

**INSTRUCTIONS
ON
FOREST FIRE FIGHTING**

FOR USE BY THE PEOPLE OF THE PACIFIC NORTHWEST



**REGION 6
U. S. FOREST SERVICE**

INSTRUCTIONS
ON
FIGHTING FOREST FIRES



For Use by People of the Pacific Northwest

INTRODUCTION

This notebook, "Fighting Forest Fires," has been prepared as a ready reference for those who will fight forest fires in the Pacific Northwest. Anyone can attempt to extinguish a fire, but to be a good fire fighter one must have both knowledge and skill. Skillful fire fighters do more work with greater safety and less fatigue than untrained workers, and they are more highly respected. Study and application of the methods described will assist one to become proficient in the job of fire fighting and increase one's usefulness to his country.

"Fire fighter" as used in this notebook may mean a patrolman, a smokechaser, a boy scout, a guard, a warden, a ranger, a rancher, a logger, or any other person who works on a fire.

WHY FIRES BURN IN FORESTED AREAS

In traveling through a forested country one's attention is attracted to the live green trees and green undergrowth. Knowing how difficult it is to start or keep a fire going with green wood, one may wonder how it is possible for a fire to sweep through a green forest. Close observation will reveal the ground is usually covered with needles, twigs, branches, and other dead forest litter. Dead trees, on the ground or standing, will be found in all forests and usually are numerous in old burns and logged over lands.

During periods of hot weather when the moisture content of the air is low, and especially when there are strong winds, these dead materials become very dry and burn readily. Needles, moss, and twigs serve as kindling for the heavier fuels. When a fire burns freely with a strong wind, it is apt to develop so much heat it will dry out and burn the branches and even the trunks of green trees.

HOW FIRES START

Fires are started by two main causes: (1) by lightning; (2) by people.

Every year lightning starts a large number of forest fires, especially in the mountains. Many are put out almost immediately by rain that sometimes accompanies the thunder storm. Others go out quickly because of unfavorable burning conditions. The remainder must be found and work must be done to put them out.

Lightning fires are frequently started far from roads and trails, and some get a good start before they are reached.

Fires caused by people are known as "man caused fires." They usually are the most numerous, cause the most damage, and could be prevented if every person was determined to do his part to stop this waste of a national resource.

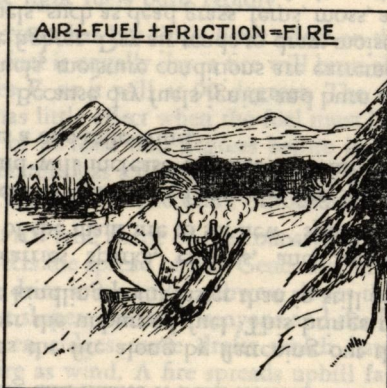
People traveling through the woods or over grass lands often carelessly or thoughtlessly throw away lighted matches or burning tobacco that start many fires. Others leave a camp fire burning or fail to completely put it out. Every forest user and traveler must acquire the habit of consciously and safely taking care of his fire and his burning material. It is a personal responsibility.

A few fires are started accidentally each year in industrial operations such as logging, sawmilling, woodcutting, and railroading. These fires often cause serious damage because they usually burn where there is much dry fuel. Some fires are started by sparks from locomotives, tractors, and trucks which do not have good spark arresters or mufflers. Occasionally fires start from burning buildings. Quite a number are started from land clearing fires and from burning stumps and debris on farms, or from burning slash. Most industrial fires can be prevented by using safe equipment and operating practices and by using necessary fire cautiously and wisely.

4

WHAT MAKES A FIRE BURN

To understand the methods used in extinguishing a fire, the conditions necessary for a fire to burn are worth reviewing. A fire burns when the following elements or conditions are present:



1. There must be something to burn — fuels such as wood, bark, pitch, ferns, moss, or other burnable material.
2. The fuels must be exposed to the air. A fire needs oxygen to burn.
3. The temperature of the fuel must be raised to the kindling point. This varies from 600 to 800 degrees, Fahrenheit.

To fight a fire (to put it out, to extinguish it), one or more of these three elements or conditions must be removed or decreased.

FACTORS WHICH INFLUENCE THE SPREAD OF FIRE

The main things which cause a fire to burn and spread in any type of country (timbered, brush, burned over areas, grasslands) are: (1) fuels, (2) weather, (3) topography.

5

Fuels may be divided into two main classes: (1) slow burning fuels such as logs, stumps, and deep duff. Duff is the compact layer of partly decomposed leaves, needles and other small material between the mineral earth and new forest litter; (2) fast-burning fuels (flash fuels), such as the top layer of dead needles, twigs and branches, tree moss, cheat grass, ferns and other light dead material.

Heavy fuels burn readily when dry and throw off large volumes of heat. Lighter flash fuels cause rapid spread and serve as kindling for the heavier fuels. Live fuels, such as tree needles, salal, and greasewood, contain oil which makes them extremely flashy when subjected to the intense heat of burning dead fuels.

