VOL. 9 OCTOBER 1948 No. 4

FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U.S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 9 Number 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. The periodical is printed with the approval of the Bureau of the Budget as required by Rule 42 of the Joint Committee on Printing.

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., 15 cents a copy, or by subscription at the rate of 50 cents per year. Postage stamps will not be accepted in payment.

Address DIVISION OF FIRE CONTROL
Forest Service, Washington, D. C.

UNITED STATES GOVERNMENT PRINTING OFFICE • WASHINGTON • 1948

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LIGHTNING FIRE DISCOVERY TIME ON NATIONAL FORESTS IN OREGON AND WASHINGTON

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In Oregon and Washington lightning causes 25 percent of the fires on State and private lands and 70 percent of those on national forests where more rugged topography favors lightning-storm development. Although many of these fires occur with rain and are quickly seen and easily suppressed, others cause great damage by smouldering unseen until dry, windy weather suddenly fans them to life in bad fuel types. Knowledge of the experience records of lightning fire discovery times is useful in planning for the load on suppression forces or the period during which extra lookouts and aerial patrols may be productive after a lightning storm.

Several circumstances may affect the discovery of lightning fires. For example, when a bolt of lightning strikes it may hit dry fuel from which flame or smoke may be visible almost at once. On the other hand, it may hit wet fuel which may smoulder for a week or more before becoming dry enough for the fire to gather headway and produce visible flame or smoke. The strike may be in an open forest cover where smoke near the ground can be easily seen or it may be in a tall, dense cover where diffused smoke is hidden until it becomes too thin to be noticed when it finally reaches above the trees.

One source of information concerning lightning fire discovery times is the individual fire report of the national forests. These reports show the time of ignition of each fire as judged from records of the time when the lightning storm passed over the area. They also show the time when the fire was first discovered. Reports for 5,300 lightning fires on the national forests of Region 6 [1] during the period 1940–44 were tabulated according to the locality and timber type in which each occurred and the interval between ignition and discovery.

The average percent of fires discovered at various time intervals after the storm occurred is shown in figure 1 and table 1 for Region 6 as a whole. If 1-hour rather than 2-hour periods had been illustrated, the chart would show that 31.2 percent of the fires were discovered in

[1] Washington and Oregon, excepting the Colville National Forest in northeastern Washington which is in another administrative region. The Olympic and Siuslaw National Forests of the Coast Ranges in Region 6 were omitted because they have very few lightning fires.

the first hour after the storm. The fires remaining to be discovered after 8 days, the limit of the chart, were 3.5 percent of the total number.

TABLE 1.—*Proportion of lightning fires discovered within various periods of elapsed time after ignition, Region 6, 1940–44*

Periods of elapsed time	Percent of total fires
6 hours	50
24 hours	78
3 days	90
7 days	96

Figure 1 shows a decreasing rate of discovery until 8 hours after the storm, then a gradual increase until 16 hours, then a decrease until 32 hours, then an increase until about 42 hours, then a decrease. Both high points occur 8 to 10 hours after the low points. The low points are 24 hours apart, and the high points are at nearly the same interval. No satisfactory explanation of this pattern has so far been found. Since burning conditions and visibility vary with the time of day, the pattern may be related to the proportion of storms beginning at different hours. In such a case, the elapsed discovery times would have to be analyzed according to the hour at which the storm occurred in order to recognize the relationship.

EFFECT OF COVER TYPE

To learn which forest cover conditions may have contributed to differences in discovery time, the kind of cover at the starting point of each fire was classified as either an open canopy or a closed canopy. The discovery times in each class were studied to learn if fires starting in an open forest canopy are usually discovered more quickly than in a closed canopy. The open cover included nonrestocked cut-overs and old burns, small regeneration and saplings, and the ponderosa and lodgepole pine types. For the two States as a whole, discovery times for these types were less than for the closed types. Within 6 hours after the storms, 52 percent of the fires in the open types and 45 percent in the closed types had been discovered. This 7 percent difference remained nearly the same for any given elapsed time from 6 to 48 hours after the storm passed. As a result, 19 percent of the closed-canopy and only 11 percent of the open-canopy fires remained to be discovered after 48 hours.

VARIATION BY SUBREGION

Since there is a great difference in fuel and fire-weather conditions between northern and southern and eastern and western parts of the two States, the fire reports were grouped according to national forests that have similar conditions. The discovery times were then studied to determine if the results previously discussed for the two States as a whole differed appreciably between the forest groups. Part of the

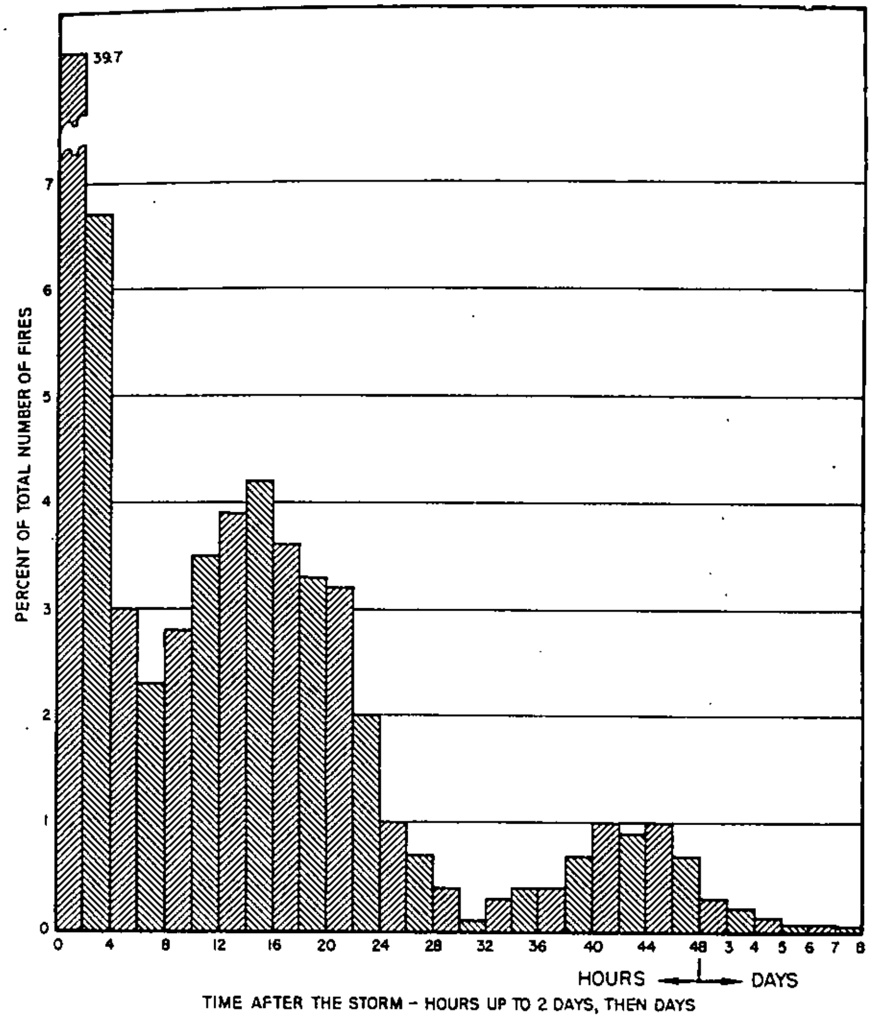

FIGURE 1.—Average rate of lightning-fire discovery at specified periods after storm occurred, for 5,357 fires in Region 6 during 1940–44.

data giving comparisons of the proportion of short and long discovery times in different forest groups is shown in tables 2 and 3.

Except in the Chelan-Wenatchee group, rate of discovery in each group followed a pattern similar to the regional pattern shown in figure 1.

The Mount Baker-Snoqualmie-Columbia group of western Washington discovered a much larger proportion of its fires than did the Oregon forests in the first 6 hours. By the end of 24 hours, however, the relationship was reversed and the Oregon forests had discovered as great or a greater proportion of their fires compared to the western Washington forests. The Chelan-Wenatchee group of eastern Washington discovered a greater proportion of its total fires than did any other group during each elapsed time period between 1 hour and 7 days.

TABLE 2.—*Proportion of lightning fires discovered in each of the first 3 hours after ignition in different national forest groups in Oregon and Washington, 1940–44*

Hour	Washington		Oregon			
	Mount Baker, Snoqualmie, Columbia	Chelan, Wenatchee	Mount Hood, Willamette, Umpqua	Rogue River, Siskiyou	Deschutes, Fremont	Blue Mountain forests
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1st	46	46	28	25	23	23
2d	5	7	9	8	11	10
3d	3	3	4	7	6	4

TABLE 3.—*Proportion of lightning fires discovered within various periods of elapsed time after ignition in different national forest groups in Oregon and Washington, 1940–44*

Periods of elapsed time	Washington		Oregon			
	Mount Baker, Snoqualmie, Columbia	Chelan, Wenatchee	Mount Hood, Willamette, Umpqua	Rogue River, Siskiyou	Deschutes, Fremont	Blue Mountain forests
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
6 hours	59	63	45	44	45	42
24 hours	74	83	74	77	82	78
3 days	86	94	87	87	92	91
7 days	92	98	94	95	99	96

The effect of open and closed forest canopy types upon fire discovery time was studied by forest groups to determine if the effect noticed for the two States as a whole was consistent in all groups. The Washington and western Oregon groups showed the same tendency for earlier discovery in the open-canopy types as discussed previously for all groups combined. But in the eastern Oregon groups the proportion of discoveries during the first 6 hours was approximately the same in both closed- and open-canopy types. This is reasonable since most forests are somewhat open in eastern Oregon, making less contrast between the open and most dense timber types than in Washington or western Oregon. On the other hand, between 6 and 8 hours after the storm the proportion of discoveries increased in the open-canopy type in eastern Oregon. As a result, in the eastern Oregon forests, as in the others, a greater percentage of the fires occurring in open-canopy timber types than in closed types was discovered before 8, 24, or 48 hours had elapsed. This left a greater proportion of the fires in closed-canopy types to be discovered after 48 hours or more in all the forest groups.

CONCLUSIONS

Results of the lightning-fire-discovery-time tabulations indicate that the peak load of discoveries and reports is in the first hour after the lightning strikes. This should be kept in mind when planning for prompt discovery by emergency lookouts and airplane patrols and prompt attack by suppression crews, although weather and visibility are usually unsafe for flying during the first hour. About 50 percent of the fires are seen within 6 hours, 20 percent remain to be discovered after 24 hours, and 10 percent after 3 days. From this it appears that emergency lookouts, patrols, and suppression help may be needed for at least 3 days. The Washington forests have a greater proportion of their lightning-fire load in the first hour than do the Oregon forests. If all fires are to be suppressed as soon as possible after discovery, regardless of locality, emphasis on action as soon as the storm strikes is then even more important in Washington than in Oregon.

Lightning being the greatest cause of forest fires in mountainous parts of all the western States, the applicability of the above results to other western States besides Oregon and Washington should be considered. Results that were consistent in different forest groups within this Region may apply elsewhere and are as follows: (1) The general form of the discovery-time pattern in figure 1. (2) About 6 percent or more of the fires remain to be discovered more than 3 days after the storm passes. (3) In closed-canopy timber types a greater proportion of the fires than in open-canopy types remains undiscovered 48 hours after the storm. The proportion of fires discovered in each hour and within various periods of elapsed time up to 2 days is not likely to apply directly to other States because these proportions varied greatly within Oregon and Washington.

Paint for Rust.—In fire fighting, as in any work, a sharp, clean tool is the best and safest tool. Maintaining such a tool under the Region 8 conditions is a constant fight against rust. We have used oil, grease, and paint of various kinds. Usually the oils and grease are too messy and pick up dirt. The ordinary paint usually blunts and slows a sharp edge.

Until coming to the Francis Marion, I had seen no one method which completely protected and still maintained the full efficiency of the tool. We use Rust-oleum number 634, quick drying, black, on the dry blade immediately after it is sharpened and ready for use. This paint drys rapidly, keeps a good protective coat in storage, and is sufficiently brittle that on use of tool it immediately flakes off leaving a sharp, clean tool.—GEORGE K. SCHAEFFER, *Ranger, Francis Marion National Forest.*

HOW TO MEET THE HUNTER

O. L. "LUTE" MULLENAX

Fire Control Aide, Monongahela National Forest, West Virginia

Fire Control Aide O. L. Mollenax at a fall fire prevention meeting on the Monongahela National Forest was assigned the subject "How to Meet the Hunter." His presentation of the subject received the hearty approval of the rangers, general district assistants and fire control aides present. The group immediately suggested his talk be reproduced in Fire Control Notes.

Some readers may feel this article presents elementary principles already practiced by everyone in the Forest Service who has occasion to contact people. However, if it does no more than assure doubtful readers, especially new employees, that this is the Forest Service way, it will be worth presenting.

"Lute" Mullenax is one of the veterans on the Monongahela, having worked intermittently on the Greenbrier District since its beginning in 1926. Naturally gifted with the knack of making and keeping friends, and a type who is very valuable in on-the-ground public relations work, he is well qualified to speak on everyday public contacts.

Putting yourself in the other fellow's place is a pretty good rule when you are trying to figure out a course of conduct. In other words, I'll suppose that I am the hunter. I want to be treated with respect and courtesy when I come into the national forest on lawful business. After all, I can say that you fellows are kind of working for me. To be serious, I feel that I am entitled to respect, courtesy, and consideration. Really, I am a guest of the Forest Service. If you come to my home, it is my duty to welcome you and try to make you feel at home. Don't you think that a forest officer should approach a hunter on this basis?

On the other hand, we as forest officers have certain things which should be understood and accepted by the hunter. For example, last spring (and the fact that it was a fisherman rather than a hunter should make no difference) I encountered a fisherman camping on Little River on the plantation side of Little River Truck Trail. Here was a situation which called for some action. The fire was built in a prohibited area. The camper was having breakfast. I greeted the fellow, identified myself, inquired about his luck and "batted the breeze" for probably 5 minutes. I then asked him if he had a camp fire permit. He said, "sure," and presented it without further urge. I noted that the permit stated that the location of the camp fire would be on Little River south of Middle Mountain Truck Trail. Actually the camper was right but I had to get his fire across the road from the plantation. I explained to him that the permit meant that the fire would be built between Little River and Little River Truck Trail. He was apologetic and offered to put the fire out right away. I told him to finish breakfast and then we'd put the fire out. He could build his noonday fire below the road. Incidentally, I enjoyed a cup of coffee with him. I left this man with the feeling that we'd enjoyed each other's company and were friends. This, I think, is the test of a good contact; gaining your point and also a friend.

