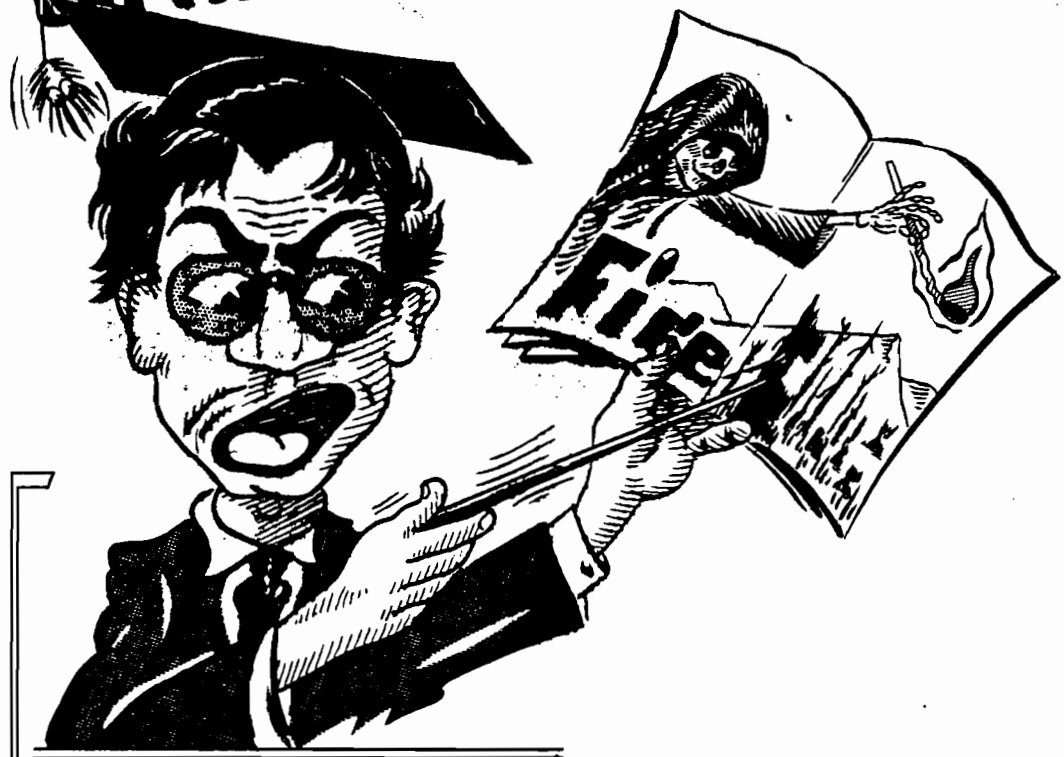


# HOT FACTS OF LIFE on the FIRE LINE



FOR MEN ONLY

DEPARTMENT OF AGRICULTURE  
U. S. FOREST SERVICE

NORTHERN REGION



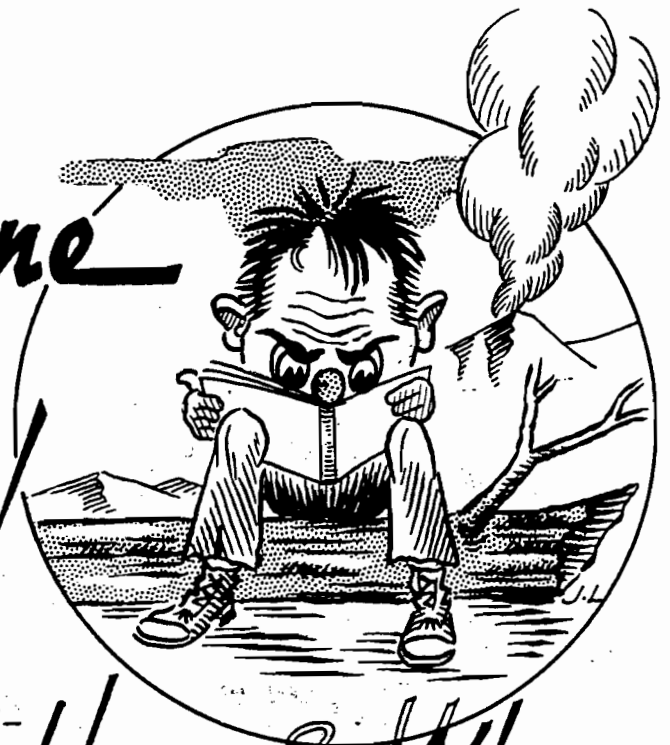
MISSOULA MONTANA

# Life on The fireline

KNOW THE WORST  
FIRST

BE PREPARED ..  
LEARN TO TAKE IT

*This book tells you-*



*How & Why*

The fellow who used to fight fires has gone to war. Lumberjacks and saw-mill workers are getting out the timber to help keep him fighting. They haven't time to fight fires. IT'S UP TO YOU. IT'S YOUR WAR JOB.

## Let's go!

JOIN THE FIRE FIGHTERS  
SEE THE COUNTRY THROUGH  
A HAZE OF SMOKE



WE HAVE CONFIDENCE IN YOU

Fellows like you who have worked for the Forest Service before have done a bang-up job of fire fighting. We know what you can do.

We'll give you the best training we can plus experienced foremen and good equipment to fight with - but you've got to give the muscle, the wind, the sweat, the "stay with it" to lick that fire. It's a man's job and we depend on you.



