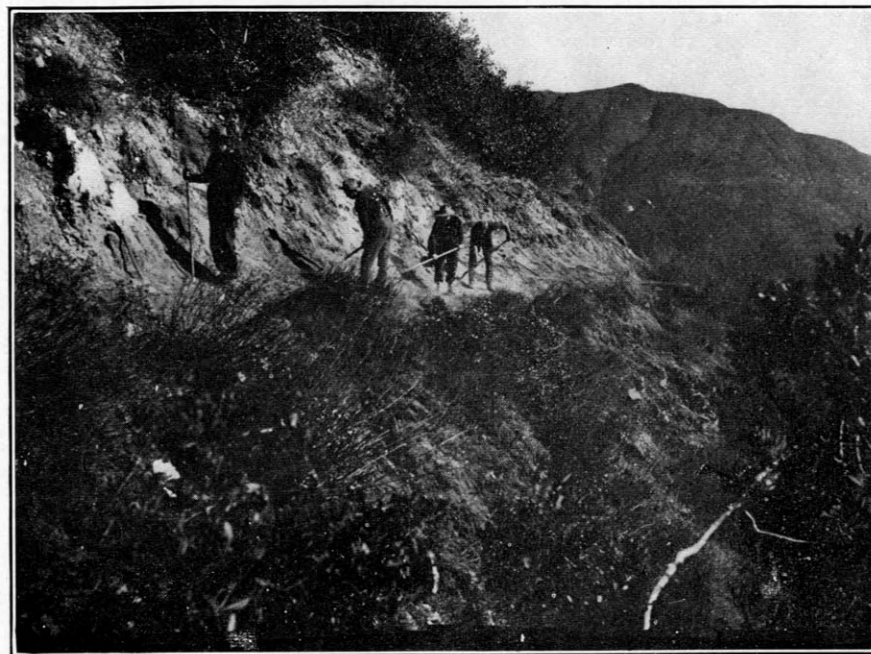


FIG. 2.—GRADING IN A MOUNTAIN TRAIL IN A ROUGH PLACE.

[Note carefully the general type of topography. Trails 18 inches wide and 8-foot clearing cost from \$50 to \$300 per mile.]

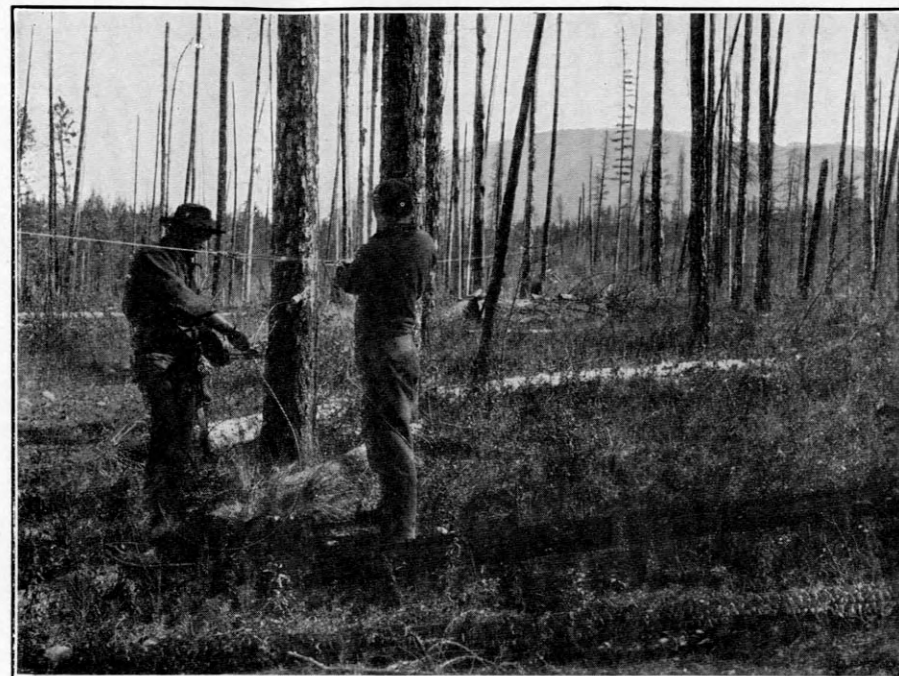


FIG. 1.—SAVING MANY LONG, HARD TRIPS AND TIME BY ESTABLISHING TELEPHONE COMMUNICATION.
[Strung to trees by forest officers.]