Here are the rules I would set down for meeting the hunter:

1. Meet the hunter with a smile, not a growl.
2. Let him know who you are.
3. Give him the impression that you are interested in his sport and welfare and want him to enjoy himself. In other words, you are glad that he is there.
4. Try to be helpful to him rather than a nuisance.
5. Don't go into lectures or instructions or preaching unless the circumstances indicate the need. In other words, if he has built a fire properly in a safe place, compliment him, don't go preaching about how to build fires in safe spots.
6. Steer him our way rather than try to order him around or regiment him.
7. Don't impose yourself on the man. There are times when you can sit down and have a nice long visit but there is also a time when he is anxious to get to his hunting. This is a matter of judgment.
8. As soon as you leave you'll know whether you have both gained your point and gained a friend. If you are not sure, figure out how you could have made the contact better.

Operator Training.—Recognizing the need of operator training, the Divisions of Personnel Management, Fire Control, and Engineering in Region 5 have inaugurated an operator training program during the past year. Driver trainers who are skilled in equipment operation and safety are furnished through the Equipment Service Section of Engineering on a request basis to the various forests.

Each operator is given a driver's safety examination which consists of questions taken from the R-5 safety examination with some pertinent questions added. In addition to the written examination, the operator is put through a series of tests to show physical aptitude including foot reaction, field of vision, and depth of vision. He also participates in the oral examination and discussion covering driving rules, courtesy of the road, etc. Finally he is given an actual field test driving the type of vehicle for which he is being qualified.

A record is kept, not only of examination grades made by equipment operators, but notes are also made regarding reaction, vision, and results of the driving tests. All such records are turned over to the operator's superior officer with notations as to whether the operator should have more training, is qualified to drive, or has been disqualified and for what reason.

Special instructions and tests are given to operators driving specialized equipment such as fire tankers, pumpers, and tractors. After the original or first-of-the-season training schedule has been completed, the driver trainer concentrates on follow-up training of tanker operators not only in the operation of the unit but also in the care, lubrication, maintenance, testing, and adjusting of machines insofar as the particular operator is capable.

In facilitating the driver-trainer program, the chief driver trainer also certifies qualified personnel on the various forests as on-the-job driver trainers to take care of on-the-job testing of new personnel or replacements. The chief driver trainer on follow-up trips checks the qualifications of new operators when requested or the occasion and circumstances demand.

Whereas, this program was originally designed and justified on the basis of safety, it has been found very beneficial from a standpoint of obtaining proper use and care of automotive equipment and probably could be justified on the basis of its effect in lowering the maintenance costs of that equipment.—D. W. McFarland, *Area Superintendent, Arcadia Equipment Depot, Region 5, U. S. Forest Service.*

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HEADFIRES ARE COOLER NEAR THE GROUND THAN BACKFIRES

A. W. LINDENMUTH, JR., *forester*, and GEORGE M. BYRAM, *physicist*, *Fire Research, Southeastern Forest Experiment Station*

Temperature measurements of fires burning with and against the wind in the longleaf pine type on the Francis Marion National Forest in South Carolina indicate that headfires create cooler temperatures near the ground than backfires. This difference is important in the management of longleaf pine, because seedlings infected with the brownspot needle disease must be burned before they will start to put on height growth. These seedlings are usually in "the grass stage," less than 6 inches high. They will remain that size and virtually starve to death unless the infected needles are burned off. Thus, in a longleaf burn, attention is focused close to the ground. In contrast with burns in other species, fire in longleaf is expected to benefit, rather than kill, the seedlings.

To facilitate prescribed burning in longleaf, fire intensity measurements in the low zone were commenced in May. Because liquid thermometers cannot measure flame temperatures that run as high as 1,500° F., thermocouples were used. These were designed to integrate the effect both of temperature and its duration. This combined effect (in other words, the thermocouple reading) may be called the heat factor. It tends to be lower than the actual temperature, but rises with the length of exposure. This rise in temperature of vegetation will be proportional to the heat factor, the exact proportion varying with the size of the vegetation. It is this heat factor that determines the amount of scorching, leaf consumption, and mortality.

Observations shown graphically in figure 1 indicate that the maximum heat factor varies in the proportion of 1.25 for backfires to 1.00 for headfires. Also, maximum heat factor in both types of fires is reached at about 5 inches above the ground. Up to some 18 inches above ground, the heat factor of backfires continues to be higher than that of headfires. Beyond this point, as shown in the figure, the heat factor of headfires is higher. The actual point where the curves cross is at present tentative, and further field work may shift the location significantly.

The reasons for the heat factor differences in the two types of fire are unknown and probably complex. Both convectional and radiant heat are involved. A partial answer, supported by visual observations only, may be that in headfires combustion occurs at a higher level above the ground and that the fire line advances considerably faster.

The value of these tentative results will be tested in field trials. Ranger Koen, Fire and Improvement Unit, Francis Marion National Forest, who had anticipated the results, is carrying out a planned

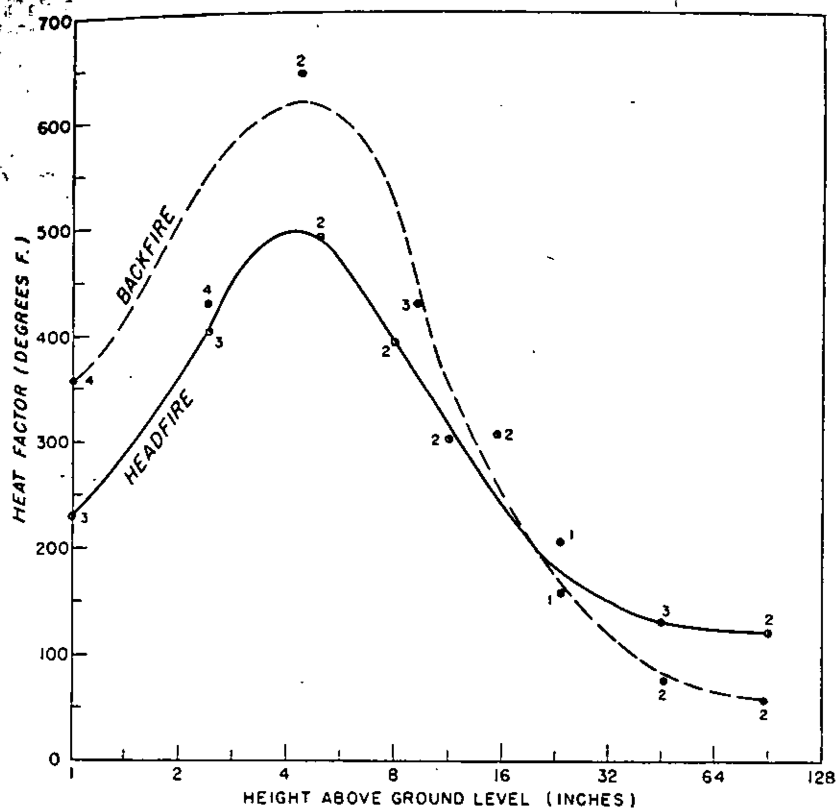

FIGURE 1.—A comparison of the heat factor associated with backfires and headfires, as measured at varying heights above ground level. Actual flame temperature is approximately 1,500° F.

burning program on a small scale to find out what use can be made of the information. In prescribed burning where it is desired to minimize damage to reproduction under 18 inches or so in height, headfires may prove more economical and effective than the backfires now so commonly used.

DROPPING SUPPLIES FROM SMALL PLANES

DEAN FIELD, *Pilot, Western Washington Aircraft, Inc., and* HUBERT O. WILSON, *Fire Staff Assistant, Mt. Baker National Forest*

We thought larger planes carrying a dropper were necessary in past years when supplies were dropped on fires; however, there are few ships of this size at the small airports that are available for our use. Two-place planes, with the pilot doing his own dropping, have been used with much success for servicing fire crews and lookouts on the rugged Mt. Baker National Forest. The small ships can maneuver in a smaller space and get down over small meadows in the valleys where a larger plane cannot. They have a slower cruising speed; therefore, it is easier to drop packages close to target.

Using only a pilot, we dropped 20,610 pounds of supplies in 1946 and 1947 from small planes. An average of five 40-pound packages were dropped each trip.

Dropping procedure for the pilot.—After dropping a package on the target, climb for a little altitude toward an open area so that you will not have to bother with flying the plane to any extent during preparation for next drop. Pull in the static line and tie to the rope ring of the next package to be dropped. Pull the package up over your shoulder and onto your lap, then ease the bottom of the package to the door and hold package by the top (fig. 1). When package is far enough out so that it is just tipped outward yet resting on door frame, it can then be held easily with the door frame supporting the weight, yet a slight push will send it down. Check the static line to insure its being free of rudder bar, stick, and other controls. When plane is in proper position, speed, and altitude over target, tip the bundle over the door frame and let it fall. Usually pull up and turn sharply so as to view the bundle falling to see if any change of timing is necessary for accuracy.

Safety factors.—Use clean sacks so that dust or other particles will not get into the pilot's eyes.

See that the static line is not fouled before dropping package.

Carry a knife to cut static line if necessary.

Fly another round if you are not in position to drop accurately; lost food does not help the fire fighters.

Keep tail high when package is dropped, throttle slightly retarded and maintain cruising speed by slight glide. Do not dive on target.

The food and supplies are packaged in a regular burlap feed sack, with a 13-inch-diameter disk of ¼-inch plywood in the bottom. A 7- by 7-foot burlap chute, with the shroud lines tied to the top of the sack by a square knot, is used. The chute is rolled with the shroud lines inside and tied with a 20-pound-test string to hold the chute roll.

These strings are sewed through the package sack with a sack needle and tied around the end of the chute roll. The string is passed through a rope ring (Molly-Hogan). A second string is sewed through package and tied around the other end of the chute, also going through the ring before tying. The static line that is fastened to the seat strut is tied to the rope ring. When the package is dropped, the rope ring breaks these string fastenings and pulls the chute out and open by another short string that is sewed to the chute apex and tied to rope ring. The package and chute float down leaving the rope ring on the static line.

FIGURE 1.—Dropping procedure: Upper, package and chute pulled from back seat; sack placed on door sill with chute inside plane; lower, package pushed out and downward as slip stream catches it.

AERIAL DETECTION ON THE SUPERIOR NATIONAL FOREST

J. W. Trygg
District Ranger, Superior National Forest

As we look back some 18 or 19 years, it is easy to see how inadequate our basic fire organization really was compared to our present day system. It was only a few years ago on the Superior National Forest, when the spotting and locating of fires through the eyes of the lookouts seemed to be perfection in fire detection.

The dispatcher at the district headquarters, acting largely upon his experience and intuition of how "bad" the day was to be, would line up the usual initial attack crew of 10 men equipped with hand tools and food supplies. When a fire was reported by a lookout, either by direct or relayed telephone message, the crew would start on its way, traveling by truck, boats, canoes, and on foot. A day or more was often spent in finding the fire. All this time, the fire burned on. As it grew, more reports were received from the lookouts and more men were dispatched only the disappear in the silence of the forest just as the first crew had done. No one at headquarters knew where the fire fighters were or what they needed.

Following World War I, flying became a pastime and private sea-going planes appeared on the lakes of the Superior. By 1929 it was possible to hire private planes to reach the otherwise inaccessible back country of the Forest. About this time the Forest Service realized the practicability of using planes for fire reconnaissance and during the next 6 years this practice was followed. The value of planes in fire work is indicated in the following narrative from the writer's personal experience some years ago:

As the lookout watched he saw a seaplane go by on its way to locate a smoke he had reported about an hour ago. In a few minutes the plane was returning the ranger and his smokechaser to headquarters with complete information about the fire. As the fire was already running, the ranger decided to send the smokechaser back to the fire with a pump operator, pump, and 800 feet of hose. The ranger felt much relieved at his action, yet he wondered if enough hose and men to handle the pump unit had been sent. If not—there wasn't room in the plane for more men and equipment—he knew it would take less than an hour for the pilot to return to headquarters for an extra trip.

The plane took off. After arriving at the fire the pilot had to help set up the pump and string out the hose. Within 15 minutes the head of the fire was stopped and the pilot was on his way back to the ranger station for additional help.

On the way back to the fire with three more men, two other fires that the lookouts had not seen were spotted. When the plane landed, the pilot reported the fires to the smokechaser. As the first fire was under control, the pump operator and one man were left to mop up and patrol. The pilot put his plane down on a small lake since one of the two new fires was only 100 feet from the shore. After leaving his last two men on this fire the smokechaser was piloted over the third fire which was about a mile away. This fire proved to be a lightning strike in a dry snag, and since there had been no rain with the lightning it might cause trouble. Knowing that the ranger had left his station to direct a 20-man crew overland to the first fire and also that all reserve manpower on the district had been dispatched to a large fire on an adjacent district, the smokechaser landed, walked across country for a mile, and alone extinguished the burning snag.

Through this and several similar incidents the Forest realized the use to which airplanes could be put in fire detection and suppression and in 1934 hired its first amphibian-type contract plane. This plane did not prove satisfactory. From 1935 to 1939 the Forest used a pontoon-equipped 4-place Stinson. While the Stinson proved to be a very good all around craft and satisfactory for initial action on small fires, it was not adequate for heavy cargo service.

In 1941 a Piper Cub was purchased and equipped with pontoons. In 1944, because the Stinson had been totally wrecked in a take-off accident, an 8-place Noorduyn-Norseman pontoon plane was purchased. This solved the cargo problem. The larger plane has worked out very satisfactorily as a capacity cargo transport and withstands the rigorous landings on rough waters.

The results of fire detection through the use of these planes led to the proposal of a detection experiment. The specific purpose of this experiment was to determine first, how effective aerial detection would be compared to that of regular lookouts, and second whether towers could be replaced entirely or whether a combination of the two systems should be used. The experimental detection was started in July 1945, and, with some changes, is still continuing.

In planning the use of aircraft for detection patrols, recognition should be given the elements that may disrupt the schedule of flying or affect visibility. These elements could well be listed as follows:

DISRUPTING ELEMENTS

Rough flying weather which taxes the physical stamina of the pilot and observer.

High winds causing exceptionally rough water on landing areas.

Time used for mapping a fire when located, and intensive checking of certain areas because of concentration of forest travelers, lightning storms, or other special risks.

ELEMENTS AFFECTING VISIBILITY

Reflected light on smoke, depending on overcast sky or shadows.

Position of sun. A wider coverage can be patterned when observation is toward sun.

Confusing haze with smoke.

Color of background.

Time of day. Evening glare and shadows.

Effect of wind on smoke rising above tree tops. Smoke is difficult to see when plane is directly over it.

Speed of plane.