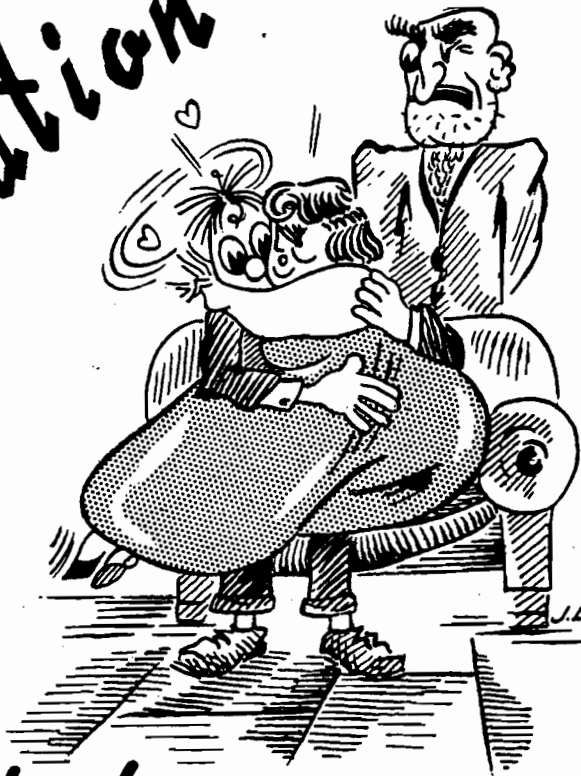
*Front line. Exciting.  
Thrilling. ~~Hot~~ Action.*

When preparing for front-line action, study the enemy.

Scientifically defined, fire is the rapid chemical union of any substance with oxygen which produces light and heat. The light we call flame.

The fire fighter knows that three essentials must be present to produce a fire, namely: (1) A fuel or burnable substance; (2) oxygen (air); and (3) sufficient heat to raise the fuel to its kindling point or lowest burnable temperature. From this he gets his basic principle in fire fighting.

# Separation



## Is the basic principle of Fire fighting

Fire fighting in its simplest terms, therefore, consists of removing one or more of these essentials. The principle is called SEPARATION.

Separation is the basis of all fire action. The fire fighter either separates the heat or flame from the fuel; separates the oxygen from the fuel; or separates the fuel from the flame.

- FUEL - OXYGEN - HEAT -

Remove any one - and there can be NO FIRE.

# Know the facts of Life

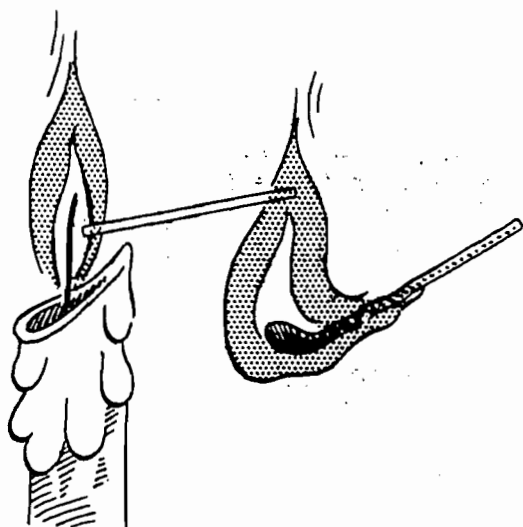
ITS THE GAS THAT  
= BURNS =



Light a match and examine the flame.

Next to the match it is rather colorless. Then it turns a light blue and finally yellow. You can run your finger through the colorless part without getting burned. But put your finger at the top of the flame and you can't hold it there. That is the hot part.

The heat reflected from the flame raises the temperature of the wood until it becomes gas which you observe as the colorless part rising to mix with the oxygen of the air. As the gas reaches the "hot part" it oxidizes, forming more heat, and the process is repeated as long as all three elements - wood, heat, and air - are present.



You can further prove this with a lighted candle. Here, too, a part of the flame is luminous yellow while the lower portion is bluish and unburned. Place a short glass tube through the flame near the wick. Light another match and hold its flame near the upper end of the tube. The unburned gas or vapor rising in the tube will burn.

It is the gases that are actually burning in either case. In the case of the match the wood is vaporized by the heat. In the candle the wax melts and vaporizes to furnish the burnable gases.

## HOW FAST DO FOREST FIRES SPREAD?

Remember that wood is vaporized at temperatures actually below the burning point. You proved this when you ran your finger through the relatively cool spot on the match itself.

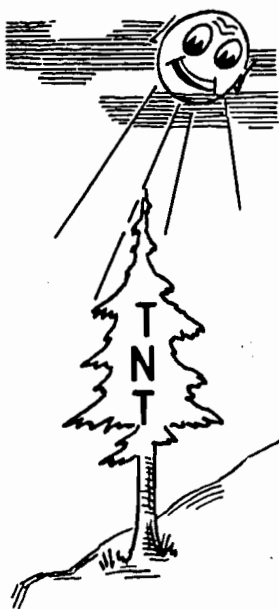
If the match were wet back of the flame, or if you had put water in the candle at the base of the wick, the heat would have been expended in vaporizing the moisture. No gas would be formed.

Now in a forest fire the radiated heat quickly evaporates what moisture may be in surrounding fuels. These burnable materials begin to heat and vaporize in advance of the flames and the fire spreads. To prove this, hold a lighted match close to a piece of paper, but do not let the flame touch the paper. The paper starts to burn as the radiated heat from the match flame causes vaporization.