A fire fighter is chiefly concerned with three weather factors: wind, moisture, and temperature.

WIND causes fire to spread for three reasons:

1. It provides a fresh supply of oxygen to the fire, which keeps it burning and makes it burn hotter.
2. It pushes the fire along by flattening out the hot air and flames over the unburned fuel. This brings the nearby fuels up to the kindling point faster than in still air.
3. Wind carries sparks, embers, and small burning chunks ahead of the main fire to set new "spot fires."

The stronger the wind, the faster the fire spreads. Thus, a ten-mile wind will increase the size of a fire at least ten times as fast as a one-mile wind.

MOISTURE. Because dry fuels ignite and burn more readily than wet fuels, moisture conditions are extremely important to the fire fighter. Dry air tends to draw moisture out of fuels. Light fuels, such as dead grass, ferns, moss, and weeds, dry out much more rapidly than heavy fuels, such as poles, logs, and snags. Light fuels dry out during the day when the air is dry and absorb moisture at night when the air is damp. Therefore, a fire usually burns more rapidly in the

daytime than at night. Fire fighters make use of this factor by doing all work possible on a fire during the night and early morning when the fuels are the dampest. During prolonged drouths the heavy fuels become progressively drier and fires are especially difficult to control, because then both the heavy fuels and the light fuels burn rapidly.

TEMPERATURE has but little direct effect on the spread of a fire. If the fuel is equally dry, a fire will burn about as well at 30 degrees F. as it will at 90 degrees. The difference of 60 degrees has little effect when the fuel must be raised to a temperature of at least 600 degrees before it will burn. A rise in temperature has a drying effect on the fuels unless the air moisture increases due to other conditions.

TOPOGRAPHY (the shape of the country, as level, rolling, or steep) affects the spread of fire. Generally, fire will spread faster on the drier south and southwest slopes than on north and northeast slopes. Heads of canyons and the low point or saddle between ridges cause drafts which have the same effect on a fire as wind. A fire spreads uphill faster than in other directions. The steeper the slope, the faster the fire will travel. Slope will also cause burning material to roll and scatter fire to the bottom of the hill. On very steep slopes even large burning logs will roll.

TOOLS USED IN FIGHTING FOREST FIRES

It is a good idea for every forest traveler to carry an ax, a shovel, and a water bucket in his car or pack outfit, so he will be properly equipped to put out his own fires or to take immediate action on any fires he discovers.

When a fire fighter is sent to a fire by a responsible officer of a forest protection agency, he will be provided with the necessary tools or be told where they may be obtained. The following is a list of the common tools and equipment used for putting out small fires:

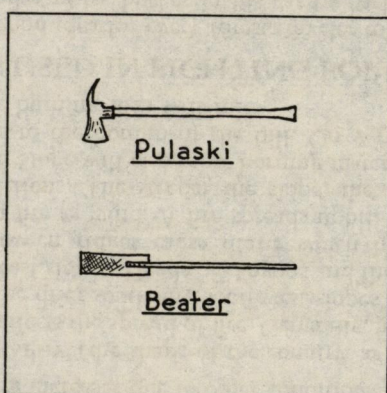
1. Ax—usually 31½ lb., double bit, 36" handle; used for cutting small trees and brush and for chopping logs.

2. Shovel—round point, long or medium length handle; used for improving the fire line and also used for throwing dirt to cool down a hot fire.

3. Hazel or adze hoe—a digging tool similar to, but heavier and wider, than a carpenter's adze; used for digging or scraping fire line.

4. Pulaski tool—a combination ax and hoe with a regular double bit ax handle; used for chopping and digging.

5. Beater—a piece of canvas belting attached to a handle, a wet sack, or green branches; used to beat out grass or light duff fires.



6. Back-pack water can—a five gallon, specially shaped water can equipped with shoulder straps so that it can be carried on the back, and a short piece of hose and hand pressure pump; used for putting out spots of fire in snags and stumps but principally in mopping up or finally extinguishing a fire.

7. Faller's outfit—consists of a 5 to 8 foot falling saw, a sledge, and steel or wooden wedges; used for falling trees and snags and bucking off logs. Wedges are used to prevent pinching of the saw and for tipping snags over.

8. Rake—similar to, but heavier than, a garden rake; used in eastern Oregon and Washington for scraping fire line.

9. Emergency rations—a one to three days' supply of concentrated food.

10. Canteen—1 gallon, canvas or blanket covered; for carrying drinking water.

HOW TO PUT OUT SMALL FIRES

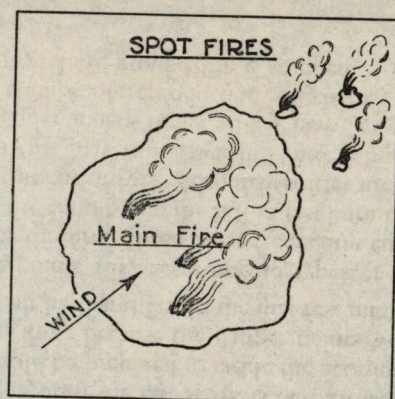
A small fire is one that can be put out by one to five men. The same principles are applied in putting out either a small or a large fire. The first job is to stop spread, the next, on a small fire, is to put it dead out.

