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FIRE CONTROL NOTES

Includes

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April 1946—April 1949

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 10 Number 2

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.

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Forest Service, Washington, D. C.

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CONTENTS

SLASH PILING BY MACHINE ON THE SOUTHERN IDAHO FOREST PROTECTIVE DISTRICT

ART ROBERTS

State Fire Warden, Southern Idaho Fire Protective District

Since the spring of 1945, it has been possible for logging operators on State and private lands in Idaho to contract their slash-disposal job to the State forester at a more or less stable rate on a State-wide basis. The law is written so that any job may be taken on its own merits, but in practice, unless the job is exceptionally difficult, it is taken at the base rate. The actual disposal work is delegated to the State fire warden on the district involved. On the Southern Idaho Forest Protective District there is almost 100-percent cooperation under the law. For this reason, it is possible to consider the problem on a district-wide basis. Roughly, the area is broken into two units and each job is considered with relationship to the large unit. Our use of machines has been pretty well confined to the northern unit which embraces the McCall-New Meadows-Council area.

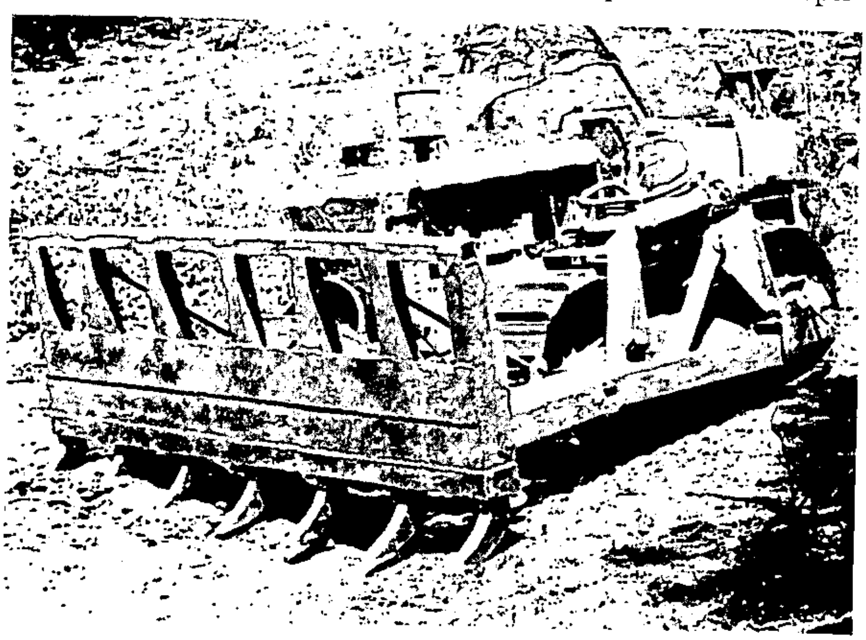
For the most part the type is yellow pine, and on quite a lot of the area the slope is gentle and the ground open. For this reason, we became interested during 1945 in operating a tractor or two on some of our slash-disposal jobs. Some work had already been done along this line elsewhere and we looked into the results obtained on some of these jobs. Late in 1945 several fire wardens visited the Biles Coleman Lumber Co. operation out of Omak, Wash., in a type very similar to ours, where brush-piling tractors had been in use for two or three seasons. The company was using D–4 caterpillar tractors with 60-inch center and 20-inch track shoe equipped with a specially constructed brush blade manufactured by the Isaacson Machine Works in Seattle, Wash. It was enthusiastic about the results obtained with these machines and was using them on its entire operation.

Our efforts to obtain machinery were redoubled and in October 1946 we acquired two D–4 caterpillar tractors through war surplus. These machines were in new condition but were narrow gage (44-inch center and 13-inch track shoe). They were equipped with La Plante-Choat hydraulic angle dozers and double drum LaTourneau winches with fair-leads. Because of the lateness of the season no slash-disposal work was done with these machines until the spring of 1947.