The experimental detection area embraces approximately 1,000,000 acres. This area was previously covered by eight primary Forest Service towers as well as one Canadian tower and three State towers manned infrequently. The direct seen-area coverage from all these towers was less than 25 percent. A seen-area study that had been previously made indicated the need for 6 more primary towers, plus a large number of secondary points for periods of low visibility to get less than 40 percent coverage. Instead of constructing these additional installations, aerial detection was immediately instituted as the primary detection system and the existing towers retained as supplementary.

We now own three pontoon planes and have two regular pilots to fly them for the particular type of service desired. Flight circuits are predetermined to obtain an established pattern of coverage. The smallest plane, a 2-place Cub Coupe, is largely used for detection patrol, and is routed over the shorter circuit so that it can return within a short time. A 4-place Seabee is scheduled for the longer circuit. The third plane, an 8-place Norseman cargo craft, is used when it is necessary to fly initial attack crews and cargo to fires. The aerial service is further augmented by employing private aircraft for emergencies or whenever the Forest Service planes cannot handle the full task of aerial detection and suppression transport.

A number of conclusions have been reached as a result of the experiment.

Aerial detection is superior and more efficient than fixed towers in all cases where fires will remain in an incipient stage to allow for less frequency of detection. A sizeable degree of risk may also be allowed since an aircraft will provide more complete and accurate information upon which to base suppression action.

Fixed towers give more continuous coverage at more frequent intervals. In aerial detection this loss in frequency of detection is offset by the more complete direct seen-area coverage which makes possible earlier discovery after a fire occurs in flash fuel types.

Fixed towers have a pattern of detection time over high risk areas. Aerial detection offsets this because it is sufficiently flexible to allow for more frequent coverage. Furthermore, aerial detection is adjustable to cover changes in these risk areas within seasons and year-to-year changes in fire occurrence zones.

Fixed towers have a distinct advantage in immediately detecting fast starting fires in light flash fuels or slash areas. Under such conditions aerial detection will have to supplement these towers during periods of low visibility.

Since the pontoon-equipped plane serves as a type of watercraft, it immediately replaces the expensive power boats previously considered essential for travel over large bodies of water. Likewise, the number of other watercraft normally used for transporting crews to and from fires for other fire control work can no doubt be reduced to a minimum. The same situation has developed for other equipment, particularly in outlying fire tool caches.

Greater efficiency can also be accomplished in providing supplies, food, and materials for suppression crews.

In comparison, the direct cash outlay for airplane detection shows a substantial saving over the old method of tower detection and all that went with it.

In regard to whether or not towers could be entirely replaced or a combination of fixed and flying detection should be used, the following seems pertinent: Our experimental detection project has been operating on the basis of using aircraft as the primary detectors, while lookouts have served to supplement them. A failure in carrying out the schedule of flights and obtaining sufficient frequence in detection coverage obviously weakens the system. The manning of towers in key locations in areas of high risk, as well as where broad extensive coverage can also be made, serves well to offset the risks that may be prevalent when aircraft are not in flight. This has been resorted to during periods of high hazard. Such a system can be justified when a high frequency fire occurrence may be patterned within the seen-area field of the towers. Otherwise there is a duplication of detection unless areas covered by the tower are eliminated from the aerial zone.

In addition to all that has been revealed by the experiment, we have found that positive and reliable radio communication is absolutely essential to efficient detection service. Without such communication we lose all the advantage that has been gained through fast discovery by air. It is further essential that the central dispatcher or base of operations responsible for directing patrols maintain up-to-the-minute information from the observer and to correlate other flying needs.

Also, the basic qualifications and adeptness of an observer must be previously ascertained. His age and physical make-up will determine his ability to perform under all conditions, especially those of unusual physical strain that are frequently encountered. He must have good eyesight. He should preferably have had flying experience so that he has a proper perception of things he has to recognize from the air. A knowledge of the general formation of terrain, timber, and forest fuel types is essential. He should also be able to read maps, interpret aerial photographs, calculate the size of fires, and understand the operation and maintenance of a radio set.

As for the pilot, he must know from experience the comparative limitations he is up against because of the variety of situations and flying conditions. The operational problems of landing and basing aircraft on the waterways of the Superior region are unique in themselves. Each lake used as a landing base has its own peculiarities such as the effect of air pressures, and wind currents. The effect of wind on the water surface makes landings and take-offs uncertain at all times. The characteristic geological formation of rocky irregular shore lines and the elevations of surrounding hills and timber create major problems in landing on an unobstructed and safe flying strip. In short, the pilot must have "bush-born" experience with pontoon-equipped planes if he is to operate safely over the Superior country.

What the future holds for detection and suppression from the air is not all imaginary. The possibilities of the helicopter have already been proven. Fire fighters dropped from the air have passed the pioneering trials. Radio communication is being constantly improved. Water bombing and dry-iced rain are in the experimental stages. We might, however, well imagine future fire control fields involving radar detection and fire observance through televised portrayal. I wonder if 18 years from now we will think of our present detection system as antiquated as our present knowledge tells us our system of 18 years ago really was. Only time will tell.

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TRACTOR MUD TONGS

Fred G. Ames
District Ranger, De Soto National Forest

The tractor mud tongs were developed on the Chickasawhay District to help fire plow tractors, mired during fire line construction, out of bogs and marshy places.

The mud tongs, developed for HG Cletrac tractors, are used in sets of two, one for each track, and a set is carried on each tractor as part of its standard equipment. They are easily put on and taken off the track shoes.

A tong consists of two hooks, each made of 3/8- by 3½-inch flat iron and curved at one end to form a short flange, connected with about 2½ feet of 3/8-inch log chain (fig. 1).

A short distance from each hook a cold shut connects the chain so that a loop is formed in the chain. The cold shut serves to hold the hooks in place on the track shoe. It should be at such a place on the

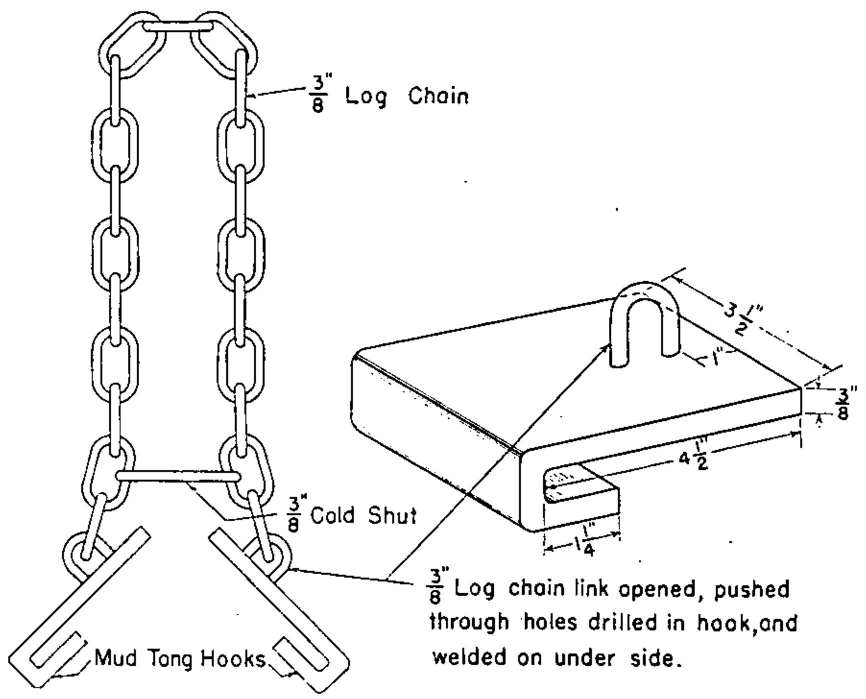


Figure 1.—Tractor mud tong. Log chain loop should have an odd number of links so that loop will not have a twist.

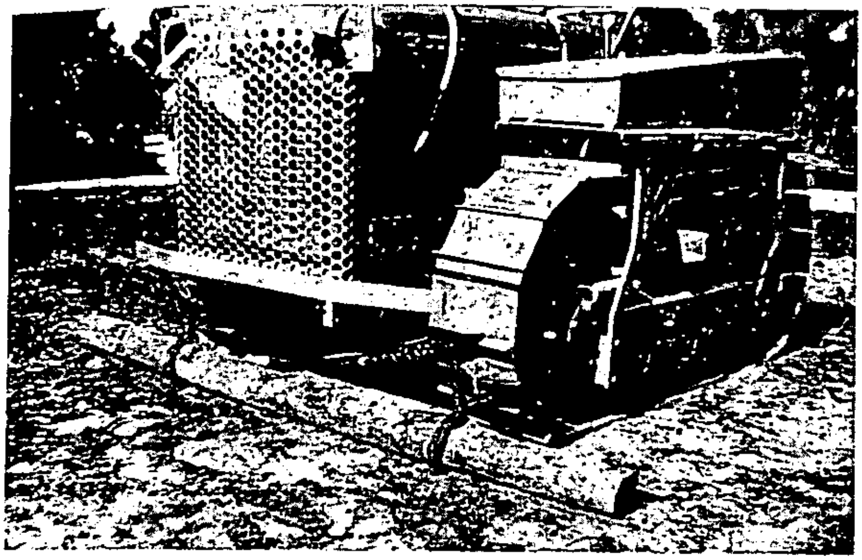


FIGURE 2.—Tongs in place with pole through chain loops.

chain that when the hooks are spread they will barely slip over the track shoe.

When the tractor mud tongs are attached to the tracks and a pole run through the chain loops, the tractor can be made to ride itself up on the pole and out of the mire (fig. 2). This method of riding a mired tractor out of mud is not new. But by use of these mud tongs much less time is consumed than by the use of the conventional pole and chain.

Why Tote a Back-Pack Pump.—Experimentation with a hand pump taken from a back-pack outfit, attached with fittings to a ½-inch garden hose 25 feet in length, the other end of which is attached to a valve fitted into a 50-gallon drum filled with water, proved that where a power pump is unavailable hand pump pressure can do a fairly good job of water dispersion.

For patrolmen or firemen pick-ups and jeeps, a 50-gallon drum of water secured in the bed, a 50-foot coil of garden hose, and a hand pump make action on small accessible fires convenient. A good supply of water is available and more freedom of motion is allowed.

With the 25-foot hose, the hand pump worked as efficiently 12 feet above the source of water supply as on the ground.—ELMER F. PETERSEN, *District Ranger, Sequoia National Forest.*

FUEL MOISTURE STICKS ARE ACCURATE

A. W. LINDENMUTH, JR., *Forester, Fire Research, Southeastern Forest Experiment Station*, and J. J. KEETCH, *Danger Station Inspector, Region 7, U. S. Forest Service*

Occasionally man's "better judgment" causes him to doubt the contributions of the devices or techniques now a part of our present civilization. Distrusting the compass when lost, for instance, is a good example. Such lack of confidence is not necessarily confined to the novice. It occurs from time to time also among the experienced, particularly in uncommon situations.

A system of fire danger measurement using Appalachian or slat type fuel moisture indicator sticks is a commonly accepted technique in use in the East and South from Maine to Texas. It is almost inevitable that sometimes under such a wide range of conditions the indications of the sticks at one or more of the 414 stations will conflict with the judgment of the observer or fire control officer. As complete confidence in the observations is essential for effective use of danger measurements, such doubts should be cleared up as soon as possible. The fire control officer wants to know that on a day like last April 18, when the moisture content indicated by the sticks varied less than one percent between Airey Tower on the Gulf in Mississippi and Ossippee Hill down East in Maine, that the effect of all the factors influencing fuel moisture content at those widely separated stations at that particular time was the same.

The fact is that the behavior of any single set of sticks compares and can be checked with an average of many sets. Curves showing the average effect of the two major variables of temperature and moisture content of the air provide a handy yardstick for this purpose. Such curves are available for limited conditions and a portion of them are reproduced here (fig. 1).

Strictly speaking, the temperature used should be an average of that of the upper and lower surfaces of the sticks. However, to avoid technical difficulties, an acceptable estimate can be obtained by exposing a regular mercury thermometer on top of the sticks for about 5 minutes. The result might be called the temperature on the sticks. Relative humidity, due to its general acceptance, is a convenient measure of the moisture content of the air.

On-the-spot checks were made with that technique in West Virginia last spring during station inspection and observer training. The data are shown in table 1.

At Sharp Knob on April 21, the wide range between actual and estimated moisture content indicates that something was radically wrong. A rain of 0.03 inch had fallen the night before. Conditions naturally were changing rapidly that morning. Under such circumstances the surface fuel moisture and the stick moisture were not in balance with their surroundings. Relative humidity provides a poor estimate at such times, so a period when conditions have been stable for some time should be chosen for checking.

The effect of wind on fuel moisture content is complex, but indicator sticks provide a simple means of measuring it. These observations expose two of the limitations of the procedure, as well as suggest two good reasons for continuing to use indicator sticks.

Another approach may be made by determining the actual moisture content of the surface litter and comparing it with the figure in-

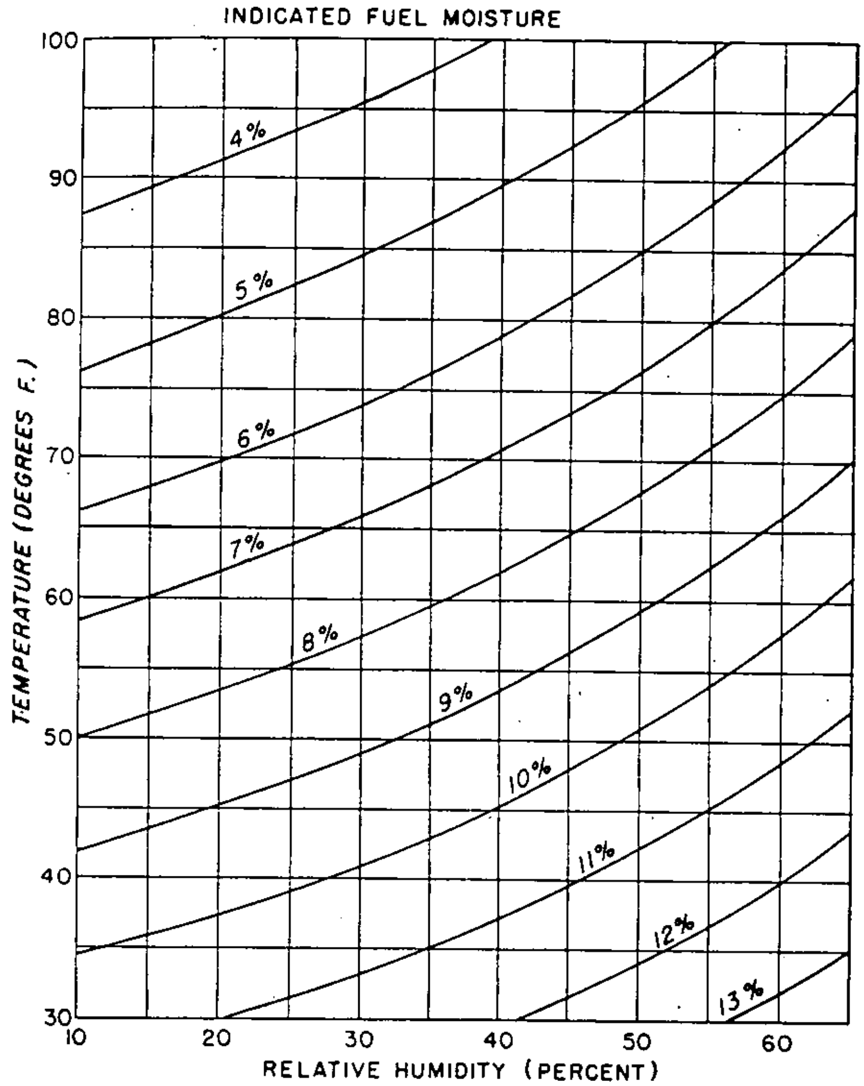


FIGURE 1.—Relation between the moisture content of slat type indicator sticks, temperature, and relative humidity under natural forest conditions during cured and transition seasons.

dicated by the sticks. This is a difficult job, particularly in pine country. Considerable care must be exercised in gathering samples to get only dead litter and only the top layer. Pine needles are inclined to intermingle with lower layers.