If the fire is spreading on the ground, it must be stopped on the ground. If it is spreading above ground on account of heat or flying sparks and embers, these sources of spread must be reduced or eliminated.

A fire is put out by doing one or a combination of three things: (1) remove or cut off fuel supply; (2) lower the temperature; (3) reduce the supply of air (oxygen).

Most small fires are not difficult to put out if one stays with the job until the last spark is out. However, every fire fighter should be prepared to tackle the occasional larger fire which gets away because the danger points were not recognized and hit hard and fast in the first few minutes.

Danger points vary according to types of fuels and the location of the fire. Those most frequently encountered are fingers of fire running up the hill in fast burning fuels, snags or concentrations of fuel which may scatter fire, burning logs or chunks that may roll down hill into unburned fuel, fire burning under mossy limbs which may "crown" out, and snags or clumps of reproduction which may catch on fire unless approaching ground fire is stopped.



When a fire fighter arrives at a fire he first looks it over (sizes it up) to determine where it is spreading fastest, or what points are most likely to spread or to cause spread. The immediately necessary work is done on these danger points first.

If the fire appears to be "man caused" when sized up, the fire fighter should look for tracks, campfire or lunch remains, scraps of paper, cigarette or cigar butts, or anything else which will aid in determining how it was started. This information is valuable to the owner or agency responsible for protecting the land where the fire occurred, and all material found should be preserved and given to the person who sent the fire fighter to the fire.

The following paragraphs explain the general procedure for putting out a fire in the more common types of fuels.

1. HOW TO PUT OUT A FIRE IN LITTER AND DUFF.

Forest litter, such as small branches, dead limbs, leaves and needles, becomes highly inflammable in dry weather and a fire may spread rapidly in this surface material, especially if it is on a slope or the wind is blowing. After the surface material has been consumed, fire will continue to smolder in the duff underneath, which may vary in depth from 2 or 3

10

inches to a foot or more, and in roots and rotten wood. All such fire must be found and put out, because the smoldering fuels will burst into flame after they have been dried by the heat and exposure to the air.

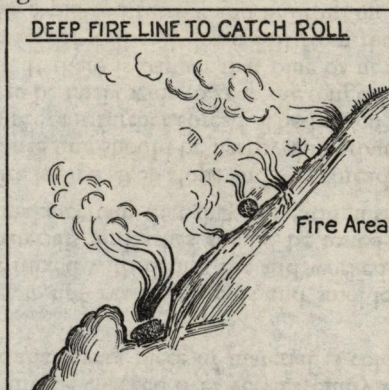
On arrival at a fire in litter and duff look it over and decide what to do to prevent further spread. If there are places where it is burning briskly, cool them off by throwing clean dirt on them with a shovel, using a sweeping motion. If the fire is spreading in surface litter, scrape it away from the flames until the spread is stopped and the fire is confined to the duff. Then with a hazel hoe or shovel dig a fire line to clean dirt, keeping as close to the fire edge as possible. Throw all burning material into the fire. Burning material thrown into the fire area is exposed to the air and will burn up or go out because of being separated from its hot bed or other hot material. The fire should be examined for places where it may be burning in roots, rotten wood, or deep duff. These places should be dug out and the roots chopped off.

If water is readily available, it should be sprayed or poured on the burning places until they are out. After some water has been used, the burning material should be stirred to allow the water to saturate it. When the fire is apparently out, it should be checked over very carefully with the hands to be sure that every piece of material is cold. Get the last spark.

If water is not available, coals and smoldering materials should be mixed with damp dirt and worked until out. All burned materials and ashes should be tested with the bare hands to make certain that they are extinguished.

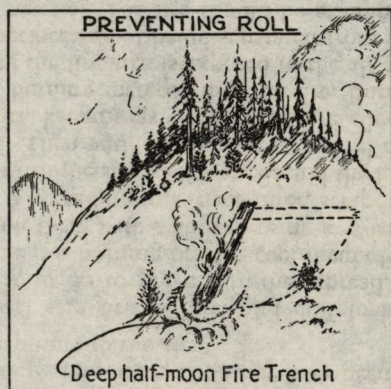
If the fire is on a steep slope and it is spreading rapidly up the hill, a fire line should be hastily dug around the head of the fire to prevent further spread. The line on the upper side may need to be fairly wide to keep the tongues of flame from crossing it. If there is danger that pine or fir cones or other burning material will roll down hill from the fire, a trench shaped like a plowed furrow and built up on the lower side

to catch and hold burning material should be dug around the lower edge of the fire.



2. HOW TO PUT OUT A FIRE IN A LOG.

If a fire is burning in a log, first cool off the places where it is hottest. This should be done with damp dirt, thrown with a shovel. A fire line should be dug around the burning portion if there is fire on the ground or danger that the fire will spread on the ground.