FIG. 2.—WALLACE, IDAHO, AFTER THE FIRE.
[Property of great value destroyed and many lives endangered. Just one of the items.]

trouble. Small portable sawmills cause many fires. The rigid enforcement of regulations requiring the use of adequate spark arresters, clearing up and burning, at proper seasons of the year, the debris resulting from logging, and the strict requirement that all employees exercise the greatest precautions against fires, is going a long way toward eliminating logging as a factor in increasing the number of fires. On the National Forests thirty-eight fires were reported in 1909 from this source. Some lumber companies have prohibited smoking in the woods, just as they prohibit it in their mills. Certainly there is as much reason for one as for the other.

INCENDIARY FIRES.

Many fires unquestionably have incendiary origin. Varied motives prompt this act, which is as hard to explain or to anticipate as any other wanton violation of law. Some are set for malice, or to "get even" for real or fancied grievances. Without question, some fires are set to create fire-fighting jobs for some of the human flotsam and jetsam of that great tide which ebbs and flows over the country, following the crops, railroad construction work, and other more or less temporary employment.

The National Forest reports for 1909 showed that ninety-seven fires originated in incendiarism. In all States the penalty for this offense is very severe, and the Federal penalty is \$5,000 fine or two years in the penitentiary, or both. The laws are stringent enough and convictions could unquestionably be secured, but the difficulty is to catch the offender and prove the case. The Forest officers have the authority to arrest without warrant a man seen setting a fire, but so far practically no arrests of this character have been made. The incendiary not only covers his tracks, but the fire itself effectively wipes out any clues.

MISCELLANEOUS CAUSES OF FIRES.

In addition to those from well-known causes, there are many fires which occur from miscellaneous causes not easily classified. The burning wad from a shotgun cartridge and the concentration of the sun's rays through a glass bottle are examples. Many of those reported as of unknown cause, however, are undoubtedly ascribable to one or another of the well-recognized causes, though to which one can not be determined. Those reported "unknown" from the National Forests amounted to seven hundred and fifty-eight in 1909.

METHODS OF PREVENTION.

Knowing the main causes of the fires, it is possible to consider intelligently the most practicable measures of prevention.

FOR RAILROADS.

To prevent the innumerable small fires set by railroads oil must ultimately be used as a fuel. An efficient spark arrester which will keep large glowing embers from being thrown out into the dry grass, brush, or débris usual along the right of way will assist greatly, but will not entirely prevent fires. The difficulty lies in securing a wire screen with a mesh small enough to catch the sparks, yet not so small as to interfere with the exhaust. Many different styles of screens have been devised in an attempt to overcome these difficulties. The use of a large-meshed screen is being made possible to some extent by special arresters which catch the larger cinders in a cuplike rim on the inside of the stack, the theory being that the heavier sparks, under forced draft, are held by centrifugal force close to the perimeter of the stack; therefore, any such obstruction properly placed on the inside of the stack should stop the large cinders, which are the main cause of the fires.

There must be some way to prevent those which do get away from starting fires, and the only effective one is to clear the right of way of all inflammable material. There should be no standing timber, no punk logs and débris, and it should then be burned over periodically, under careful supervision, to prevent further accumulation of inflammable stuff. Through open country it is best to plow a furrow or two at the outer edge of the right of way to serve as a fire break. The method to be adopted depends to a great extent on topography. Two to four furrows on each side of the track are usually sufficient. In addition, it is necessary to patrol the right of way immediately after every heavy freight train, by a man on a speeder.

Caches of fire-fighting tools should be located at each section house and at other stations along the right of way. These may be boxes similar to those used by contractors, placed at the most strategic points. Telegraphs and telephones for summoning assistance are of utmost importance in controlling railroad fires. Since the saving of time is the main consideration in handling a fire, provision must be made to use employees of the railroad for fire fighting, and this applies particularly to section gangs and other manual laborers immediately available. (Pl. XXVIII, fig. 2.)