Surface litter samples taken on the Francis Marion National Forest in South Carolina on April 27 at 1 p. m. showed an average moisture content of 5.5 percent. Stick moistures at Bethera Tower were recorded as 7.0 percent at 12 noon and 5.5 percent at 5 p. m. Such close agreement seldom occurs, and it is possible only under very stable conditions. The sticks are intended to reflect changes in moisture content in the same degree as the litter but not necessarily the actual moisture content.

The fact that the behavior of each set of sticks almost always follows the group pattern is not merely a matter of chance. Basswood slat stock is purchased as free of defects as possible. Careful sorting upon receipt removes any other defective pieces which might not behave satisfactorily. These carefully sorted sticks are later exposed in the open until they lose 5 percent of their original weight. That step is necessary to overcome the initial period of rapid weathering. Later losses in service are small and can be offset by adjusting the dry weight of the set. Thereafter, the slats are oven-dried and grouped into sets of approximately uniform weights. Following that, the sets are tested at two prescribed temperature and relative humidity levels; whereupon all sets which show a departure of more than ±0.4 percent from the average are discarded.

Fuel moisture indicator sticks are not infallible, but the variation between sets should not exceed ±0.4 percent. The scale is accurate within ±0.25 percent at low moisture contents, and the weathering correction should offset weight losses within ±0.5 percent. Any

TABLE 1.—*Comparison of actual and estimated stick moisture content at various stations in West Virginia, Apr. 19–26, 1948*

Date	Time	Station	Relative humidity	Temperature	Wind velocity	Actual moisture content	Estimated moisture content
1948			*Percent*	°*F.*	*M.p.h.*	*Percent*	*Percent*
Apr. 19	11 a. m.	Huttonsville	19	78	0	5.2	5.2
Apr. 20	10 a. m.	Beaverlick	14	84	0	4.6	4.5
Apr. 20	3 p. m.	Neola	18	80	4	6.3	4.9
Apr. 21	11 a. m.	Sharp Knob	57	50	10.5	23.5	10.6
Apr. 21	4 p. m.	Cranberry	60	50	4	12.0	10.8
Apr. 22	1 p. m.	Mikes Knob	15	77	4	5.8	5.1
Apr. 23	11 a. m.	Bee Mountain	15	90	[1]	4.8	3.9
Apr. 23	4 p. m.	Kendalia	21	75	0	5.3	5.6
Apr. 24	10 a. m.	Buck Knob	24	87	0	4.5	4.5
Apr. 24	3 p. m.	Blair Mountain	12	96	[1]	3.6	3.4
Apr. 26	12 m.	Mingo Mountain	11	100	5	3.2	3.0
Apr. 26	5 p. m.	Tick Ridge	15	90	[2]	4.2	3.9

[1] Varying from 0 to 2.0.
[2] Varying from 0 to 1.5.

errors in excess of those amounts are usually due to improper handling or weighing.

All in all, checks in West Virginia, New Hampshire, Virginia, and South Carolina show that if care and precision are used in fuel moisture measurements, the record of individual sets of sticks compares significantly with the group average.

A Gee Whiz on Fire Line Construction.—The Gee Whiz, a horse-drawn spring tooth cultivator, has been used by farmers in the South for many years for working new ground. A few farmers have used it as a tool for fire line construction. About 1938 the Forest Service hired Louis H. Nowland, one of these farmers, as a lookout. He repeatedly asked why the Gee Whiz was not used on fires by the Forest Service but we stuck to the conventional Council tool and ax.

In March 1947 Mr. Nowland again brought up the subject during a fire inspection. The inspectors visited a farm where the farmer had built a Gee Whiz on a Roto-tiller garden tractor. It looked good, so the ranger was authorized to purchase one for experiment. A five-tooth Gee Whiz was purchased for $11. Several trial runs were made, with the ranger's pick-up for power. The pick-up had an extra low gear so it would travel slow enough for a man to walk behind it and guide the cultivator. These trial runs built some very good fire lines.

During these trial runs we found that the device worked best with the teeth set so that they turned the debris all in one direction. Also, when being operated by an inexperienced man, about 20 pounds of extra weight should be added to the Gee Whiz (to supply this weight a large stone was placed in the fork of the handles). The Gee Whiz showed up so well in the trials that we purchased two more. One of these has been placed with a warden tool cache and the warden has signed a rental agreement to use his mule and the Gee Whiz on fire suppression.

On March 11, 1948, the lookouts reported a large fire at 5 p. m. This was our first chance to use the Gee Whiz on actual line construction. The fire was coming up a steep slope to a long narrow ridge. Pine needles were 4 to 6 inches deep on the ridge. We took the pick-up as far down the ridge as we could and fastened the Gee Whiz to the back with a short piece of chain and started out. Seven minutes later two men, a pick-up, and the Gee Whiz had built 15 chains of fire line. One other man had backfired most of the line. About 4 chains had to have the second trip made over it to completely clear the line. No line was lost. The line was about 16 inches wide and went down into mineral soil about 2 inches.

The experience gained on this fire showed quite plainly that a man cannot handle a Gee Whiz at more than 3 miles per hour for more than a very few chains, so if a pick-up is used for power, it should have a truck transmission with four forward speeds.

On March 25, State Ranger Leroy Taylor drove up to a fire of over 200 acres. He had two men with him. At a nearby farmhouse he enlisted the help of a man and a boy, and the farmer's mule and Gee Whiz. There was a large amount of black jack oak limbs on top of a heavy accumulation of oak leaves and pine needles. It was necessary to make three trips over each segment of line. The first trip cleared off the brush and part of the leaves. The second cleared the line about 16 inches wide and 2 inches into mineral soil. The third was deadheading ahead to the next segment. One man drove the mule, one guided the Gee Whiz. The third backfired the line and the remaining two held the line and patrolled it. In 2 hours they constructed 50 chains of fire line through fairly heavy going. Taylor estimates it would have taken the five men approximately 5 hours to construct a line through that same location with Council tools.

The results of our experimenting so far have proved that the Gee Whiz is a good, cheap, light fire tool if it can be gotten to a fire with some type of power to pull it that can get around in the woods. The use of a pick-up truck for power is limited to the very accessible locations. It is often hard to locate a mule or horse that is available to pull the Gee Whiz. We hope to be able to try a jeep in the near future. It should be able to go over all but the very roughest of the country and will have more than ample power to pull the cultivator.—DON L. GERRED, *District Ranger, Talladega National Forest.*

BRUSH GUARD AND TIE-ROD PROTECTOR FOR THE JEEP

Solon Hyde
District Ranger, New York State Conservation Department

In the spring of 1946, the State of New York acquired its first jeep for use in forest fire control. It was felt that there would not be much advantage in having a jeep unless it could be used for transporting water, fire-fighting equipment, or supplies over terrain too rough or too steep to be negotiated by a conventional type of vehicle. Further, it was intended that this jeep would travel not only over rough steep going in open country, but when necessary, in brush or small saplings to the limit of its capacity to push through. To do this the jeep required protection. The result was the development of the brush guard and tie-rod protector shown in the accompanying illustrations.

Figure 1 gives a good general idea of the construction of the brush guard. This brush guard is made of two pieces of 3-inch channel iron, each piece being approximately 13 feet 3 inches in length. These pieces are joined together in front, where they are secured by 4 bolts to a U-shaped supporting brace, which is bolted to and projects

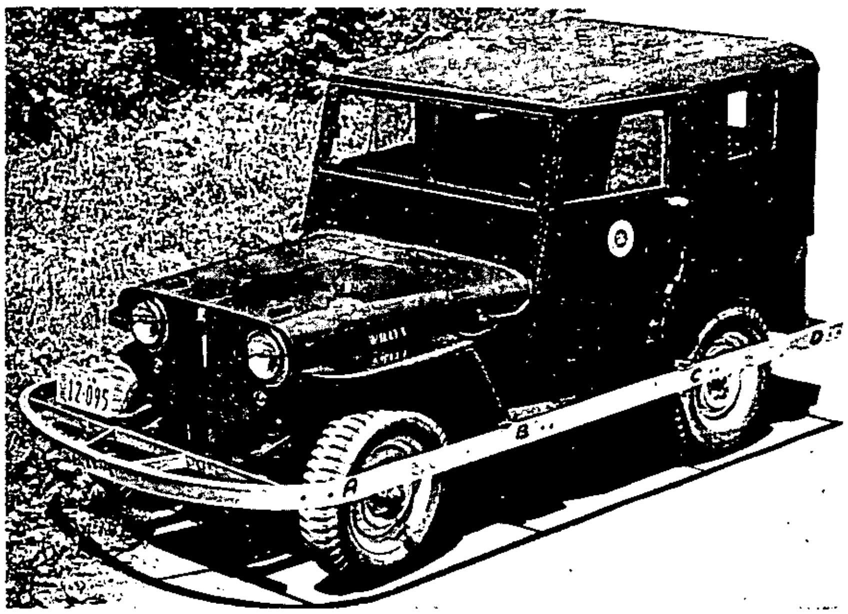


Figure 1.—Jeep of the New York State Conservation Department equipped with brush guard and tie-rod protector.

about 1 foot in front of the bumper. Other supporting braces are at points A, B, C, and D in the illustration. All braces except C are made of ½- by 2-inch iron. Brace C is made of ½- by 1½-inch iron, and goes through to the other side. It lies flat on the frame of the vehicle, is bolted to the top of the frame on each side, and then is twisted and shaped at each end to be bolted to the channel iron guard. Braces at points B and D do not extend through. Brace B is bent back and bolted to the side of the frame. Brace D is bolted straight to the rear of the frame.

Figure 2 shows the construction of the tie-rod protector from below. This consists of an iron plate 16 by 20 by ⅛ inches, reinforced by 3 heavier iron braces. The 2 outer braces are ½- by 1½-inch iron, the middle brace ⅜- by 2½-inch iron. The front of this assembly is bolted to the bottom of the jeep bumper, and the rear

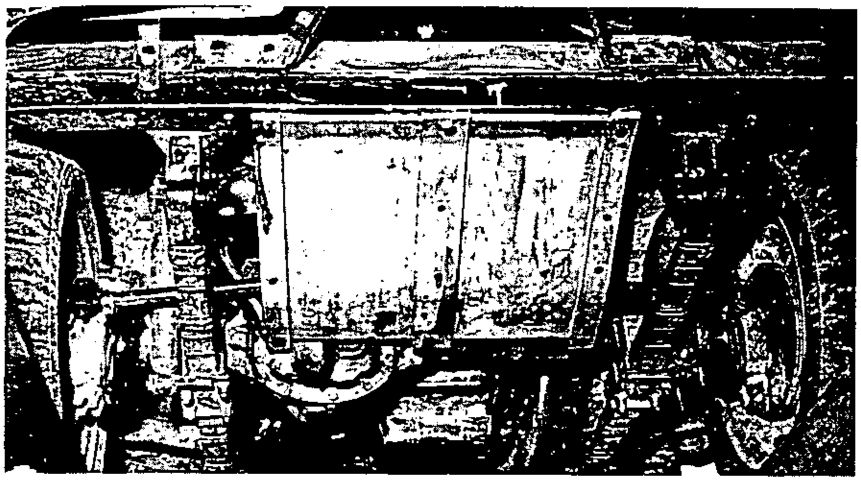


FIGURE 2.—Tie-rod protector from below.

to the supporting brace which bends upward on each end to be bolted to the frame of the car. This rear support is made of ½- by 1½-inch iron.

It will be noted that no dimensions other than sizes of iron used in construction have been given. The only important dimension is the complete over-all outside width of the brush guard. While it is desirable that this be as narrow as possible, it must be wide enough to permit maximum turning of the front wheels, and also to permit the removal of a wheel to change a tire. It was found that 70 inches over-all width, with 3-inch channel iron for the guard, was about the minimum. This width is about 2 inches wider than necessary to permit the full cramping of the wheels, but it is necessary for the use of tire chains on the front wheels and to permit the removal of any wheel. However, using an over-all dimension of 70 inches does not permit the removal of a wheel unless the vehicle is jacked up with a bumper jack applied to the brush guard, thus letting the wheel sag sufficiently so that it may be readily removed. The necessary clearance between the inside of the brush guard and the front tire is 6 inches.

No cost data are available on the construction of these protective features. The need for the devices was recognized. One of the rangers, who is also a good blacksmith, was assigned to the job, and with the help of a couple of other rangers produced the results on our first jeep in a matter of 3 days. The material used on the first one was on hand. No drawings other than rough sketches were made and there were no calculations regarding stress and strain. The idea was "Be sure it is strong enough." No holes that might weaken the frame had to be drilled. In most cases it was possible to attach supporting braces to existing holes in the frame.

The first jeep so modified was subjected to rigid tests, and the protective guards stood up. Three more jeeps have been equipped in the same manner. The vehicle illustrated recently delivered water on a fire where one would think that only a crawler type tractor could go without suffering major damage. Lacking these protective devices, the jeep would never have been considered by the ranger for driving to the site of this fire.