Consequently, rate of spread of a forest fire depends upon air temperatures, heat of the fire itself, oxygen supplies, and the amount of dry burnable material. Increase either of these and the fire spreads faster.

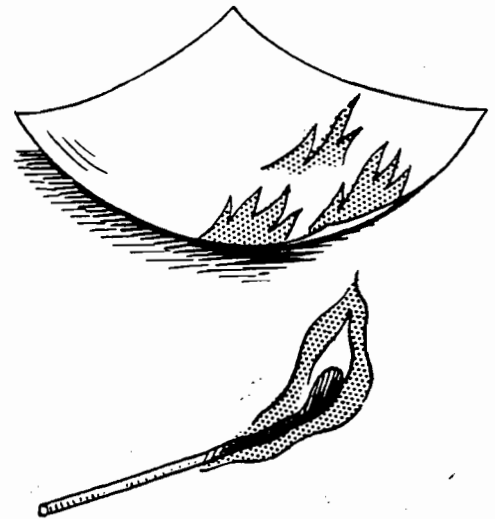
## THE BLOW-UP

Conditions similar to those created by a burning fire can be brought about by long periods of hot dry weather. Temperatures go higher. The air loses its moisture. The forests become drier and drier until they are tinder dry. As the hot sun beats down you can "feel" the danger. This is a blow-up period.



A carelessly flipped match falling in the dry grass or duff on the forest floor is like an electric spark that starts an explosion. Jumping from the ground to the crown of the trees, the fire generates its own wind as the hot air rises and the relatively cooler air comes in. Flaming embers are carried ahead of the fire to start more fires. Sheets of flame shoot into the heavens as the oxygen in the air below is exhausted by the rapid oxidation taking place within the fire. The unburned gases escape upward where the intense heat generated from the fire underneath unites them with fresh oxygen in the upper air.

This is a "crown fire," the fire fighter's nightmare. It may become a sweeping inferno, destroying anything caught in its path in a matter of hours - miles of timber, wildlife, forage, farm homes, communication lines, everything.

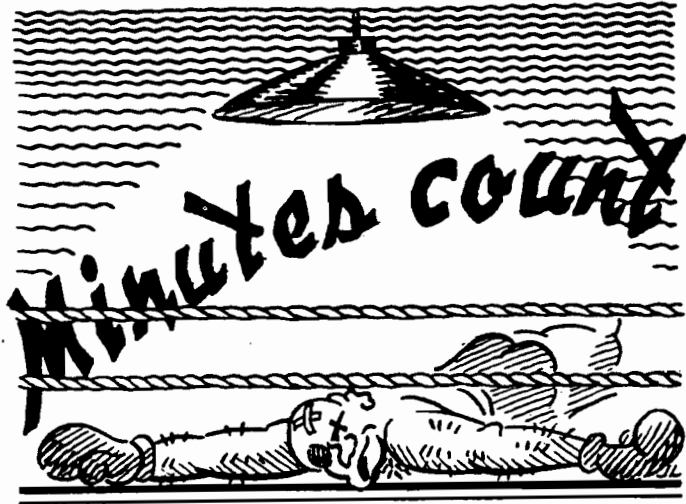


You will learn more about the various degrees of fire danger, but this is the extreme - the blow-up period.

### MINUTES COUNT

These are some of the reasons why minutes count in fire fighting.

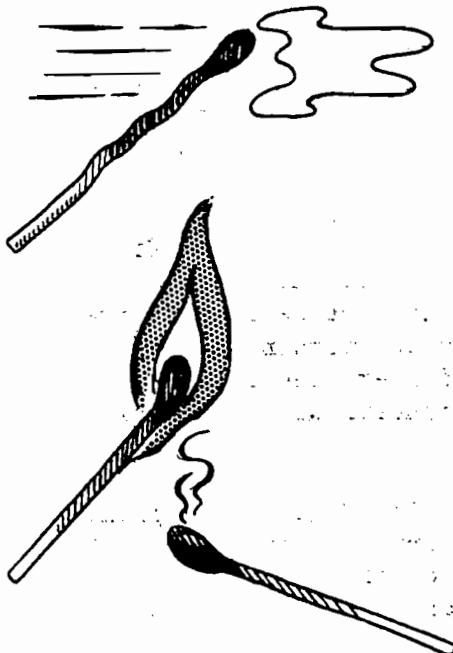
The fire fighter battles to keep the fire on the ground, to keep it from spreading, and the sooner he gets to it the better are his chances. He must use intelligent methods to knock down the "hot spots" that generate heat; to keep the fire from spreading to heavy fuels; to "cool it down" until he can "corral it" which means building a line around the fire to keep it from spreading on the ground. When he once has the fire corralled he has a chance to "mop up," that is, put the fire out. But the big fight is to bring the fire under control.



### APPLYING THE PRINCIPLE OF SEPARATION

#### Separating Flame or Intense Heat From the Fuels

One of the everyday methods of separating heat from the fuel is by blowing as is done in blowing out a match. The force of the air blows the flame away from the fuel and volatile gases which are escaping from it, thus separating them. That volatile gases are still present is shown by the following simple test.