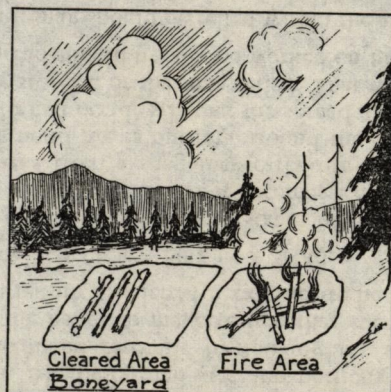


12

If the fire is on a steep slope, the fire line on the lower side should be trenched like a plowed furrow to catch any rolling embers and burning chunks. If possible, the log should be turned so that it will lie up and down hill to prevent it from rolling and scattering fire. If this cannot be done, it should be securely blocked with rocks or rolled into a dug trench.

After the fire has been cooled down, chop or saw off the part of the log that is not on fire. Then roll the portions apart. The section on fire should be split open if possible so the fire will be exposed. If water is available, it should be sprayed on with back pump can or poured on with a pail or hat. If water is not available, burning pockets in the log should be chopped out and all burning portions rubbed well with clean dirt. Scrape out the mixture and scatter it over cleared bare ground.

If there are several burning chunks or pieces, it is usually necessary to clear all debris and duff from a nearby area. The area of clean dirt will look like a small garden patch and will be used as a "boneyard." Then rub each burning piece in the clean dirt until it can be handled and rubbed with the hands. Lay the pieces in the "boneyard" so they do not touch each other. The burned pieces are "bones"—the bones are



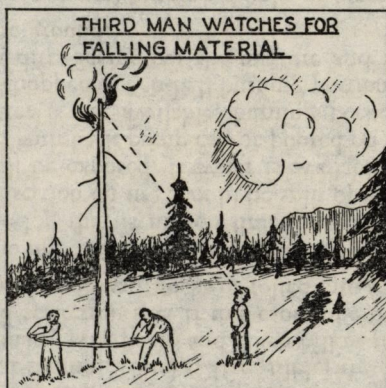
13

parallel to each other. If the fire has burned into the ground, it should all be dug out and mixed with water or damp dirt until it is out. All the burned area and portions of the log should be examined carefully by looking for smoke and feeling with the hands to make certain that every spark of the fire is out before it is left. Check twice to be sure.

3. HOW TO PUT OUT A FIRE IN A SNAG.

Snags are dead trees in various stages of decay that are still standing. When one is afire it becomes a dangerous fire spreader. Sparks from a snag may carry fire for long distances. If a ground fire is burning around the snag, it will be necessary to first decide whether the spread of the ground fire should be stopped or the snag felled. That which causes the fastest spread should usually be worked on first.

The burning snag should be felled within the area already on fire. If this cannot be done, it may be best to prepare a safe place in which to fall it by first clearing away brush, trash, and other material. The deciding factor will be whether spot fires, starting from the standing snag while its bed is being prepared, are more dangerous than the ground fire which may result if the snag is felled without clearing a place in which to fall it.



14

Three men, if available, should be used in sawing down a burning snag. One man should watch for falling limbs, bark and burning pieces, and warn the fallers. If one man is alone on the fire, or no saw is available, it will be necessary to chop the snag down with an ax or Pulaski tool. Even large snags can be chopped down. When the snag has been felled, the same action should be followed as for burning logs. Cool hot spots with clean dirt. Dig a fire line around the ground fire. Extinguish each piece of burning material and place in the boneyard. A thorough search should be made for spot fires that may have been started from sparks from the snag. All snags that are afire should be cut down or, if the fire is near the ground and water is available, it may be possible to put it out with a back pump can without felling the snag.

4. HOW TO PUT OUT A FIRE IN A STUMP.

If a large stump is burning and the fire has spread to the ground, the fire should be looked over to decide where to begin work. Hot spots should be cooled down with a few shovelfuls of clean dirt. If fire is spreading on the ground, a fire line should be hastily dug around it to prevent further spread.

Work should then be started to extinguish the fire in the stump. The burning portions should be chopped out or put out by rubbing with damp dirt. Water should be used if available. Fire in the roots should be dug out and the burning roots chopped off so the fire can be put out. Use the boneyard. The ground fire should be put out the same as in litter and duff fires. All parts of the fire should be worked on until it is out. Determine this by feeling all the burned places with the hands.

5. HOW TO PUT OUT GRASS FIRES.

Grass, principally "cheat grass," covers large areas in the low country east of the Cascade range and sometimes in openings bordering timbered areas. It cures or dies in the early part of the summer and becomes very dry. Dead grass is more readily affected by changes in weather than any other

fuel. It dries out or absorbs moisture rapidly. Changes in air moisture are quickly reflected in the way grass will burn.