Appreciating the common danger, the Government and certain railroads have outlined, and in some cases have put into effect, a practicable cooperation. Such cooperative agreements are in force between the Forest Service and the Northern Pacific and the Great Northern railroads, which traverse National Forests in Idaho, Montana, Washington, and Oregon.

Under this cooperation the railroad agrees: To clear and keep clear its right of way of all inflammable material to the satisfaction

of a duly authorized Forest officer; to use effective spark arresters on all locomotives; to grant the use of pin room on the poles on its rights of way for wires of the Government, provided such an arrangement can be made with the company that owns the poles; to permit use of tricycle speeders for patrol purposes during the dry season; to furnish such assistance as is available in case of fire; to pay all expenses directly to the men employed in fire fighting, if the fire is within 200 feet of the right of way (this is made 100 feet in some cases); to allow Forest officers to ride on certain designated freight trains when provided with proper transportation; to notify the nearest Forest officer in case of a fire.

On its part the Forest Service agrees to patrol the right of way during the dry season; to supervise the clearing of the right of way; to construct such telephone lines connecting Forest officer's headquarters as may be necessary; to furnish caches of fire-fighting tools at convenient points along the right of way; to give to the railroad all timber cut in clearing its right of way or an additional strip not to exceed 200 feet in any case, provided the timber does not run over 10,000 feet per acre; to pay directly the men employed in fighting fire outside of the 200-foot strip (but if the railroad is later found to be responsible for the fire the United States is to be reimbursed); to notify the nearest station agent of any defects found in the tracks by the patrolmen.

Both parties to the agreement are bound: Not to terminate agreement during the fire season; not to terminate it outside of the fire season without 30 days' notice.

FOR CAMPERS.

To prevent fires, all campers should observe the following simple rules: Clear thoroughly of débris a space of about 10 feet around the place where the fire is to be built. Build small and not large fires. Never leave a fire burning, no matter how safe it might appear; put it out, either with water or dirt, and use special precaution to put out punky logs, since they burn for a long time.

These three simple rules, if followed, will prevent any conflagration from camp fires. Campers should not risk themselves or jeopardize others who wish to enjoy the woods. If they are careless the severest penalty under the law should be inflicted.

FOR FARMERS.

The system adopted by many of the timbered States to make effective a closed season during which time no brush can be burned without permit is helping tremendously to reduce the danger from settlers burning brush. Many States now provide for a closed season and compulsory brush burning during such time as it is safe.

PREVENTION THROUGH LEGISLATION AND EDUCATION.

Plainly noticeable on every road or trail in the National Forests are fire-warning notices. The essential feature of these notices is an outline of the Federal law against setting or leaving any fire. It states that malicious fire setting is met with a punishment of \$5,000 fine or two years in prison or both; careless fire setting with \$1,000 fine or one year in prison or both.

Practically all of the States have enacted forest-fire laws. With very few exceptions all of the early legislation provided for penalties rather than for fire prevention. The more recent acts emphasize preventive measures. They provide in brief for the creation of fire districts upon the request of any timber owners in a given locality; the selection of a fire warden by the petitioners and ratification of his appointment by the State; the prohibition of brush burning during the dry season unless a permit is secured from the State fire warden; the compulsory burning of slash during the early spring or late fall in order to eliminate danger from logging.

In practically all of the western States, but more particularly in Idaho, Oregon, Washington, California, and Montana, aggressive steps are being taken in the direction of adequate fire protection.

COOPERATIVE ASSOCIATIONS.

Many of the forestry and conservation associations of the West are carrying on an active propaganda of education not only among the timber owners, but among the people at large. That this work is achieving results is shown by the fact that the lumber owners themselves have organized associations in which each one of the members is assessed according to his acreage. The funds cover expenses of hiring guards and temporary fire fighters, of keeping horses, and of equipping men with tools. The primary purpose of this educational campaign is to impress in a vivid, lasting way the meaning of a forest fire in losses to the Nation, to the State, and to the local community.