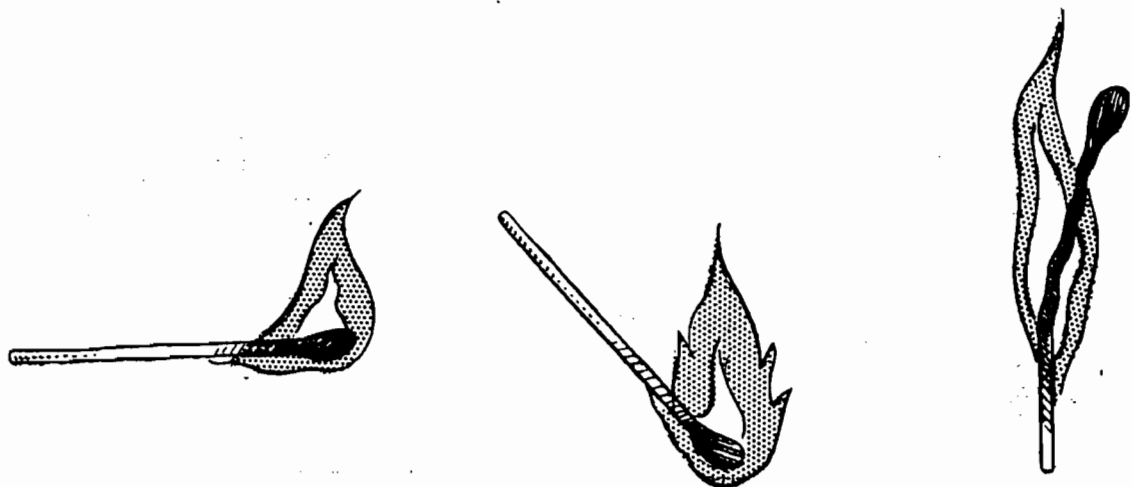


Light two matches. Paper matches work best. Blow out one match and immediately hold it at the base of the burning match. The sketch in the margin shows the relative positions. The lower match will relight. On close observation you will see that the flame from the burning match ignites the column of volatile gas still rising from the other.

But blowing out a forest fire would take a terrific blast of air. In reality a wind is like a draft in the stove. It supplies more oxygen, bends the flames horizontally to preheat adjacent fuels, and spreads the fire.

To a degree, however, blowing is used in fighting grass fires where the fuels are light. Slappers, green brush, and wet blankets or gunny sacks owe their effectiveness in part to this principle. The flames directly under the slapper or brush are put out - separated - by breaking the flaming portions of the grass from the unburned portions and by excluding the oxygen. But an area of flame beyond that covered by the slapper is also extinguished by the blow. This is caused by the rush of air from under the falling slapper. Slappers, brush, or wet blankets should always be applied from the outside of the fire, therefore, so that the separated flames are forced into the burned area and not to unburned grass or fresh fuels.

A second method of separating flame and fuel is by preventing the radiation of heat to the fuels. Light another match. Hold it in a horizontal position and its rate of burning is normal. Hold the head of the match down and it burns more rapidly with greater volume of heat and flame. This is because the heat rises and by placing the unburned portion above the flame the heat releases more volatile gases. Now hold the match vertically with its head up. Notice that the flame grows smaller and smaller and finally goes out. This position prevents the fuel from being heated by the flame. Volatile gases are no longer released and the flame and fuel are separated.





Raising the burning end is used in fire fighting. Pieces of burning logs and branches are placed in an upright position, burning end up, against a dirt bank or rock. The separation of the heat from the fuel will cause it to eventually go out.

The same with logs which usually catch fire on the underside from the burning duff or grass. By simply turning them over with the burning side up, the same separation is accomplished and they will go out.

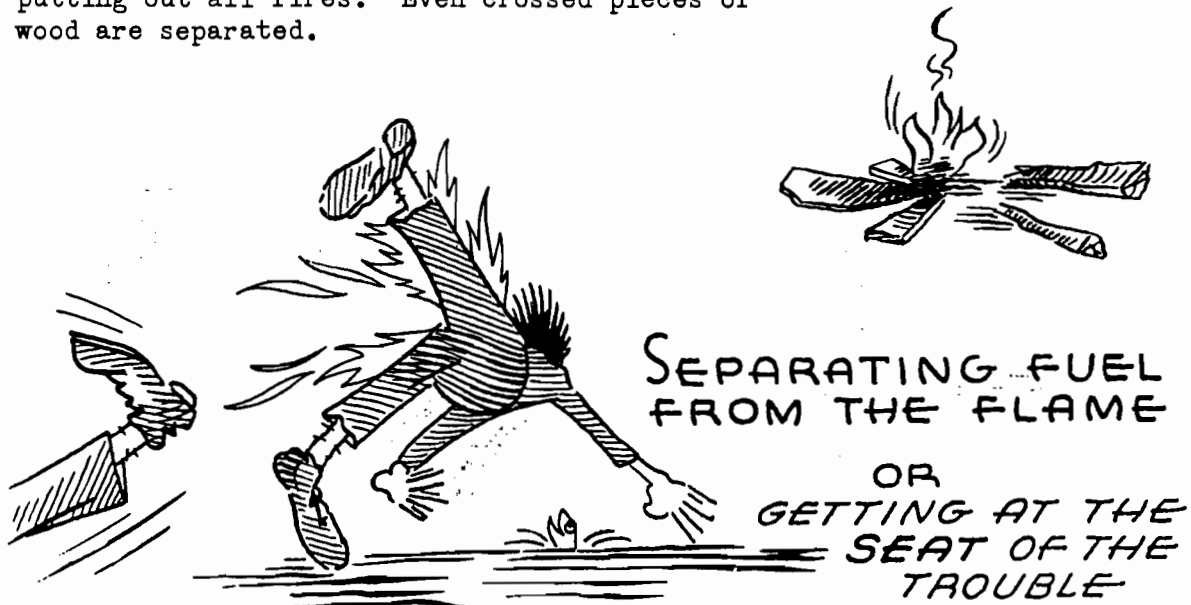
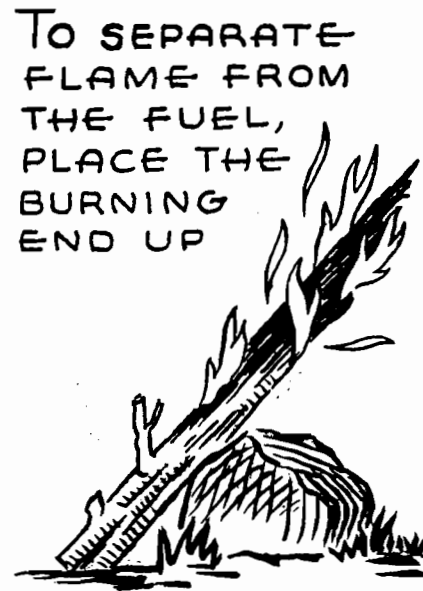
These methods are most effective on very small fires or in the later stages of completely extinguishing a fire - the "mop-up" stage after the spread of the fire has been stopped.