Equipment Service in the Region 5 Emergency Fire Plan.—In Region 5 the servicing of equipment is conducted on a centralized basis. The Region is broken down into three areas. Each area has a central equipment depot and repair shop, with a branch shop on most forests. A superintendent has charge of equipment assignments in the area as well as the general overseeing of repair shops.

In addition to carrying on the various duties incident to equipment repair, the Equipment Service is geared to the emergency fire organization through the fire zone dispatcher who requests services when a forest is unable to handle the job with personnel and equipment already assigned.

In general, depot overhead, mechanics, truck drivers, and such clerical help as may fit into the fire organization are split into two teams. One team is on call 24 hours per day for 7 days, at the end of which period the second crew takes over on an uncalled basis. This gives a crew of overhead with a properly selected working crew to start required action upon call from the zone dispatcher.

In addition to the stand-by personnel, certain equipment is kept on hand at the central equipment depot. A typical roster of stand-by equipment would be as follows: 2 transport trucks, 2 D-7 tractor trailbuilders, 1 convoy luber, 1 fuel truck, and 4 stakesides.

In the stand-by crew are usually a tractor mechanic and a pumper mechanic who are available to accompany equipment to a fire. The on-call crew mans the transport truck, convoy luber, and fuel truck. The stakeside trucks and tractors are usually manned by zone personnel.

The off-call crew will, in most cases, be available immediately on call or within 1 to 3 hours after they are contacted unless permission has been granted to be out of contact for a longer period.

In the forest branch shops, the shop foreman cooperates with the forest fire control officer or dispatcher in setting up the fire organization. On large fires, the forest shop foreman is usually instructed to report to the fire camp to take over equipment repair and servicing for the transportation officer. Mechanics and helpers furnished from either the depot or other sources are usually placed under his jurisdiction.

In the foregoing capacity, the Equipment Service personnel relieve the zone dispatcher of a considerable amount of work incident to placing equipment on large fires; also they act to obtain equipment from other areas and to provide rental equipment from outside sources in case the need of the area in question exceeds the equipment available. It is evident that the area superintendent must not only know sources of Forest Service equipment but also keep his fingers on possibilities of commercial rental equipment.—VERL JEFFREY, *Acting Equipment Engineer, Region 5, U. S. Forest Service.*

BROKEN HANDLE REMOVER FOR SINGLE AND DOUBLE BIT AX AND PULASKI

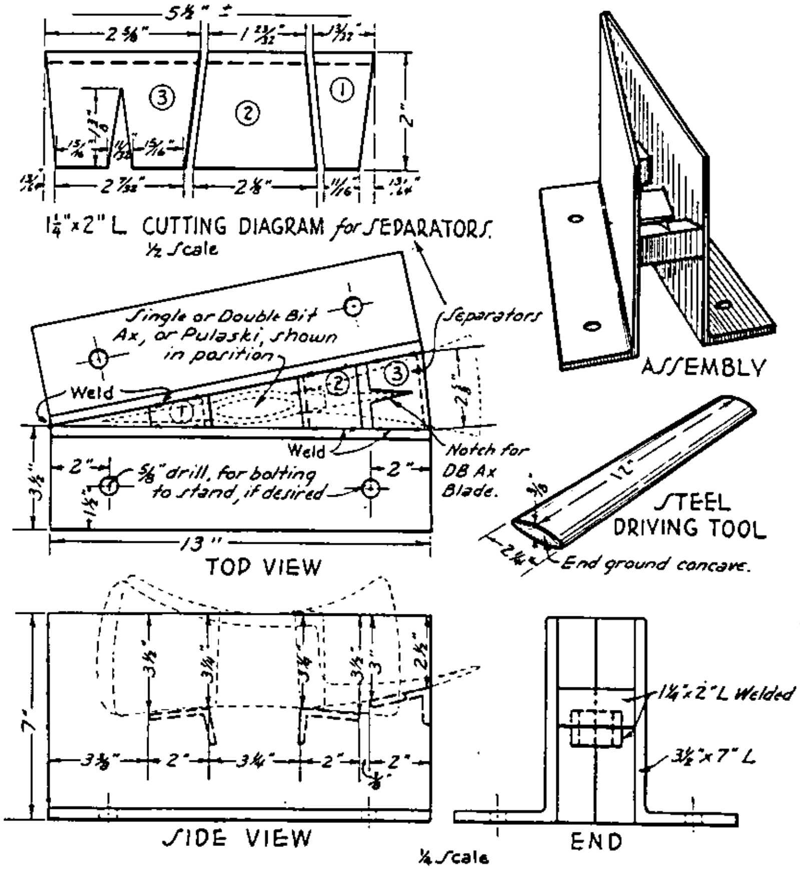
Division of Fire Control

Region 4, U. S. Forest Service

A safe and fast method for removing broken ax and Pulaski handles from the tool heads has been developed by John Nasi and Tom Coski of the Payette National Forest and F. E. Powers of the Salmon National Forest. The idea originated in Region 1.

The broken handle remover consists of a holder, in which a head from either a double or single bit ax or Pulaski may be placed, and a steel driving tool. To remove the broken handle saw off the handle flush with the ax head, then place head in holder and drive out the wood in the eye with the driving tool. Holes may be bored in the end of the eye wood to aid in removing stubborn wedges.

The remover can be made of hardwood bolted together; inside dimensions should be the same.



EXPERIMENTAL TRIAL OF WETTING AGENTS

DIVISION OF FIRE CONTROL

Region 9, U. S. Forest Service

About a year ago five forests in Region 9 were furnished with small supplies of a wetting agent for experimental purposes. While only three of the forests have reported, and one of these has only tested the material on a brush pile fire, all were quite enthusiastic over the results obtained and the possibilities of a wetting agent for effective fire suppression. Excerpts are quoted from their reports.

MARK TWAIN NATIONAL FOREST, MO.

"Solutions were used in back-pack pumps by fire fighters on approximately 20 fires during the recent fire season. Their observations are as follows: Both 1-percent and 2-percent solutions were more effective than water in all types of fuel.

"These solutions were found to be especially valuable in knocking down hot spots, extinguishing spot fires, and in checking spread until the line could be constructed. The solution seemed to go farther and to hold a fire in check much longer than water did. These were particularly important features on high danger days with strong shifting winds. The solutions had greater penetration than water, which made them very effective in deep leaf litter, our most common fuel. Probably because of its penetrating quality, the wet water will extinguish faster and hold a fire in check longer than plain water. This was noticeable in the heavier fuels such as oak slash and snags. In line construction, line holding, and in mop-up, the solutions were very definitely superior to water.

"The 2-percent solution seemed much more effective than the 1-percent solution. It is estimated that it compares in effectiveness with the 1-percent solution as the latter compares with water.

"Although several of the back-pack pumps held the solutions for weeks, there was no apparent corrosion of the galvanized lining. This, however, may not have been a sufficient test of the corrosive properties of the solution. If corrosion will not occur or can be prevented, it would be very desirable to use the 2-percent solution in the pumper units."

CHIPPEWA NATIONAL FOREST, MINN.

"It so happened that we did not have an opportunity to use the solution on an actual fire. However, one of our Rangers experimented with it in extinguishing a brush pile fire on a road clearing job this fall. The brush pile was burning well and one application of the solution resulted in complete extinguishing of the fire. It appeared to do a very good job of saturation.

"This forest also experimented with the use of other wetting agents. These were also found to be satisfactory, but were more difficult to mix."

LOWER MICHIGAN NATIONAL FOREST, MICH.

"The Mio District had an opportunity to give wet water a good trial on the McNeely, Class C, fire which occurred on Sunday August 17.

"This fire started in the middle of a large area of jack pine slash produced a year ago. The fire danger at 9 a. m. was 21, at 1 p. m. the danger was 39. The fire started at about 11:30 and was reached shortly after noon. The greater part of the suppression work took place near 1 p. m. so it would be safe to say the fire danger during the suppression period was 39. There was an 11-mile wind at about 1 p. m. and at times there seemed to be gusts of wind of higher velocity at the fire. It had been 15 days since a rainfall of 0.01 inch had occurred. The humidity at 1 p. m. was 48 and at 5 p. m. was 46. The fire was held to 23 acres, of which practically all was slash covered. Individual trees were observed to crown, but the crown fire never carried from tree to tree. The area had been cut over and there was only a light stand left which probably helped prevent the crown spreading.

"The fire spread across full width furrows and we were unable to stop it with only water in the back-pack pumps. After the fire would be knocked down it would seem to dry out and start up again. I then brought in our pumper and put the 10 gallons of wet water in the 200-gallon tank, a rate of 1 gallon of wet water to 20 gallons of plain water. We used the pumper and hose on some piles of burning slash and on burning snags and stumps with very satisfactory results. We filled the back-pack pumps with the wet water mixture and found that when the spreading ground fires were extinguished with the wet water they stayed extinguished. By the time we got the wet water into action a large number of volunteer fire fighters had been recruited or had reported without request so we had sufficient men to handle the available back packs with the wet water and we soon had the fire under complete control.

"Considering the fuel conditions, the burning index, and the comparison with the plain water we were all convinced that the use of the wet water was well worth while and that we should secure additional supplies for future use and test. If we find that the wet water is not any more corrosive than plain water, I would advocate having all of our first run equipment supplied with it at all times."

HUSKI GARDENER FIRE PLOW

R. F. IRWIN
District Ranger, Trinity District, Davy Crockett National Forest

The Huski Gardener is a two-wheeled garden-type tractor with a Briggs-Stratton gasoline engine for power. It was first used in Texas by the Texas Forest Service, who developed the plow attachment with 12-inch rolling coulter and front brush guard. Two of these plows were secured by the U. S. Forest Service for experimental use in Texas, in October of 1947.

The following items have been added to the original Texas Forest Service plow: Brush guard over handle bars to protect operator; prestone solution in tires to increase weight; 6-volt battery and headlight for night work; 4-quart canteen in a rack; backfire drip torch; 4-pound double-bitted ax; fire rake; tool box containing Allen wrench, first-aid kit, snake-bite kit, pocket compass, map, notebook, pencil, and 4-cell electric head lamp. Cost of the Huski plow tractor was $300; the plow, coulter, and brush guard, $150; and the battery, headlight, and tool brackets, $25.

The Huski plow is 29 inches wide and will fit into a 48-inch pick-up bed, allowing a 17-inch tool box to be mounted on one side of the bed (fig. 1). The Huski plow unit consists of a pick-up truck loaded as

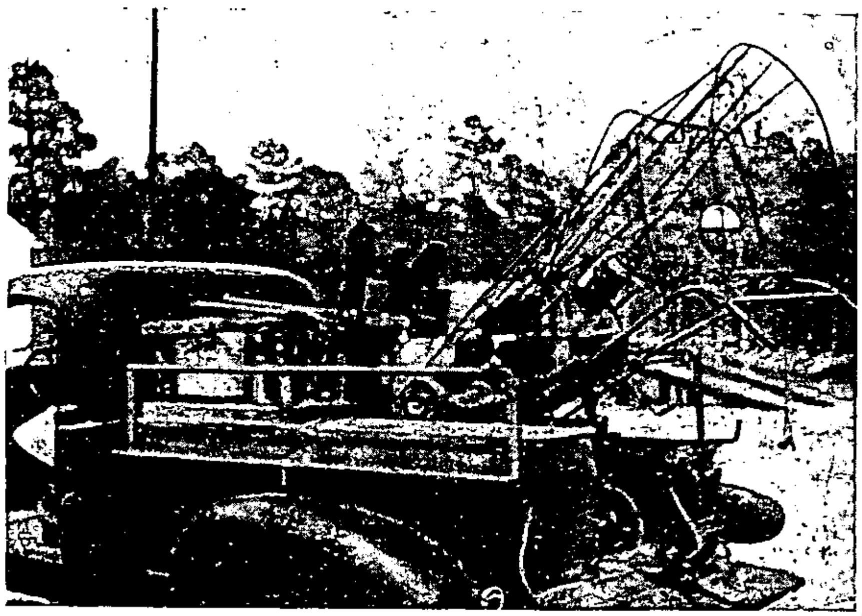


FIGURE 1.—Huski plow unit loaded on pick-up truck.

follows: The usual tool box carrying 4 fire rakes, 1 shovel, 1 double-bitted ax, 1 4-quart canteen, 1 portable phone; a back-pump crate which contains two 5-gallon back-pack pumps and two kerosene lanterns; a 55-gallon drum of water with rotary pump for filling back cans; a sled for carrying the water drum, and the Huski plow. This load weighs about 900 pounds.

A significant value of this unit is that two or three men making a quick getaway to a fire can strike with the working equivalent of seven to ten men far sooner than such a force of hand-tool men can be gathered and transported to a fire (table 1).

Some advantages of the Huski plow unit are as follows: Plow is light and flexible. It can be transported any place a pick-up can go. The plow can be walked across country at a rate of 1½ miles per hour, and it will plow a line 18 inches wide at a rate of 40 to 80 chains per hour in shortleaf-loblolly pine type with moderately dense underbrush. The motor is so geared that the wheels keep turning when the plow is "hung," and the motor is seldom choked from overloading. The plow will replace 5 to 8 men using fire rakes, depending upon conditions.

By means of a "wooddeck" loading ramp, the plow can be loaded from the storage shed in less than 5 minutes. This eliminates the need for a stand-by pick-up truck. Cost of operation is almost negligible since one gallon of gasoline will operate the plow for 2 to 3 hours, and the motor requires only 1 half-pint of oil every 25 hours of operation.

TABLE 1.—*Summary of the use of Huski plow on seven fires in flat country*

Fire class	Soil type condition	Ground cover	Number of men in crew	Chains of line per hour	Remarks
B	Dry, sandy	Sl-loblolly pine, medium underbrush.	5	96	Good line.
C	Very dry clay and some sandy loam.	Open pine, heavy grass.	5	30	Only fair line: dry clay soil difficult to plow. Gullies present.
C	Very dry, sandy	Sl-loblolly pine, dense underbrush.	2	30	Night, only fair line.
B	do	Sl-loblolly pine, light underbrush.	2	80	Very good line, held 30 chains in ½ hour with 2 men.
B	Damp bottom-land.	Bottom-land hardwood, no underbrush.	2	88	Night, good line.
B	Moist, sandy	Sl-loblolly pine, medium underbrush.	3	60	Good line.
B	do	do	2	50	Fair line, had to stop plow to backfire.

Some disadvantages of the plow unit are as follows: Plow must be operated by a man walking. In heavy underbrush this is strenuous work and wears out the operator very quickly. The tractor has a very delicate clutching system and has no reversing gear to back it up when the plow hangs. After installation of 6-volt battery and headlight, plow became somewhat top-heavy. An unskilled operator will have occasional upsets.