Dry, dead grass ignites easily from a small spark. It is the fastest burning of native fuels, particularly where it grows thickly. Grass fires usually do not burn very hot and they cool off quickly after the advance edge has passed. Unless quickly controlled, a fire may cover huge areas in a single day. This is particularly true if either wind or slope, or both, are present. These characteristics make it highly important that the most dangerous points be quickly determined when the first fire fighter arrives. Work should start at once on the most dangerous point. Continue to put out progressively the next most dangerous point until the fire is out.

Fighting a grass fire differs from fighting a forest fire in heavier fuels. There is seldom time or need for building the usual fire line. The customary method is to use a wet sack, a green tree branch, or a beater. With any of the above tools, work directly on the fire edge. Beat the fire edge out. A downward and inward stroke will avoid throwing sparks into unburned area. Hesitate slightly at end of stroke. This tends to smother the fire. Keep an eye on the edge already worked to see that some smoldering spark does not come to life. Where soil and topography allow, a furrow plowed with either a team or tractor is a fast, effective way of controlling a grass fire.

Backfiring should never be done except under the specific direction of an experienced and competent protection man. It should be done then only when it is certain that this fits in to the overall plan of the protection man in charge of the entire fire. Promiscuous or poor backfiring methods usually do more harm than good, and should not be used.

6. HOW TO PUT OUT FERN OR WEED FIRES.

Ferns and weeds cover large areas in old burns, cut-overs and hilly ranches. They make a rank growth each year and then die. The accumulation of dead plants in late fall or early spring is a dangerous fuel because it dries out readily

and burns rapidly. Fast fire fighting action is necessary. A fire in these fuels, when logs, brush or trees are absent, resembles a grass fire, but there is usually a greater amount of flame and smoke. Work directly on the edge of the fire. Dirt can be fanned on the base of the flames with a shovel to cool down the fire and make it possible to work close to it. Water from a back-pack can be used for the same purpose. Scrape the burning material at the fire edge into the fire. When the fuel is dense or mixed with rotten wood, logs, brush or trees, clear a strip ahead of the fire and dig a fire line to clean dirt. A hazel or adze hoe is effective for this purpose. Work close to the fire and work fast. The fastest spreading spots should be stopped first. Then work around all the edge of the fire, especially on the side toward which the wind is blowing. Then mop-up by extinguishing all fire, beginning at the outside and working in. Ferns and weeds are flash fuels which do not burn very long, therefore a fire in them can be mopped-up quickly. However, there are usually rotten wood, snags, stumps, logs, or other heavy fuels present, which require considerable work to mop up and put out.

7. HOW TO PUT OUT SMALL FIRES IN A MIXTURE OF FUELS.

A fire often burns in or around several fuels, such as duff and litter, logs, small trees, and snags. In such cases it is especially important quickly to size up the fire to determine the danger points and plan the attack. Remember the danger points are the parts of the fire that are causing, or are likely to cause, spread. Do just enough work on each danger point to stop spread or the threat of spread, then systematically extinguish the fire as outlined in the above paragraphs.

APPROVED PRACTICES IN FIGHTING ALL SMALL FIRES

1. Waste no time hunting for or packing water for initial attack on a fire—it won't wait for you.

2. Damp dirt is about as good as water for knocking down fire; slap it on hard with a sweeping motion. A twist of the shovel handle will spread the dirt and assist in smothering.

ering the fire. Many a hot fire has been saved by one man by the vigorous throwing of dirt.

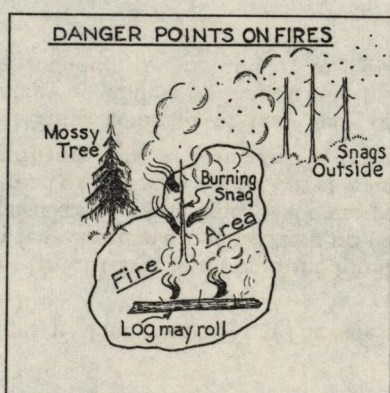
3. Dig or scrape a fire line as close to the fire edge as possible. In any event do not leave unburned material between fire edge and fire line—burn it out, dig it out, or build new line closer in. A fire line may need to be 4 inches wide or 4 feet wide to prevent the ground fire from spreading across from the heat or flames, and width varies with the ground fuels, topography and weather. Do not dig or scrape wider than necessary—strive for length, not width and quality.

4. Where logs lie across the fire line, chop off a 2 to 3 foot section of the bark and rotten wood and clear out a hole underneath. Cover the top with dirt to prevent fire from burning across until all the fire is put out. If a log is rotten or small, cut out a section at least as wide as the fire line.

5. The final clearing line through small trees and brush should usually be as wide as the height of the material cleared. Width should vary with the cover, topography and weather.

6. Burning or charred material should be thrown into the fire. On small fires the unburned material is thrown out, but when building fire line on the upper side of a steep slope, it may be easier to pitch and scatter the unburned material well into the fire.

7. Keep a close watch for spot fires. They may spread more rapidly and cause more trouble than the main fire if unattended. When you extinguish a lightning fire, look around from an opening or a tree top before leaving. You may find another fire nearby. Lightning often strikes in two or three nearby places at the same time.