#### Separating the Fuel From the Flame

Place two matches together. Light them and observe the volume of flame and heat. Now separate them and note that the intensity of both immediately diminishes. The volume of heat is reduced and the amount of volatile gases is correspondingly reduced.

The effectiveness of this separation of burning fuels to extinguish a fire is demonstrated by a campfire which ends up as shown in the illustration below. This is why, in suppressing fires, piles or masses of burning materials are pulled apart. If not separated the volume of heat produced will quickly evaporate the moisture and release the volatile gases of nearby fuels, causing the fire to spread more rapidly.

Burning material is similarly separated in mop-up operations to hasten putting out all fires. Even crossed pieces of wood are separated.



## Separating Oxygen From the Fuel

Complete separation of oxygen from burning forest fuels is rarely ever possible. But partial separation is used to slow down a fire through the use of dirt or water. This is especially effective on light fuels like grass.

## COMBINATION METHODS ARE BEST

There are many ways of putting out fires that combine the separation of two or more of the essentials necessary to produce a fire.

When a smoker rubs his cigarette on a stone to put it out, or in the sand, he combines separation of both oxygen and heat from the fuel. He does the same when he spits in the palm of his hand and douses the burning end of the cigarette in it.

## Water Is Effective When You Can Get It

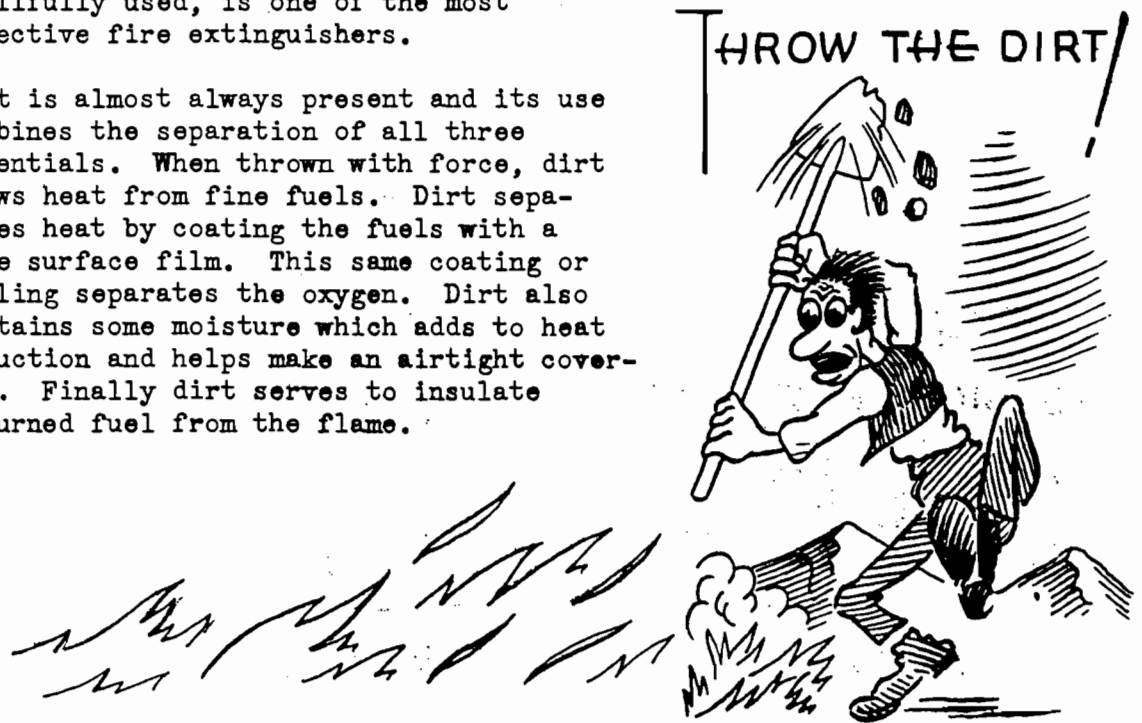
When sprayed on a fire, water combines separation of heat by cooling, and separation of oxygen by coating the wood with a thin film. This is one reason why the water is sprayed from a hand pump, for instance, rather than shot into the flames in a single stream. The water covers more area and is not wasted.