It has been determined by actual use that a skilled operator using the Huski fire plow, can build a good 18-inch fire line at the rate of 40 to 80 chains per hour in shortleaf-loblolly pine type, with moderate underbrush. The operator should be assisted by an axman in the lead to clear out logs, and a man with a fire rake behind the plow to clean out skips and "roll backs." There should be a fourth man for backfire, although, on the small fires either the rakeman or the axman can drop back to handle the backfire.

In conclusion, it is believed that the Huski plow is well worth the cost. Correction of clutch difficulties and training of two skilled operators to go with the plow to each fire should make it a very successful piece of fire control equipment. The plow is suitable, principally, for operation in light sandy soils of the shortleaf-loblolly pine type with moderately dense underbrush.

Use of SX Radio in Aircraft.—To obtain air to ground radio communication on the Los Padres National Forest by the use of regular U. S. Forest Service radio equipment the SX type portable two-way radio has been found to work satisfactorily. This equipment has been used during approximately 900 hours of flying on the forest with better than 95 percent of plane to ground calls completed. Calls averaged four per hour of flying. The equipment naturally does not compare with that designed for aircraft, but is practical, especially in the infrequently used contract ship.

Several types of antenna set-ups are possible. In most aircraft the regular antenna wire may be attached to either the tail or wing assembly and strung through the window of the plane directly to the radio. On some types (Beechcraft Bonanza) it may be necessary to attach a permanent L-shaped clip to the wing tip in order to have something to which to tie the antenna. Wire should be fairly taut to avoid whipping.

On the Stinson "Voyager" the standard aircraft antenna may be utilized by soldering a 6-inch piece of extension aerial to it and extending this wire through the zippered inspection slot above the pilot's head. A convenient length of wire then connects this to the radio. No adjustment of the radio has been found to be necessary to accommodate it to the plane antenna. The aircraft radio must be turned off before SX aerial is clipped on or the tubes of the SX will be blown out.

The radio is operated in any convenient location in the ship. Ear rubbers on the headset are required to exclude plane engine noise.

With some practice by the operator and cooperation from the pilot it is felt that no aerial observer should be without radio communication when any regular Forest Service crystal controlled portable radio set is available.

It must be taken into consideration that the SX radio was not primarily built for use as an aircraft receiver and hence is not as efficient as a commercial receiver, however until we can get a better piece of equipment the SX will be the only radio in use on the Los Padres aerial project this season. WARREN E. BARNES, *Fire Control Officer, Los Padres National Forest.*

Meeting A Fire Situation.—The fire boss has to consider many factors, analyze and correlate them, and make his decisions in order to be assured of a successful plan to control a fire. The failure to take into account any one of the factors can easily mean the difference between catching the fire promptly and losing it. The need for prompt but sound decisions is all important due to the rapidity with which fires can spread and cause damage. The fact that a forest fire presents an emergency situation often results in the fire boss or his staff overlooking some of the factors.

The following outline or check list was worked out at the advanced Regional Fire Strategy and Organization School to aid the trainees in making a complete and systematic plan for control of the fires presented in the course's big fire problems. It is the joint product of the instructors and fire men who attended the training sessions. The outline resulted in better planning and it was agreed generally that the fire boss and his staff could make good use of such an outline when actually on a fire.

P PROBLEM
- a. Fire facts (inventory)
  - 1. Behavior of fire:
    - (past)
    - (present) Time of day and year
    - (predicted)
  - 2. Weather
    - Wind:
      - (velocity)
      - (direction)
      - Times
    - Humidity
    - Fuel moisture
  - 3. Topography
    - Features—ridge, saddle, river, etc.
    - Slope
    - Barriers
    - Culture—roads, trails, firebreaks, etc.
  - 4. Cover
    - Type
    - Density
    - Continuity or changes
    - Values
    - Control accomplishments
- b. Facilities for fighting the fire (inventory)
  - 1. M a n p o w e r, overhead, equipment, tools
    - Kind
    - Quality
    - Quantity
  - 2. Production rate
  - 3. When available

A ANALYSIS OF SITUATION
- Consider, correlate, and calculate elements applicable to the fire

P PLAN
- a. Line
  - 1. Strategy and broad tactics by individual sectors
  - 2. Alternate plans of control and conditions requiring their use
  - 3. Time action is to be completed—p r i o r i t y, sequence
  - 4. Assignment of overhead, manpower, tools, special equipment by sectors
  - 5. Reserve forces available
- b. Plans
  - 1. Information to be gathered and time required
  - 2. Records to maintain
  - 3. Assignment of personnel and facilities
- c. Service
  - 1. Services to be provided—quantity, location, and time
  - 2. Assignment of personnel and facilities

E EXECUTION
- a. Convert plan into action
  - 1. Brief personnel
  - 2. Dispatch personnel
  - 3. Provide follow-up supervision

R REVIEW AND REMEDY
- a. Check—each step from inventory to execution
- b. Inspect performance and accomplishments
- c. Modify plan promptly to meet changed conditions, errors, or omissions

One feature of the outline is that it has a catch word "PAPER" to make it easier to remember the main steps and their sequence in meeting a fire situation; P for problem, A for analysis, P for plan, E for execution and R for review and remedy. This is a patterned after a similar device used in many Air Corps check lists.—George M. Gowen, *Forester, Region 5, U. S. Forest Service.*

PROBLEMS OF FIRE PROTECTION ON REFORESTED STRIP-MINED AREAS IN INDIANA

S. J. HENSLER and J. H. WINCHELL
District Foresters, Indiana Division of Forestry

Foresters in Indiana are viewing with some concern the problems in fire protection on some 14,000 acres of stripped coal lands that have been or are being reforested. The Strip Mine Act of 1941 requires that strip coal mine operators revegetate all land stripped (fig. 1) since the enactment of the law. At the present rate of stripping more that 2,500 acres will be planted annually with trees (fig. 2). The chief difficulty is in the uncertainty of just how severe or mild the fire protection problems will become as the trees get older and complete timber cover is accomplished. At the present time the problem of fire protection in these lands is not significant of anything that might happen in the future. There are no cases on record where a fire has swept over spoil lands to destroy a natural cover or a plantation of young trees. Fuel conditions conducive to burning are in general lacking on most stripped areas. Even the older plantations 15 to 20 years in age do not have as yet an accumulation of duff which might be considered a severe hazard. Just what will happen when these plantations, which are principally pine, advance in age and leaf litter and dead branches accumulate remains to be seen.

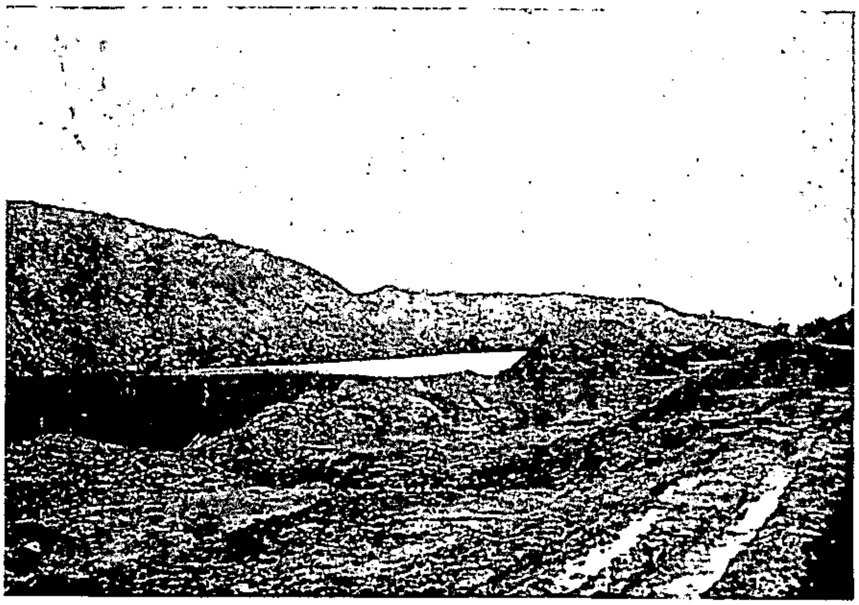


FIGURE 1.—Stripped area before planting. Note the long, narrow lake.

FIGURE 2.—A typical young pine planting on a strip-mined area.

The stripped lands from a fire protection standpoint have several factors in their favor. Most areas have long narrow lakes sometimes a mile or more in length which will act as natural fire barriers. Deep box cuts in many cases separate the stripped areas from adjacent flat lands and will act as fire barriers. Old haulage roads will act as barriers also and provide, to some extent, access to the areas. Another factor which from the surface is not readily apparent but has been definitely established is that soil moisture conditions are higher in the strip bank than on adjacent unstripped areas. This might indicate that fuel moisture conditions will also be high.

On the other hand there are several factors which can add to the difficulties of fire protection.

As already mentioned the reforestation of stripped lands has been largely with pine species. These of course constitute a more severe fire hazard than hardwood species. Most areas will offer little encouragement toward the use of any mechanized fire equipment as the terrain in most cases is forbidding. Unless access roads or fire lines are constructed the fire fighting will be limited to the use of hand tools.

The area of the stripped lands does not come under the surveillance of the present tower detection system and this along with access roads and fire lines will have to be planned.

Present trends point toward heavy use of stripped lands for recreational purposes. Many lakes on these lands are already intensively used for fishing and boating. Many areas offer attractive sites for cabins and will no doubt be more fully developed for this purpose in the future.

With a heavy influx of recreationists during periods of high fire danger the problems of fire protection will no doubt increase.

The State Division of Forestry feels that any problems in fire protection which are peculiar to these areas will be solved with the excellent cooperation of the coal operators.

VEGETATION TEMPERATURE AND FIRE DAMAGE IN THE SOUTHERN PINES

George M. Byram

Physicist, Fire Research, Southeastern Forest Experiment Station

It has long been known that pine stands in the South are more severely damaged by late spring or summer fires than by winter fires. The usual explanation is that a stand is most susceptible to fire injury during the growing season, or that dormant trees during the winter season are least susceptible. It is also thought that summer fires are hotter than winter fires.

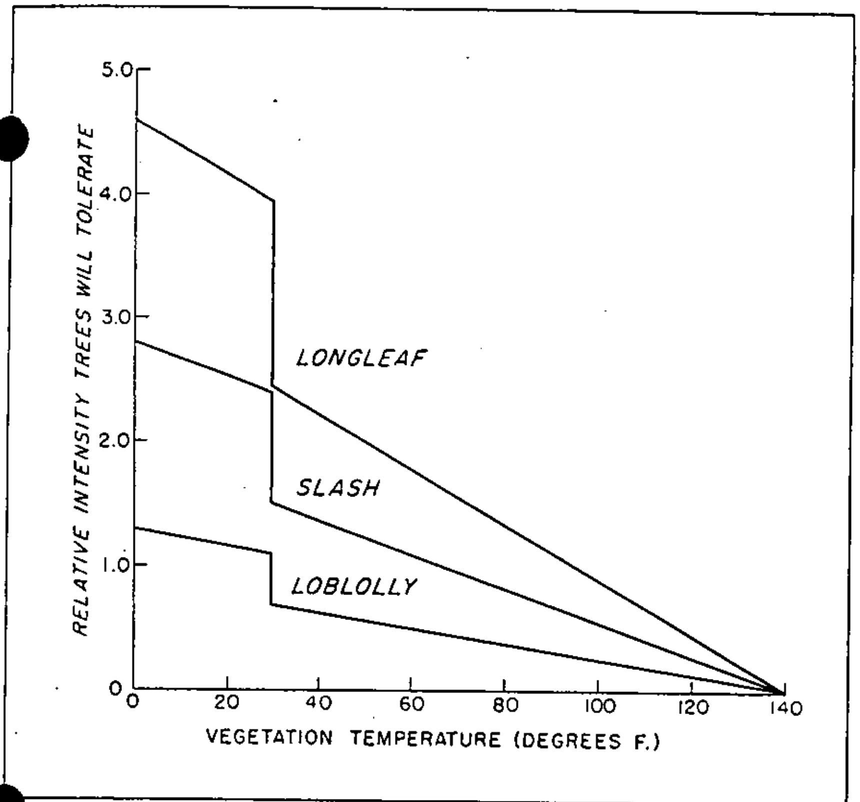
Summer fires probably do have a somewhat higher intensity than winter fires. It is also likely that pines may be slightly more susceptible to injury during certain periods of the growing season. However, a theoretical analysis of the factors contributing to fire damage has shown that other factors may be considerably more important than the two just mentioned. The details of the analysis are outside the scope of this discussion, which will concern the results of the analysis rather than the technical aspects of its development.

The lethal temperature for plant tissue is in the neighborhood of 140° F. It may be assumed that the buds, needles, and branch endings of a pine will die if heated to a temperature exceeding 140°. An analysis of the lethal effects of fire, therefore, reduces to an analysis of those factors which directly or indirectly affect the temperature of the susceptible parts of a tree. Of these, the initial vegetation temperature may be one of the most important. The temperature of the foliage of a pine in bright sunlight may exceed 105°. Therefore, an increase of only 35° would be required to reach the lethal temperature, and the absorption of a relatively small amount of heat by the foliage would accomplish this. On the other hand, the foliage temperature might be only 35° or 40° during a cold period in winter. Under these conditions considerable heat would be required to raise the temperature up to the lethal value of 140°. A fairly intense fire during cold winter weather might therefore do no more damage than a low intensity fire in hot summer weather. The same comparison might be made between hot and cold spells both occurring in the winter, or both occurring in the spring.

Theoretical curves in figure 1 show the relative fire intensities that longleaf, slash, and loblolly pine should tolerate at different temperatures. At a temperature just above freezing, any one of these pines should tolerate a fire more than twice as intense as it would on a warm day when the vegetation temperature is 95°. One of the most noticeable features about the curves is the sudden increase in a pine's heat tolerance at temperatures below 29°. At this temperature, since most of the water in the needles and buds would be frozen, large quantities of heat would be required to convert the ice back to water. At a temperature of 29° pine foliage should tolerate a fire about four times as intense as at a temperature of 95°. Some field men have noticed that cold weather fires have resulted in much less damage than might be expected.

Curves for hardwoods should be very similar to those for pine, except that their heat tolerance would be lower. In stands managed for the perpetuation of pine, hardwood sprouts could probably be girdled most effectively by burning in hot, sunny weather.