MOPPING UP THE FIRE.

All fires are potentially dangerous until they are dead out. The object of mop-up work on small fires is to put them out as quickly as possible. It is usually faster and safer to extinguish a small fire piece by piece and part by part than to wait for it to burn out. Waiting around for it to burn out has caused more than one fire fighter who has had his fire under control to lose it when the weather changed. A dead fire is a safe fire.

Give first attention to:

1. Separate burning materials to reduce heat.
2. Roll burning logs and chunks out of their hot beds and expose burning portions to the air.
3. Chop burning pockets out of logs, stumps and roots.
4. Trim low branches off trees in or near the fire.
5. Keep fire out of trees and snags by throwing on dirt and by scraping away burning material.

Do the above five things and the job will be a lot easier and quicker, and therefore safer.

If there is not room within the burned area to work the

fire out of burning material, a boneyard should be cleared off down to clean dirt for this purpose. Coals can be scraped off burning chunks and mixed with clean damp dirt on top of the ground. Rub any remaining fire out of each piece with dirt until it can be handled with the bare hands. Lay the pieces parallel in the boneyard so they don't touch each other.

After the burned surface materials have been disposed of, next give attention to beds of hot embers and fire smoldering in the duff. These materials should be mixed and re-mixed with clean dirt much the same as spading a garden. The stirring must be continued until no hot materials or coals can be felt with the bare hand.

If water is readily available, it can be used to good advantage in mop-up work. Hot sticks or small chunks can be dipped in a bucket of water or the water may be used to form a mud puddle. With a back-pack can, water should be squirted in hard to reach pockets in logs and stumps. To be effective water must be placed directly on the fire. This can be done by rolling logs and chunks over to expose the fire. Burning duff should be dug out with a hoe or shovel before applying water.

The fire should not be abandoned until every spark is out and a search has been made within a reasonable radius to see that no spot fires are burning. Make a second check to be sure.

SAFE PRACTICES IN FIRE FIGHTING. (The safe way is the best way.)

1. Have a plan of travel to a fire in the forest or mountains. Make a few directional notes. Check up on your way in to avoid mistakes and lost time. Mark the point where you leave the road or trail with a sheet out of your notebook, indicating your name, time, and direction of travel.

2. If you become confused or lost, keep calm. Don't waste your energy by aimless walking. Climb to where you can see the surrounding country and try to locate yourself.

20

If night is approaching, stop and make camp, near water if possible. Gather enough dry wood to keep a small fire going all night. Put your fire out soon after daybreak. Try to determine your location by checking your map and sizing up the country for familiar landmarks. If you cannot locate yourself, follow a water course down hill in the probable direction of a trail, road or settlement. When you reach a trail or road, follow it.

In case of injury keep calm—stay in place—if possible put up a smoke by placing green material on a small, *safe* fire built in a *safe* place. Under no circumstances leave your signal fire even for a short while; someone will find you.

3. Avoid passing a dangerous burning tree or snag on the down hill side; do not lie or sit down within reach of one.

4. Keep alert for rolling rocks or logs on steep hills. If you hear one coming down, don't run blindly. Determine its falling direction and then get in the clear.

5. Keep sheaths or guards on sharp-edged tools while traveling and carry your ax or pulaski at your side, not over your shoulder.

6. Clear away all obstructions before chopping. Hold small material with one hand and chop it off with short, well-directed blows. Be sure of your footing and chop away from your legs and feet.

7. Wear calked, hobbled, or composition soled shoes in the woods. Slick leather soles will surely cause falls and injuries.

8. Apply first aid treatment to blisters and minor cuts or scratches to avoid infections.

9. Report injuries to your superior officer.

REPORT ON FIRES PUT OUT

The responsible protection officer wishes to make out a complete report on each fire which occurs in his unit. He depends on the fire fighter sent to the fire to furnish him with the following information:

1. Cause of fire: lightning, railroad, logging, slash or clearing fire, camp fire, smoker.
2. When you were sent to the fire, when you arrived at the fire, and the number of men with you.
3. If additional men arrive on fire after you begin work, note time of their arrival and number of men.
4. Note time fire was made safe and when you left it as out.
5. Write a brief description of the approximate size of fire when you arrived, amount it spread, and materials fire burned in.
6. Miles traveled to fire by road, trail and cross country to get to fire.
7. The above information should be given or mailed to the person who sent you to the fire; or if you took independent action, it should be sent or given to the nearest officer of a forest protection agency, who will see that it reaches the right party.

HOW CREWS ARE ORGANIZED AND FUNCTION ON LARGE FIRES

All but a few of the several hundred fires that start each year are controlled by a small crew of one to five men. Occasionally during periods of critically dry fire weather a fire gets started in an area where there is a large amount of fast-burning fuel on the ground. Under these conditions a fire may spread so rapidly it becomes too large for a small crew to control before the necessary work can be done to stop it.