Water is of course very effective when you can get it. But forest fires are usually so far from a water supply that other methods are quicker and require less work.

## Dirt Does the Job

Fire fighters have found that dirt, when skillfully used, is one of the most effective fire extinguishers.

Dirt is almost always present and its use combines the separation of all three essentials. When thrown with force, dirt blows heat from fine fuels. Dirt separates heat by coating the fuels with a fine surface film. This same coating or sealing separates the oxygen. Dirt also contains some moisture which adds to heat reduction and helps make an airtight covering. Finally dirt serves to insulate unburned fuel from the flame.



### Throw the Dirt to Cool Down a Fire

To cool down a hot spot or put out flaming material, the fire fighter throws the dirt at the base of the flame with all the force possible. He thus gets the benefit of the blowing action, the sealing action, and the cooling action simultaneously. Grass fires are frequently fought by throwing dirt in a sweeping motion and for the same reason.

### Mix in the Dirt to Put Out Glowing Embers

But glowing embers should be mixed with the dirt, usually using a shovel. By repeated mixing the embers can be thoroughly cooled, sealed and extinguished. To be sure they are out the fire fighter then feels with his hands until he is sure no hot coals are left.

To illustrate, take a camper putting out a campfire. When he soaks his fire with water and stirs it in he is separating heat from the fuel, excluding oxygen with a film of water, and separating individual burning embers by water and wet ashes.

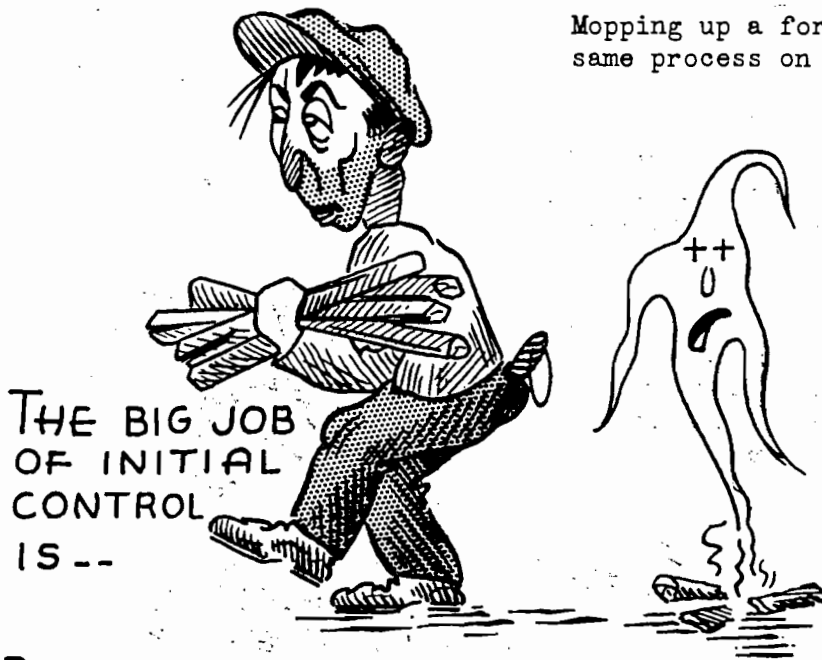
The same thing is accomplished by using dirt. To bury the fire with dirt does not mean putting it out because dirt is porous and the air that gets through just keeps it burning. So he mixes dirt thoroughly with the embers, stirring it in with the shovel and then feeling for any coals not yet entirely out.

HEY JOE  
SHE'S HOT!



FEEL WITH YOUR  
HANDS TO BE SURE  
-IT'S OUT-

Mopping up a forest fire is much the same process on a bigger scale.



THE BIG JOB  
OF INITIAL  
CONTROL  
IS --

ROBBING THE FIRE OF FUEL

Use of the simple principle of separating the fuel from the flame is the most commonly used method of preventing or fighting forest fires. The fire fighter calls it "Robbing the fire of fuel."

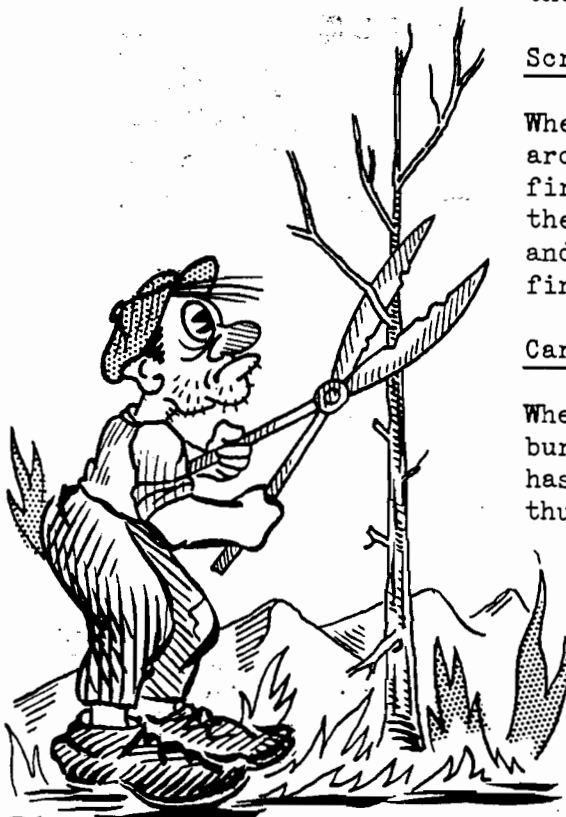
#### Digging the Trench or Building the Fire Line

When a camper scrapes away all burnable material from the place where he expects to build his campfire, he scrapes everything down to the mineral soil which he knows will not burn. If he clears a space for a distance of a few feet in all directions he knows he can control his fire. Unless there is a strong wind, even sparks are not apt to reach burnable material.