Another important factor associated with temperature changes in the crown of a tree concern the morphological characteristics or "geometry" of the needles, buds, and branch endings. The rate of temperature rise in these susceptible parts is inversely proportional to their size. When they are massive and heavy, they will not reach as high a temperature as when they are thin and light. This may explain why suppressed trees, the susceptible parts of which are dwarfed and of small volume, are more easily killed by fire than vigorous trees of the same size. It may also explain why longleaf pine is less susceptible to fire than other species of pine. Also the terminal buds of long-



GURE 1.—The theoretical relation between vegetation temperature and a tree's heat tolerance. Heights of these curves represent the relative fire intensity that slash, longleaf, and loblolly pine will tolerate at different vegetation temperatures. The three species of trees are assumed to be of the same size

leaf are surrounded by a protecting sheaf of needles which retards a temperature rise in the bud.

The following tabulation shows the diameter in centimeters of the terminal buds on longleaf, slash, and loblolly pine. Susceptibility ratings are given in the third column. These ratings are found by taking the reciprocals of the values in the bud-diameter column.

Species:	*Bud diameter*	*Fire Susceptibility*
Longleaf pine	1.16	0.86
Slash pine	.72	1.39
Loblolly pine	.33	3.00

The relative positions of the three curves in figure 1 were determined by the diameters of the terminal buds in the three species.

Wind is another important factor affecting the temperature of vegetation exposed to radiant heat. Wind has a conductive cooling action on buds and needles, which reduces the rate of temperature rise. Men who have done much work with prescribed burning usually consider wind the most important factor in the amount of scorch they are likely to get. Unlike temperature, many of the effects of wind can be readily observed. A sudden shift in the wind can convert a low intensity backfire into a high intensity headfire in a few minutes' time.

Some of the effects of wind are not yet well understood. It is known that scorching is severe when a fire burns in calm air. In this case, lack of turbulence permits the hot gases to pass straight upward in a more or less streamline flow. However, recent thermocouple measurements indicate that there may be additional reasons for the scorching in calm air. When a line of fire passes under a tree, the foliage is subjected to two peaks of intensity. One peak is the result of radiant energy from the approaching fireline; the other is caused by convective heat from the burning gases. For a backfire the peak for radiant heat comes first, and for a headfire the peaks occur in reverse order. In calm air they occur simultaneously.

It is difficult to compare the relative importance of wind and temperature because their effects are interrelated. In a headfire, wind increases the fire intensity by speeding up the combustion process. This is partially offset by turbulence which retards the upward flow of heat. In addition, wind exerts a conductive cooling effect on buds and needles.

Basic studies are now in progress on the Francis Marion National Forest to obtain experimental checks on the results of the theoretical work discussed in this paper. In addition, these studies should yield information for determining the proper place of fire in the management and protection of loblolly pine. This information should also be applicable in large part to other species of pine such as slash, longleaf, and possibly even shortleaf.

Higher Helicopters Limits.—The value of the helicopter in fire suppression activities is no longer questioned. Anyone who read Frank Jefferson's excellent article on the subject in the January 1948 issue of Fire Control Notes should need no further convincing that rotary-wing aircraft has long since passed the experimental stage in this field. But helicopter operations have always been hampered by the low hovering ceiling of the aircraft. Forest Service reports in 1945 stated that a helicopter then being tested (Sikorsky R–5A) lacked the ability to carry the necessary pay load in spot landings and take-offs at elevations over 3,000 feet with summer temperatures. Two years later, California foresters used improved models at elevations up to 5,400 feet under similar conditions. But this is still not sufficiently high in the Rocky Mountain Region, where in most places an elevation of 5,400 above sea level only means an impressively deep hole in the ground.

It was, therefore, with considerable consternation that we learned that the Denver branch of the U. S. Geological Survey had chartered a helicopter to transport surveyors in triangulation work on a mapping job near Canon City, Colo., last winter. It was intended that the machine should transport surveyors and their equipment, one at a time, from the airport to adjacent triangulation points. Since the elevation of the Canon City airport is a prohibitive 5,500 feet, the project seemed a shade on the doubtful side; but the Geological Survey report, portions of which are given below, speaks for itself:

"The helicopter operation was accomplished in 10 man-days. The same triangulation work, under summer conditions and by automobile and foot travel would have taken an estimated 36 man-days.

"Wind velocity for these operations varied from zero to an estimated 40 m. p. h. One take-off was accomplished from 9,300 feet above sea level with a 12 m. p. h. wind; and one at 10,200 feet in zero wind. The temperature varied from 4° to 48° F., with most flights being made while the temperature was above 32°. All high altitude landings and take-offs were made under favorable conditions, but it was eventually decided to forego any more landings at extreme elevations due to the fact that the weather and wind conditions were not sufficiently stable at this time of the year to provide the necessary margin of safety required at maximum altitudes.

"During the second day of the operation, Mark Rousseau was transported to a mountain peak at an elevation of considerably over 10,000 feet above sea level. He erected a triangulation signal and was returned to the airport by the helicopter; but after discussions with the pilot, it was decided not to attempt to occupy this point as he stated that every bit of power was required to make the take-off from this point and it would be unsafe to make repeated flights to points of that elevation.

"All triangulation point landings were normal hovering landings. All take-offs were normal hovering or 'jump' take-offs."

There is no doubt but that unusually favorable temperature and air density conditions enabled successful helicopter operations at such elevations and that the aircraft was being skillfully piloted near its uppermost limits, but the machine itself deserves considerable credit. It was a Bell 47D, currently the latest thing in commercial helicopters. Some of its specifications follow:

Seating capacity	1 passenger and 1 pilot
Engine	Franklin, 178 h. p.
Cruising speed	92 m. p. h.
Speed range	0 to 100 m. p. h.
Gas capacity	33 gal.
Gas consumption	12 gal. per hr.
Rotor blades	Matched woods with stainless steel leading edge and steel core
Main rotor diameter	35 ft.
Blade tip speed	400 m. p. h.

This account is not a plea for pushing our existing rotary-wing aircraft beyond their safe operating limits, but is rather an indication that further equipment development may before many more fire seasons make timber-line helicopter operations a normal procedure. Distinct hope for this is held out in a final quote from the Geological Survey report:

"Representatives from the Bell Aircraft Corporation have advised us that they have a machine now undergoing tests that will have a service ceiling of 20,000 feet above sea level, and that should be able to make hovering landings and take-offs anywhere in the Rocky Mountain area."—Wilfred S. Davis, *Forester, Region 2, U. S. Forest Service.*

SMOKE JUMPING IN THE SOUTHWEST

F. L. Jackson
District Ranger, Gila National Forest

The year 1947 started a new era of fire fighting methods in the forests of the Southwest. This was the first year the aircraft and smoke jumpers were used to suppress forest fires.

The crew of men selected and assigned to Region 3 for a trial run (fig. 1), arrived on the scene on May 23. A day or two of preparation ensued, and was followed by an actual fire call a few days later. This was the initial fire for the smoke jumpers in Region 3.

Since that time it has been demonstrated that the use of smoke jumpers is practical to reduce burned acreage in the forests of Region 3. Adaptations will have to be worked out for each forest, based on the experience gained on other forests. The 1948 project now in progress is already developing many changes and should be continued if smoke-jumper activity is expanded to other forests in the Region.

Under the present set-up on the Gila Forest, a single engine Noorduyn (C–64) is used. This ship was modified for jumper use and for dropping cargo before it came to the Region. One pilot is assigned to fly it, and to care for all maintenance as required. So far this type of plane has been found to be well adapted to conditions here in the Southwest and has given excellent service. The plane and pilot were assigned from Region 6.

Under normal operating conditions, the plane carries the pilot, a spotter (or cargo dropper), two to four jumpers, and their fire packs. The jumpers, foreman, and leader were trained and assigned from Region 1. All are well qualified to handle the suppression job.

The load the plane can carry depends upon the weather conditions and time of day. This factor is carefully weighed against the urgency of the call for the jumpers or cargo. The safety factor is given full consideration. For example, under favorable conditions the plane would carry a safe load of two thousand pounds, when later in the day during the summer months, as the temperature increases, this loading capacity is reduced to around one thousand pounds. In addition, considerable air turbulence is encountered in flight to the forest area, and unpredictable downdrafts make close flying hazardous over mountain areas. The pilot is required to fly at a low altitude over the fire or drop spot to safely release the men or cargo.

Fire detection on the Gila Forest is handled by the regular detection force on the ground. No patrol work is done, except on request while the plane is in flight. Radio contact is maintained between the plane and the ground by means of the regular plane radio and an SPF set on one of the main lookouts. Secondary contacts are maintained with SPF sets at ranger stations en route. So far this arrangement is satisfactory but it is believed could be improved upon by better location of the SPF sets.

When a fire call is received by the smoke-jumper dispatcher the crew and pilot function as one operating unit. The spotter assigned to the jump crew for the day acts as leader. The dispatcher and the

FIGURE 1.—Smoke jumpers, pilot, and plane assigned to Region 3.

pilot plot the best course to the fire from the readings given and pin point the fire location on the maps to be used by the pilot, spotter, and jumpers. A copy of the fire call request is carried by the pilot and the jumpers in the event further information is needed after they leave the ground. The spotter organizes his crew according to the request. The men are suited up on the ground, parachutes checked, numbers recorded, etc., and the pilot and spotter briefed by the dispatcher before take-off. Jumpers are instructed as to the best way out from the fire and when and where relief by ground crews can be expected. Usually the jumpers reach the fires before the ground crews though both receive their fire calls at the same time. Here is an element of competition that cannot be overlooked, especially if suppression by air crews can reach fires before ground crews, keep the fires small, and reduce the total cost of suppression and damage. On the remote areas of the Gila Wilderness Area fire suppression from the air has proved its worth judging from the records of the past 2 years.

The usual get-away time for the plane and crew is less than 10 minutes. This requires needed preparation, servicing of the plane, and a coordination of all hands toward the one important objective, getting on the fire as soon as possible. Usually fire packs consisting of chuck, beds, tools, water, etc. are prepared for two men and packaged so that it can be sent down with one chute. The minimum number of men on one jump is two men, unless fire conditions warrant more, or other emergency exists.

So far in 1948 the crew has made 33 jumps. Four fires were handled without follow-up assistance from ground men. Food and supplies were dropped to a Coronado fire of 2,500 acres, to eliminate a difficult pack string job. Some of these fires would, no doubt, have attained large proportions had they not been reached in time, and would have cost a large amount to control.

A NEW FIRE DANGER METER CARD

James R. Crowell
Dispatcher, Talladega National Forest

A simple method of using index numbers to determine fire danger on the Appalachian 100 Point Scale has been developed at the Talladega Ranger Station, Talladega, Alabama, by the writer. There are no wheels to turn, no slide rules, in fact no moving parts whatever, to wear out or to confuse the inexperienced. For example from the card illustrated below:

	Index No.
Days since ½″ rain, cured stage: 4 and over	4
Wind rate: 7.5 to 12.5 m. p. h	2
Fuel moisture: 4.0 to 12.5	4
Total	10

Now, under Fire Danger Class, index number 10 gives High IV (class day) and 45–55 (100 point reading).

FIRE DANGER METER (*Type 7*)

Days since one-half inch rain by fuel stages

Green		Transition		Cured	
Days	Index No.	Days	Index No.	Days	Index No.
0–3	0	0–3	2	0–3	3
4–8	1	4–8	3	4 and over	4
9–15	2	9 and over	4		
16 and over	3				

WIND

Miles p. h.	Index No.
0–3.4	0
3.5–7.4	1
7.5–12.5	2
12.6–18.5	3
18.6–24.5	4
24.6 and over	5

FUEL MOISTURE

Weight	Index No.
25.1 and over	0
12.6–25.0	2
4.0–12.5	4
3.9 and less	5

FIRE DANGER CLASS

Index No.	Class day	100 point reading
1–4	I	0–10
5	Low II	11–15
6	High II	16–20
7	Low III	21–26
8	High III	27–33
9	Low IV	34–44
10	High IV	45–55
11 and 12	Low V	56–77
13 and 14	High V	78–100

To determine Fire Danger use sum of index numbers in Fuel Stage, Wind and Fuel Moisture columns as index number in Fire Danger Class column.

Mobile Telephone Service in Cooperative Forest Fire Area.—It is a well-known fact that cooperation is the key to effective fire protection for certain western watersheds. In these areas the protective organization is often one knit from the suppression forces of a number of cooperators, private as well as public. Such organizations lean heavily on a reliable interagency communication system.

Recently there has been introduced into the communication picture a vehicle radio-telephone service developed by the Bell Telephone System. Subsidiaries of the American Telephone and Telegraph Company are installing such units in the heavier subscriber areas to furnish service to municipal power, water, policing, and fire protection organizations as well as private businesses having need for communication from mobile units to their central place of business. This vehicle radio-telephone system bids well to become an important adjunct to a cooperative fire protection force which is activated through a central dispatcher such as the joint Federal, private, and municipal organization developed under the Clarke-McNary Section 2 program for the Salt Lake Valley watershed in Utah.

One of the principal advantages of using the equipment developed by the telephone people is that it furnishes a common medium of communication that all cooperators can afford to install. Many cooperators could not afford to invest approximately $1,200 per unit in mobile VHF-FM equipment, but can afford to set up a small budget for seasonal rental of standard telephone equipment from a commercial concern that is devoting its entire program to furnishing the public the communication it demands. Then too, the company takes over responsibility for installation, repair, maintenance, and development. Maintenance alone is an item of considerable expense when equipment is owned outright.

Regardless of whether a cooperator owns his VHF-FM mobile equipment or rents it from a telephone company, there is an initial cost of preparing a motor vehicle to insure sufficient continuing power for a full fire season use. The costs of such installations are about as follows:

Generator, 35 amp. at 10 m. p. h.	$40
Power battery, 180 amp	20
Regulator	6
Installation of above	40
Total	106

For the Salt Lake City area the Mountain States Telephone & Telegraph Co. is making the following charges now for installation and rental. As more units are installed these costs should go down.

Cost of initial installation	$25
Rental of equipment per unit	15
Monthly message guarantee allowing up to 40 minutes of calls per month	7
Anything over 40 minutes at rate of 20 cents per 3 minutes.	

If a dispatcher system is set up the $7 guarantee is reduced to $2.50 per unit, but there is a $3 charge made for a dispatching terminal.

This development by the telephone people demands investigation, especially where dollars are a big consideration in outfitting a diverse group of cooperators and where VHF-FM reception has sufficient coverage. In Region 4 of the Forest Service two areas where it is especially practical are the Salt Lake Valley protection area and the Reno-Carson area. In the Salt Lake area the cooperative protection force is activated through one common dispatcher. The following list of major cooperators gives some idea of the scope of coverage and the need for good interagency communication:

- Salt Lake Water Department
- Salt Lake Fire Department
- Bountiful Fire Department
- Farmington Fire Department
- Salt Lake Parks
- Salt Lake Police
- State Traffic Forces
- Salt Lake County Sheriff
- State of Utah Highway Department
- State Forester
- Wasatch National Forest
- Utah Power & Light Co.
- Mountain States Telephone & Telegraph Co.