The following information on how crews are organized and function on the larger fires will give the fire fighter an appreciation of how he will work and fit into the organization if called on to help on a larger fire.

Regardless of the size of the fire, whether it be ten acres or a thousand, the things to be done to stop further spread,

to make safe and to extinguish the fire are essentially the same. They are:

1. Clear brush, reproduction and low limbs for the fire line.
2. Dig or scrape the fire line to clean dirt.
3. Fall burning snags near the fire line.
4. Burn out dry unburned fuels between fire edge and fire line.
5. Hold fire inside fire lines until it dies down.
6. Mop up fire and work on it until it is extinguished.

As the size of the fire increases and large numbers of men are needed to control it, three factors become increasingly important: (1) Organization and assignment of responsibilities; (2) planning and supervision of attack; (3) effective use of manpower. (The use of machinery might be mentioned as a fourth factor but for the most part it is used to replace or supplement manpower.)

1. ORGANIZATION AND RESPONSIBILITIES.

Where even a few men are working on a fire, the best qualified person is placed in charge. He is the fire boss and is responsible for directing the combined efforts of the crew or crews in controlling the fire. Twenty to thirty fire fighters make up an average size fire crew. If one crew of this size is sent to a fire, the foreman in charge is the fire boss. He plans the attack on the fire and supervises the work of the men. He may divide his crew into two units and place a straw boss in charge of each unit.

If fifty men were needed on a fire, the fire boss in charge would likely divide and organize his men into two 25-man foreman crews. On large fires, a sector boss is placed in charge of two to four foreman crews. As the size of the fire and crew increases, the fire boss may place a division boss in charge of two or three sector bosses. The division bosses are responsible for all action on certain assigned parts of the

fire. The division bosses work under the general direction of the fire boss who, in every case, has charge of the entire fire.

On a large fire, it is often necessary to have a scouting unit with a scouting boss in charge. This unit is composed of fire scouts, messengers, and radio and telephone operators required for the communication system on the fire.

On many large fires one or more fire camps are established, and the camp work is usually supervised by a camp boss who works under the general supervision of the fire boss. In a large fire camp, the camp boss may have several assistants in charge of activities such as: (1) time keeping and commissary; (2) checking and repair of fire tools and equipment; (3) dispatching of trucks and pack strings; (4) first aid and sanitation; (5) food supplies, including preparation of meals. In a small fire camp, the camp boss may handle all these activities or he may be assisted by a timekeeper and cook.

2. PLANNING AND SUPERVISION.

The first job of the fire boss is to be sure his crews have transportation to the fire, tools with which to fight the fire, and sufficient food and drinking water. The primary job of the fire boss is to plan ways to get the fire out in the shortest possible time. To accomplish this he will plan to:

1. Attack the danger spots first and do just enough work on them to stop the spread of the fire. This includes felling of dangerous snags.

2. Clear for and then build a fire line around the fire in the shortest possible time. This operation can be speeded up by first building a narrow line and improving it if necessary after the spread of the fire is stopped. The smart fire boss will substitute railroad grades, roads, rock slides, and other fire barriers for constructed fire line wherever this can be done faster and safely without including too much unburned area.

3. Construct a fire line as close to the edge of the fire as

24

the men can comfortably work, and burn out immediately the area between the fire line and the edge of the fire.

4. Take advantage of the night and early morning for accomplishing most effective work. Promptly fall snags which might spread the fire in the heat of the day.

5. Keep a close watch for spot fires and put them out promptly when discovered.

6. Separate burning material, dig out burning roots, remove decomposed material from fire line, widen line where necessary, place burning logs parallel with slope so as to prevent them from rolling, cut low hanging or mossy limbs where there is danger of ground fire igniting them and spreading to the crowns.

7. Provide adequate drinking water on the fire line for fire fighters.

8. If a fire camp is necessary, place it as close to the fire as possible and avoid hiking men long distances to and from work. Hiking wastes energy.

9. Have men either pack their lunch or provide them with a lunch on the fire line. Avoid hiking men to and from camp for lunch.

10. Provide a first aid kit with each crew.

11. Establish an adequate service of supply, which includes designation of a camp boss.

3. EFFECTIVE USE OF MANPOWER.

It has become general practice to use the "One Lick" (or progressive) method for fire line construction. The key idea of this method is continuous forward movement of the clearing and digging crews. It is also used to some extent with line-holding and mop-up crews. The method reminds one of a continuously moving freight train, each fire fighter being a box car.

The men assigned to clearing and digging are given the right tools (axes, pulaskis, hazel hoes, etc.) and lined out in

a single file. They work 10 to 15 feet apart to avoid striking or getting in one another's way. In practice they pause momentarily and take one or more licks at the material to be cleared, dug, or scraped, then step ahead one to several paces and repeat. The men hold their positions in the line and do not pass each other. The rate of forward movement depends on the number of men in the line and the amount of work to be done. As each man moves forward he does only a small amount of the work needed to finish the fire line. The last man should complete the necessary work. Those ahead of the last man in each crew should stay out of his way but they should not leave him with too much unfinished work. The last man in the crew automatically sets the pace for the crew.