Similarly, when a fire fighter surrounds a fire with a narrow trench dug to mineral soil, he has separated the burning fuels from the unburned. If the fire can be held within the trenched area it will soon burn itself out for lack of fuels.

#### Trimming the Trees

When he trims the lower branches of a tree under which the duff and litter are burning, he separates the upper branches that are left from the burning material below, thus stopping the spread of the fire to the crown of the tree.



#### Scraping Away the Duff

When he scrapes unburned duff away from around a snag, he knows that the creeping fire in the duff has been separated from the snag, preventing the snag from burning and thereby shortening the life of the fire.

#### Carrying Fuel Away

When he carries unburned material from the burning area to beyond the trench that he has dug, he separates fuel from the fire, thus shortening his fire job.

#### Cutting Down Snags

When he cuts down a snag well within the trenched area, he has made sure that separation is nearer complete for then the winds have less chance of carrying sparks to unburned fuels outside his trench.

#### **TRIM LOWER BRANCHES TO KEEP FIRE FROM CLIMBING**

#### Turning Burning Logs Up the Slope

When he turns a burning log up and down the slope so that it will not roll across the trench, he is separating fire from the fuel by preventing additional fuels from being ignited.

### Chopping Fire Out of Logs

When he chops fire out of a log, a tree, or a stump, he is separating the fire from the fuel.

### Every Fire Its Own Problem

Every fire presents different problems. Experience teaches the best methods of attack. But the principle never changes. Knock down the hot spots - keep the fire on the ground - separate heavy concentrations of fuels - build a line and dig a trench to mineral soil - backfire from the trench - stand burning logs on end against a rock - or turn larger burning logs up the slope to prevent rolling - get the fire under control - then gradually work from the outside in to mop up.

The length of time required to put out a fire will depend directly on how long it takes to separate the oxygen, heat, or fuels.

## WHAT THE WELL DRESSED FIRE FIGHTER SHOULD WEAR

**HAT.** ANYTHING EXCEPT STRAW WHICH MAY BECOME A CROWN FIRE.

**JACKET.** NONDESCRIPT COLOR AND MATERIAL -- LEFT WITH TIMEKEEPER DURING DAYTIME BUT WORN WITH THE COLLAR TURNED UP DURING BREAKFAST.

**SHOES.** FAIRLY HEAVY 6 OR 8 INCH TOPS WITH COMPOSITION OR HOBNAILED SOLES PREFERRED.

**TROUSERS.** BOTTOMS-CUFFLESS VICTORY DESIGN WITH LENGTH OF LEGS AT HIGH-WATER MARK - ALSO TO BE SLIGHTLY BAGGY AT KNEES MATERIAL TO BE MOST ANYTHING THAT IS TOUGH-TOUGH-AND TOUGH.

**SOCKS.** MEDIUM HEAVY WOOL -- UNLESS BLISTERS ARE DESIRED.



### OTHER USEFUL INFORMATION

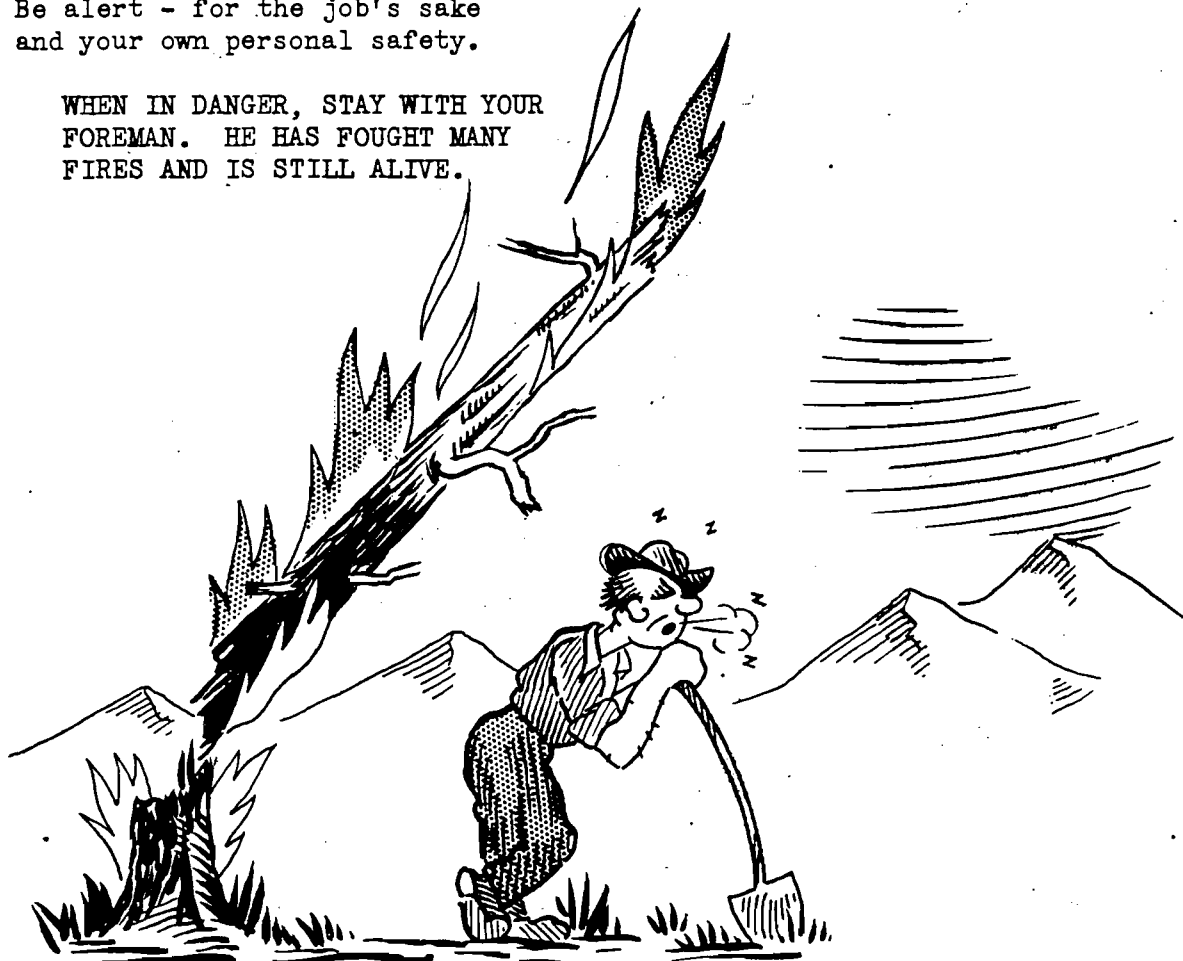
Fire fighting is for the quick and the strong - the quick get their food into their mouths before a yellow jacket lights on it.