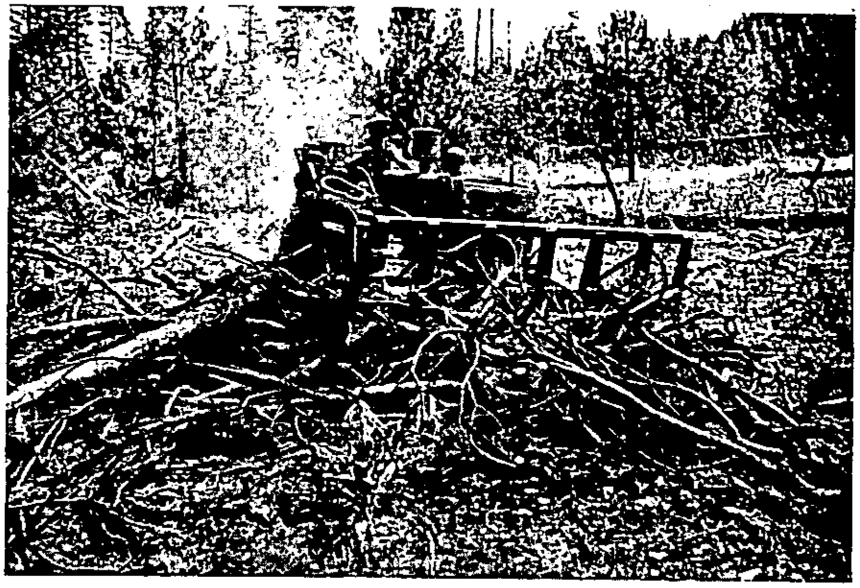
During the early spring, we had special blades manufactured to our specification by the Catlow Transport Co. at Spokane, Wash. These blades were built along the same general lines as the Isaacson blades but with several modifications. In the first place, the blades were made interchangeable with the angle dozer blades already on the machines. This was not the case with the Isaacson blade. Second, we extended the blade 10 inches on each end because of the narrowness of the machine. This made the over-all width of the blade 109 inches instead of the 89 inches of the angle dozer blade. The change made little difference in the hook-up as the dozer arms readily move out an inch from the A-frame and the connections were moved in 9 inches from the ends of the blades. The original arms and A-frame were used. The blade was held in place by the same three pins which held the angle dozer. However, it was impossible to use the brush blade in any but the straight blade position. A secondary brace from the top of the brush blade to the back hole in the A-frame was tried but soon discarded as it was found to be superfluous. Slack in the hook-up also made it very hard to keep this brace from breaking.

The blade was equipped with seven detachable teeth that gave 11 inches vertical clearance and point forward 10 inches from the perpendicular. Above the teeth the blade was solid for 20 inches and was then a lattice-work affair to its over-all height of 50 inches. This open top was left for greater visibility for the operator and to reduce the weight of the blade, which even with this open work weighed approximately 300 pounds more than the angle dozer. One disadvantage of the changeable blade arrangement and the hydraulic dozer is that the blade is some 18 inches in the front of the machine because the A-frame is hung far enough ahead to clear the hydraulic pump. Another is the weakness of the hydraulic hoses in work of this kind. These disadvantages are offset by the speed of change to angle dozer for fire work and the ability of the hydraulic dozer to exert pressure down.

Work was started with one machine in June 1947, and one machine was kept in the field during the entire season or until mid-November. The limitations of the machine soon became apparent. Because of the narrow gage, it was unable to operate on slopes much over 20 percent. Rocky ground also stopped it. No attempt was made to oper-



A D-4 caterpillar tractor equipped with the 7-toothed brush blade.