For example, if one 25-man crew were sent to a fire, the fire boss would divide his crew into 3 units and assign them to jobs about as follows: In the first unit of 11 men the most experienced man would lead off and locate the fire line, followed by 4 men clearing line and 6 men digging. In the second unit of 7 men, 4 would be falling dangerous snags along the line and three would use torches to burn unburned material between the fire line and the fire edge. Four of the 7 men in the third unit would hold the fire—keep it from crossing the line—and the last three would begin the most urgent mop-up work next to the fire line. The objective of the whole crew would be to get a safe line around the fire as quickly as possible.

On a large fire one or more foreman crews may be assigned to clearing and an equal number to digging. Another crew would fall snags. Several foreman crews would follow to "hold" the line and begin the mop-up. As a rule on all but small fires, the crews are divided and work on at least two sides of the fire.

Anyone assisting in the suppression of a large fire may be assigned to any job. Assignments will depend a great deal upon previous experience, arrangements, and training.

LINE HOLDING AND MOP-UP ON LARGE FIRES

After the fire line has been constructed and the unburned material in the area between this line and the fire edge has been burned out, there is a tendency for the crew to relax or let down. As a result many fires have gotten away after control appeared certain. Experienced fire bosses recognize the period immediately following line construction as one of the most dangerous and plan to have a holding crew work immediately behind the line construction crew. It is the job of the holding crew to cool down the fire and do the necessary work to prevent it from crossing the line. This is accomplished by throwing dirt to knock down the heat and flames, falling the last of the burning snags that are throwing sparks across the line, looking for and putting out spot fires, and removing burning chunks, logs and hot burning fuels from near the fire line.

The holding crew should keep up with the line constructing crew. If a gap should develop, the alert fire boss will close it by increasing the size of the holding crew or by assigning additional work to the line constructing crew. The holding crew removes the immediate danger of the fire crossing the fire line, and it in turn is followed by the mop-up crew who take over and make the line safe. Again there should be no gap between the last man of the holding crew and the first man of the mop-up crew. The mop-up work on a large fire is similar to that described for small fires; the difference being that there is greater length of fire line to make safe, involving many more burning logs to roll out of their hot beds, burning stumps to put out, low hanging mossy limbs to cut, and places to improve in the fire line. Since the burning material close to the fire line constitutes the greatest danger, this burning material should be mopped up first. It is usually safe practice at first to quickly extinguish all fire in a strip 50 to 100 feet in from the fire line.

The amount of mop-up work required in addition to that done near the fire line will depend on many factors and will

be determined by the man in charge of the fire. The rule is to put out all fire inside the fire line that may build up under more favorable burning conditions and threaten to cross the fire line.

PREVENTING FIRES

EVERY PERSON TRAVELING IN OR USING A FOREST IS PERSONALLY RESPONSIBLE FOR PREVENTING FIRES

You can prevent fires by:

1. *Smoking only* while stopping in a safe place—such as a gravel bar, on a large rock surrounded by water, or some other such place where there is no dry fuel. Observe special posted "No Smoking" rules or restrictions.

2. *Breaking your match in two* before you throw it away. A cold match head will not start a fire. Use your *ash tray* while in a car.

3. *Placing cigarette stubs*, cigar butts or pipe heel in your *ash tray*. If not in a car, clear a spot one foot across to clean damp dirt and stamp in the tobacco remains with your foot.

4. *Before building a campfire or warming fire*, scrape away all inflammable fuel from a spot 5 feet in diameter at least 10 feet away from any log, stump, snag, or mossy tree. Dig a hole in the center and in it build a small fire. Obtain a campfire permit when required. Hunters should not build warming fires away from camp unless they have a permit to do so, and will put them out. Permits are not required for well developed campgrounds with stoves or fireplaces, and which are posted with a sign to the effect that permits are not required.

5. *Extinguish your campfire or warming fire—dead out—*before you leave, even for a few minutes. Thoroughly stir the coals while soaking them with lots of water. Turn all sticks and chunks, wet both sides, and rub out all fire. Wet the ground around the fire. If you can't get water, use clean,

28

cool or damp dirt and mix with burning coals and rub charred sticks with dirt until they can be held in the bare hands. Then lay sticks separately on top of bared ground. Do not pour water on a fire in a masonry stove or fireplace if so instructed by signs or a campground attendant.

6. *Carry fire tools* while in a forest area. With an ax, shovel and bucket you can take care of your fire or extinguish any small fire you find.

7. *Burn accumulated debris or slash* during safe periods only and in such manner as directed by the responsible representative of the forest protection agency. Burning permits must be obtained in advance of burning during the period of the year prescribed by law. See your local forest protection agency.

8. *Put out any small fire you can*. Report promptly other unattended fires by telephone or in person to your local forest protection agency.

9. *You can also help* by informing the other person who has not seen these rules.