Don't leave valuable articles in your bedroll - if you must take your bank roll, leave it with the timekeeper at your own risk.

The timekeeper is the man who spends most of his time in camp wondering how you are succeeding on the fireline.

Be alert - for the job's sake  
and your own personal safety.

WHEN IN DANGER, STAY WITH YOUR  
FOREMAN. HE HAS FOUGHT MANY  
FIRES AND IS STILL ALIVE.



### **DON'T SNOOZE UNDER A BURNING SNAG**

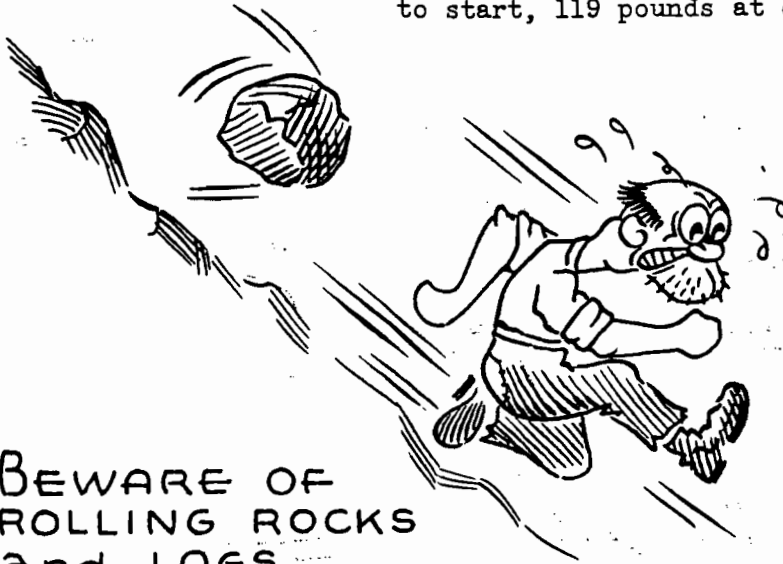
Be sanitary - use the facilities provided at the camp.

Learn to cover the miles - a woods mile is the distance a hound pup will travel during his lifetime.

Equipment is scarce and hard to replace - see that it is returned.

A brass hat is anyone from the regional office - full of ideas and frequently allergic to smoke.

A firepack contains a Pulaski, shovel, file, water bag, compass, map, first aid kit, and rations. It weighs 19 pounds to start, 119 pounds at end of trip.



BEWARE OF  
ROLLING ROCKS  
and LOGS

The step-up method is a line building system that makes you move just when you have spotted a good place to rest.

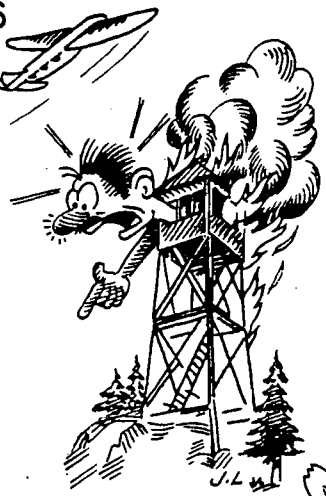
An actionable fire is any fire - you supply the action.

Over the hill is where the guy goes who can't take it.



DON'T WALK BEHIND A MAN  
CARRYING A SAW

LOOKOUT SPOTS  
**FIRE**



RANGER DISPATCHES  
SMOKECHASER AND  
MEN



REGIONAL OFFICE



SUPERVISOR  
SENDS MORE MEN  
AND SUPPLIES

*DISPATCHES ADDITIONAL  
HELP - SMOKE JUMPERS - LOCAL  
AND OTHER FOREST CREWS - PACK  
STOCK AND SUPPLIES BY AIR AND  
BY TRUCK -*