The D-4 with the brush blade working in heavy slash.

ate in reproduction stands although some tops were winched out of these places. As the season progressed, we worked our hand piling and lopping crews closer to the machine and used the machine only where it worked most efficiently. During 1948 both machines were in the field from June until late October. Our greatest mechanical difficulty was the vulnerability of the oil return hose to the hydraulic pump. This was comparatively safe from brush in front but limbs and small stumps would get it from below and pull it off. Finally guards which extend under the pump and hoses were devised and bolted to the pump and radiator guards. This addition stopped our trouble.

We intend, but have not yet made, a second revision in the original blade. This will be to make the lattice work solid directly in front of the radiator in order to further protect the machine. This will not interfere with the visibility of the operator as he seldom looks directly over the front anyway, but should serve to protect the screen which must be used over the radiator to keep it from fouling up with moss and dust. Experience indicates that the added weight will make little difference, contrary to our original fears.

There are several advantages connected with handling brush with these machines. First, machine-made piles will burn much later than those made by hand because they are larger and tighter. Then, quite a percentage of the windfall and top that would normally be left on the ground gets into the pile. Not all this burns but the flash fuel is no longer around it to give a bad time in the fire season. In operating machines in piling, the ground is worked up, providing a better seedbed. While this is not vital, as it is already pretty well taken care of in present methods of "cat" logging, it still may be an advantage. During 1948 quite a bit of lopping was done with the machines. This lopping was quite satisfactory where there was insufficient slash to make piles or where the debris was too scattered to make it pay to put it together in piles. Lastly, machine piling is much faster where it is possible and reduces the need for manpower, that has not been readily available during the past few years.

On the Southern Idaho Forest Protective District job, the machines are now used strictly as an integral part of the whole operation and always in connection with men for the outlying areas, the reproduction stands, and the steep or rocky places.

During the bad fire months, July, August, and early September, the machines are kept on jobs as centrally located as possible or as close as possible to our areas of high hazard. The angle dozer blades are kept on the job and the change from one blade to the other can be made by two men in 5 to 10 minutes. The machines are transported on a 6 by 6 International 2½- to 3-ton truck that is kept on the job during the summer months. In the course of the operation the machines are used to keep roads open to the jobs and so give freer access to slash areas at far less cost than that by hand or by hiring it done with contract machinery. As we have had two easy seasons since we started our machine project, we have used them only rarely on fire control but they are always ready and can be moved rapidly.

It is extremely difficult to estimate costs on an operation of this kind, but in areas on which we have done all the work with the machines, our costs for a 100-percent piling job have run from 20 cents to $1 per 1,000 feet board measure depending on the site, the tractor operator, and the quality of the job done. When the machines are used in conjunction with a handlopping operation, the costs, of course, come down. It is our opinion, from 2 years' experience, that a 100-percent piling job can be done, with a good operator and on the type of terrain on which the machines can operate, for about half the cost of a hand job of the same quality.

The D-4 caterpillar tractor is a little small but we believe that the ease of transport and the speed with which it can be made ready for use on the fire line more than make up for this limitation. The operator must be efficient and must understand and take care of his machine as the work is extremely hard on machinery.

More protection for the machine and operator are needed, and the narrow gage on our machines materially limits the percentage of slope upon which we can operate. The machines, however, justify themselves on the slash-disposal operation alone, but at the same time they provide for fire control work a protection force which would not otherwise be available.

FOREST PROTECTION ADOPTS "BLITZ" METHODS

FRANCIS M. BURKE

Forest Area Supervisor, Wisconsin Conservation Department

With fire crews hard to recruit, rangers turned to mechanization. Now 2 or 3 men do the work of 50.

Forest fire suppression in Wisconsin just isn't what it used to be!

Prior to and during the early thirties, a fire call meant the forest ranger hustled his old "jalopy" from the garage, hastily threw on an armful of shovels, another of grub hoes or mattocks, a few back-pack water cans, and a jug of drinking water, slammed the door, and was off on his prearranged route to assemble his scattered fire crew of townspeople and settlers. Then off to the scene of the smoke as rapidly as the poor roads and trails of the day would permit.