Such organized associations are of the greatest practical benefit to the National Forests where the holdings of lumber companies and the National Government are intermixed, and cooperation prevents duplication, makes the work effective, and properly places expenses and responsibilities. Cooperative agreements provide for a division of the territory into cooperative districts, which districts are determined by the topography and extent of the private and Government holdings and of the areas which are not included in either; a prorating of the expenses of fighting fires in the cooperative district on the basis of the proportion of holdings; a division of each cooperative district into patrol units and a definite agreement at the beginning

of each fire season on the distribution and responsibilities of the men assigned to these units; the appointment of the association's patrolmen as Forest Service guards to give them better authority to cope with executive problems and to make arrests for violation of Federal fire laws. In like manner the Government guards and rangers are appointed State deputy fire wardens, which gives them authority to make arrests under the State law and also to incur expenses and provide for the prorating of the accounts paid by the association.

This plan of agreement has been found most effective under the severe test of the extremely bad fire season of 1910. It has meant the elimination of duplication both in patrolling and actual fighting; it has brought about system as against an emergency arrangement; it has culminated in a mutual effort to cope with a common danger through securing the greatest degree of efficiency by both the association and the Government.

Similar cooperative agreements are entered into with individual lumber companies or with owners who are not members of the association, where their holdings are of sufficient acreage to make it advisable. Ordinarily the protection of these areas would have to be assumed by the Government in order to protect its own holdings, and this plan of cooperation places the responsibility for protection control on these privately owned lands where it belongs—on the private owners themselves and not on the Government. The value of this kind of cooperation can not be overestimated in the general plan of fire protection in the National Forests.

CONTROL OF FIRES.

It is axiomatic that to control fires they must be discovered and reached when they are small. In a city the location of the fire-alarm boxes so that a report of the fire can be sent to the engine houses; the arrangement whereby anyone may turn in the alarm and can therefore act as a patrolman; the use of electrical appliances for transmitting the alarm; the complete readiness of men, horses, and engines to move on the first signal—or the substitution of the motor for the horse-pulled engine; the readiness of all vehicles and pedestrians to give entire right of way to the engines—all these bespeak a combination for most quickly locating and reaching a fire. On the National Forests the problem in essence is the same. Fire engines scarcely can be used, but the reporting of fires, the quick calling for assistance, and the keeping in readiness of necessary tools and equipment can be had.

THE NATIONAL FOREST FORCE.

First, the Forest is divided into ranger districts to distribute the patrol force properly and to fix the responsibility for a specific piece of territory on a permanently employed ranger, who can become

thoroughly familiar with the country in which he is to work. This is important, since much depends upon the ranger's knowledge of the topography of his district. The size of the ranger district varies, but under present conditions is altogether too large. In no case should it include more than two townships, or approximately 72 square miles. Since the ranger must not only oversee the fire-protection work, but must handle the administrative work, such as making estimates, maps, and reports on timber sales; must exercise general supervision over the construction of roads and trails; and make examination of claims, it is necessary to have additional men to assist in patrolling the territory. These additional men are needed mainly during the fire season—from June to October—and are employed temporarily as guards to assist the ranger in patrol work. To properly distribute these additional men, the ranger subdivides his district into patrol units, to each of which he assigns a Forest guard. From 1 to 10 Forest guards are assigned to a ranger, depending, of course, on the size of his district and the comparative danger from fires. (Pl. XXVII, fig. 1.)

The unit of patrol varies according to the character of the country. In the very heavily timbered regions of the coast and Northwest one man can not adequately cover, even with every facility for readily getting over the country, more than from 25,000 to 30,000 acres. In the more lightly timbered regions, where there are a great many open parks, one man can cover from 50,000 to 60,000 acres. This would mean for a Forest of 1,000,000 acres a patrol force, not including rangers, of thirty-three men.

LOOKOUT POINTS.

After dividing the Forest into ranger districts and subdividing the districts into patrol units, with a man in charge of each, it is still necessary to make sure that these men are in a position to render effective service. The ranger must select certain lookout points and ridges from which he can see over his entire district. A view from these high points will, in many cases, be worth a great deal more for discovering fires than patrol lower down; hence these points are carefully selected and coordinated to give primary control of the entire Forest. They are generally high isolated peaks from which an unobstructed view may be obtained. If possible they should be in sight of each other, so that two men can locate a fire accurately by taking triangulation compass bearings. (Pl. XXXI, fig. 2.)