Proper correlation of all these organizations results in a communication load which Forest Service facilities probably never would reach. But the vehicle radio-telephone service reaches all mobile and fixed station installations of all cooperators.—J. W. Mattsson, *Forester, Fire Control Region 4, U. S. Forest Service.*

PORTABLE TRACTOR HEADLIGHTS

M. D. Stowell
Fire Control Officer, Plumas National Forest

For several years the need for an emergency set of tractor headlights that could be installed quickly and easily on logging tractors used on fires has handicapped our night control efforts.

The U. C. Lite Manufacturing Co., Chicago, manufactures a portable light, Big Beam #700, that operates on 4 screwpost dry cell batteries. This light fills this need for a light weight readily portable headlight. A bracket to mount this light on tractors was designed by E. E. Kessler, Plumas welder and blacksmith (figs. 1 and 2). This

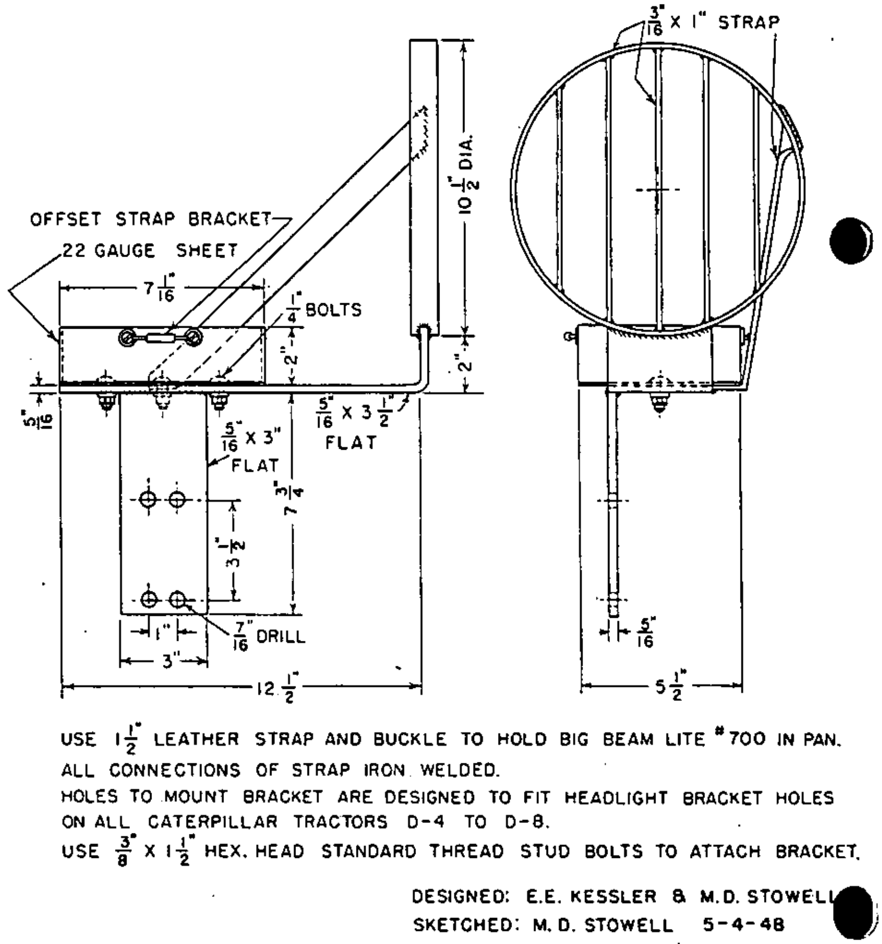


Figure 1.—Bracket for portable battery tractor light.

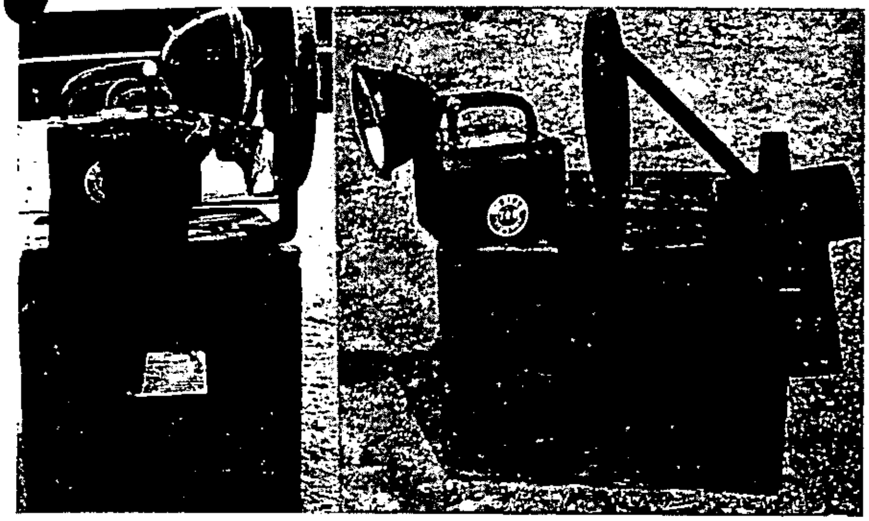


FIGURE 2.—Portable tractor headlight and bracket, assembled and separate.

bracket can be quickly attached to any caterpillar tractor by merely inserting 4 stud bolts into the tapped holes in the radiator housing designed to hold regular headlight brackets. Tests on fires proved that this light will operate for 6 to 8 hours continuously on one set of batteries. The cost of the light is approximately $18.25.

The bracket can be readily made by any welder and can be installed by anyone. Spare batteries can be carried and quickly installed if longer use of the headlights is desired.

Pocket-Size Fire Control Plans.—The Rhode Island Forest Service has endeavored to make the most and best use of its annual forest fire control plan. Beginning with the spring of 1948, State Forester Jacobson, at the suggestion of Ranger Alton M. Markham (recently deceased), revamped the fire control plan by making a pocket-sized edition. An inexpensive standard 6-ring, 4- by 6-inch binder has been used for cover protection of the loose-leaf plan. Each of the 35 State forest fire wardens has been furnished a copy with his name on the cover. The booklet is labeled "Rhode Island Forest Service—Fire Control Plan." In addition to the text, the most recent forest fire law publication is included.

The advantages of this unique project are at least three-fold:

1. Provides a fire control plan and directory of personnel which can be easily carried in one's pocket.
2. Sections can be amended without making a complete run of the plan.
3. Fire wardens are given a boost in morale by having names printed on individual covers.

Anyone interested may obtain more detailed information of the contents, costs, and the like by writing Mr. Eric G. Jacobson, Chief Forester, Office of Forests and Parks, 18 State House, Providence, R. I.—EDWARD RITTER, *Region 7, U. S. Forest Service.*

DEMOUNTABLE TRANSPORT BED FOR 50-MAN FIRE UNIT

M. O. Adams
Central Dispatcher, Shasta National Forest

The device discussed here was prepared by the Shasta to obviate keeping a loaded truck on stand-by. This Shasta idea prompted the development of a standard slip-on bed for Region 5. Design and specifications should be available soon.

District Ranger L. L. Feight, Fire Control Assistant G. Call, and Prevention Aid K. Mason of the Pit Ranger District developed and put into use a loaded 50-man fire camp unit which has reduced loading time and can be handled by one man with a minimum of effort.

These men constructed a wood bed with stakes, similar to a standard stakeside, out of lumber salvaged from an abandoned sawmill. The complete unit is 11 feet, 7 inches in length, 6 feet, 5 inches in width, and 38 inches high. Six wheels salvaged from safes were mounted between the bed members to aid in loading and unloading. The finished bed has an unloaded weight of 400 pounds and when fully loaded a gross weight that does not exceed 3,000 pounds.

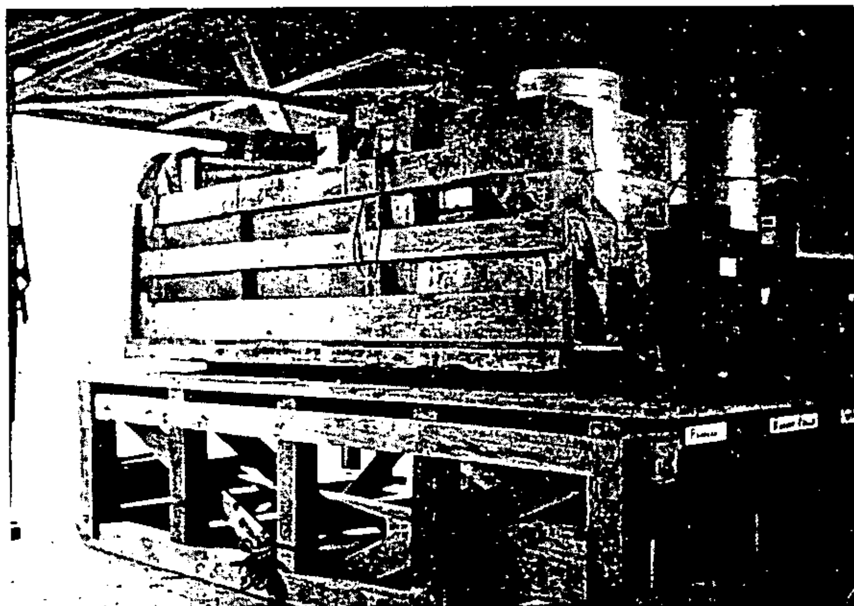


Figure 1.—Transport bed with 50-man fire camp unit on loading platform.

To facilitate loading, a platform, built of salvage lumber, was placed in a warehouse stall. The 50-man unit fully loaded and ready for instant loading onto a truck, is stored on this platform (fig. 1).

The loading platform is 2 feet longer than the transport bed, and the back is 1 inch higher than the front. This slight tilt gives a downhill roll onto a truck. As another aid in loading, salvage metal strips were placed on the platform deck as wheel channels for the transport bed (fig. 2).

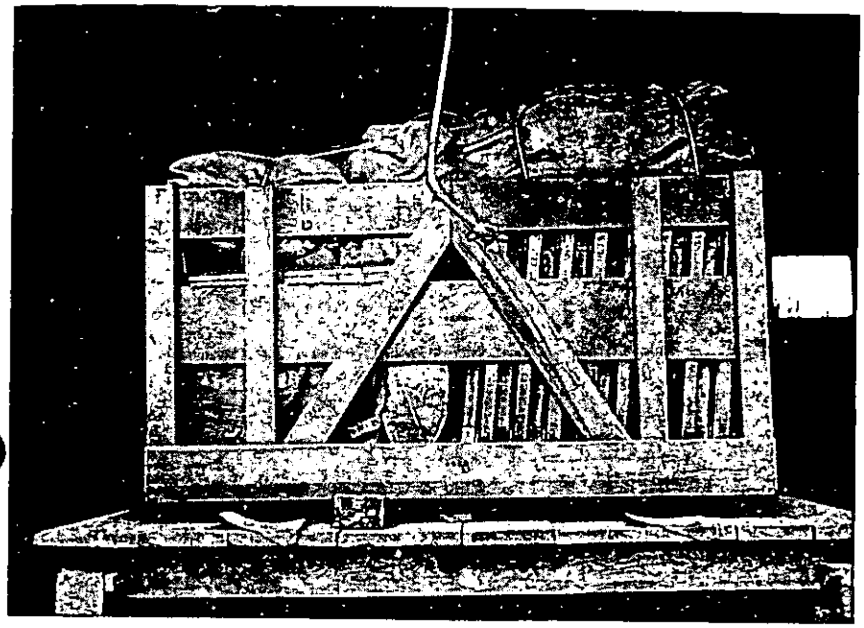


FIGURE 2.—Front view of transport bed. Note metal strips on platform deck for wheel channels, and holding wedge.

The loading platform was constructed to the same height as the bed of a Ford stakeside used by the district. When a fire strips the district headquarters of automotive equipment, a private truck can be used to haul the camp unit. Should the private truck bed be higher than the loading platform, holes may be dug in the ground for the rear wheels to lower the bed to the height necessary for loading.

Whenever a call for the 50-man unit is received, the district dispatcher has a truck back up to the loading platform in position to load. The dispatcher then pulls out the holding wedges, which prevent the unit from rolling off the platform when it is stored, and with a pry bar rolls the unit onto the truck. Chains and binders are used to tie the unit to the truck bed.

The time required to load, bind, and start this unit on its way to a fire is 5 minutes. This is much less than the time formerly required, when each piece of camp equipment and line tools were loaded by hand.

Material Carried on the Unit

15 shovels, l. h. r. p.	5 gallons kerosene
15 tools, McLeod	5 gallons oil, motor, S. A. E. 20
15 axes, d. b.	3 brush hooks
5 tools, Pulaski	1 brush knife
3 shears, pruning	3 saws, felling
1 rake, asphalt	3 sledges, 8-pound
12 files, 8-inch	6 wedges, steel
1 torch, Hauck	12 wedges, wooden
48 fusees	1 pump, barrel
50 lamps, electric, head with batteries	2 flame throwers
40 canteens, 1-gallon	5 outfits, back-pack
1 set irons, campfire	1 outfit, first aid, large
1 water heater, Flamo	1 range, Flamo
8 tables, folding	2 cylinders, Flamo
1 outfit, mess, 50-man	1 desk, camp boss
10 knapsacks	4 cans milk, 10-gallon
1 funnel, Coleman	6 lanterns, gas, Coleman
50 bags, sleeping or 150 blankets, bed	300 feet rope, ⅜-inch
2 rolls wire, emergency, single or duplex	1 telephone, portable
1 radio, S set	1 outfit, camp boss
15 signs, campfire	5 gallons gas, white
	1 drum gas, leaded, 50-gallon

After the truck with the 50-man unit arrives at a fire camp and the equipment is unloaded, that truck is then available to haul men or tools from the fire camp to the fire line. When the fire camp is disbanded, the 50-man camp equipment is reloaded into the transport bed and returned to the district headquarters where, by use of a set of blocks, the unit is pulled from the truck onto the loading platform.

All equipment is unloaded, checked, and used articles are replaced. In a short while a complete 50-man unit is again ready to roll to a fire.

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed on a strip of paper attached to illustrations with rubber cement. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustration. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired. Do not submit copyrighted pictures or photographs from commercial photographers on which a credit line is required.

India ink line drawings will reproduce properly, but no prints (black line prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.

The approximate position that illustrations bear to the printed text should be indicated in the manuscript. This position is usually following the first reference to the illustration.