Yet these lookout points and ridges are of little value if after the fire is discovered there is no way to get to it quickly, because of a lack of trails, or no way to call for immediate help. Travel without trails through mountainous regions, over windfall and through brush, must be on foot; the time lost in getting to a fire is a serious matter. Where

the guard himself possibly could put the fire out when he first discovers it, provided he could reach it quickly, it might take an army of men to control it after a delay. In most cases ready assistance can be had only along the railroads and in the settled lower valleys.

TRAILS AND TELEPHONES.

In many cases help is from 10 to 60 miles away. With a telephone line the distance can be spanned in five or ten minutes; to travel it may take as much as four days. Unless, however, it is possible to bring in men, supplies, and tools over road or trail, the delay is still greater, for then a trail must be cut for pack horses. (Pl. XXIX, fig. 2; Pl. XXX, fig. 1.)

Permanent trails must be built to make the country accessible. They should be along all of the main streams and ridges as trunk trails, then up the tributaries and on the spurs as laterals. The system must be complete, comprehensive, and coordinated in order to make it possible for a man on horseback to reach any portion of his fire patrol unit within a few hours. In case the fire gets a start and it becomes necessary to bring in a number of men and many supplies, even better means of transportation must be provided. These can be secured only through wagon roads as far as they can be constructed and then trails for pack animals. Pack trains of from eight to thirty horses should be kept on each Forest where there is risk of delay in getting horses from the outside. These horses may be distributed over the Forest on trail construction work, or used for packing supplies and carrying mail to the patrolmen away back in the hills, so that the men will not have to leave their stations to come out for two or three days at a time during a critical period.

When a large fire occurs which can not be handled by the local force of rangers and guards and assistance is needed, the telephone gets word to the supervisor, who, in most cases, is in a town on the railroad, and help is sent in. The horses are called into service from their routes or construction work and put to packing supplies to the fire camps. The caches of tools at strategic points throughout the Forest contain enough tools to equip from ten to fifteen men. Larger caches at central points of distribution in the Forest provide against the loss of time which would result if they had to be packed in, in addition to the food supplies for the men. (Pl. XXXI, fig. 1.)

FIGHTING FIRES.

In general there are two kinds of fires, ground and top. All fires, with the exception perhaps of some started by lightning, begin as ground fires. A ground fire runs in the grass or underbrush, while the top fire reaches into the crowns of the trees. Crown fires occur and run only under the impetus of a good wind. Such a wind throws

fire brands and sparks for miles, setting innumerable small fires which only need the right combination of wind and weather to produce a general conflagration such as occurred during the season of 1910.

To stop the ground fires, trenches are dug from 2 to 4 feet wide down to mineral soil, the brush and débris being thrown away from the fire. When the fire reaches this line, unless it is burning very intensely, under a high wind, it will stop. Patrols are established along this entire fire line to keep it from crossing. Some men fight these ground fires by getting very close to them, simply following the fire line as it extends; others cut their line some distance ahead and then back fire from the line. Both methods are good, but are applicable to different types. In open stands of timber close fighting is best; in the heavy underbrush close fighting is out of the question. The tools used for trenching are the mattock or grub hoe, shovel, axe, and cross-cut saw. Each crew usually contains from fifteen to twenty men, having tools in the proportion of two mattocks for each shovel or axe. For example, fifteen men would be using five shovels or axes and ten mattocks. Such a crew can build about 1 to 2 miles of fire trenches in a day. (Pl. XXIX, fig. 1; Pl. XXXII, fig. 1.)

Under high winds the ground fires may start top fires, that is, the fire runs up the dry moss on a tree or catches some of the lower branches, which in turn catch the next, and the crown fire is started. The fire crew then selects a place some distance ahead of the fire and puts in a trench and also cuts the trees for a space about 20 feet wide. A back fire is set near enough to the advancing fire for the back draft to bring the two together and cause them to burn out. With a hurricane-like wind the only thing to do is to get out of the way as quickly as possible.