In those days, persons residing in wild land areas expected to be—and usually were—called to assist the ranger when smoke from a forest fire rolled across the horizon. Manpower was available in considerable numbers and the economic conditions at the time were such that the low fire fighter wages were sought by many.

Upon arrival at the fire, the ranger unloaded his crew, distributed hand tools to each, and assigned them work at the burning edge of the running fire. Slowly and laboriously they proceeded to bring the fire under control. After the fire was knocked down, a control line at the outside edge was usually hand dug to mineral soil, thus confining the fire. Following this the crew worked at mop up on the burning interior by watering down burning stumps, logs, and other forest debris or covering them with cold, damp, mineral soil.

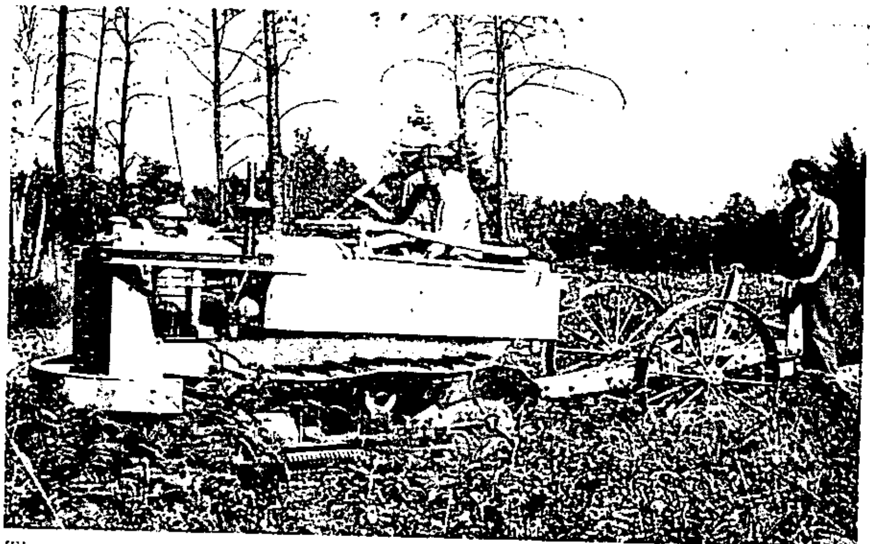
Delay in assembling a crew, the slow method of control, and the ever-present confusion when large numbers of persons are involved, all contributed to increased numbers of major fires.

As small fires became large, the services of more fire fighters were required. Greater numbers of supervisory personnel were needed to adequately apply the efforts of the fire fighters. Transportation to and from the fire as well as providing meals became costly and difficult to perform. Reconnaissance on the fire usually was accomplished by cruisers and scouts. Communication was handled by runners. Fire control practices and procedures of the day were the best possible but certainly not adequate to confine the many fires which occurred to small burned acreage.

The legal responsibility of a Wisconsin citizen to assist in forest fire suppression has not changed but the forest protection division of the conservation department is making every effort to minimize its need for large numbers of untrained, unskilled laborers for fire control purposes. The economic picture has changed so that it has become increasingly difficult to hire individuals at the low fire fighter wage when this means taking them from better pay employment.

The present-day trend is to hire small crews seasonally, locate them strategically near the hazard and high-risk areas, give them a complete short course in fire behavior and control practices, outfit them with equipment and machines especially designed to move rapidly to any fire area and quickly knock down and mop up all fires when they are small, send them back to their base to stand by for the next fire call.

To accomplish this "blitz" method of control we have late model trucks outfitted with tool boxes, water tanks, and power take-off pumps with which water may be applied to the fire edge from the truck tank supply. In addition we have small, narrow, crawler type tractors, readily maneuverable in wild land areas, which tow our middlebuster fire plows and thus rapidly establish control lines to mineral soil at the burning edge of the fire. Tractors also are equipped with water tanks and pumps so that the burning edge of a running fire may be cooled down with water at the same time control line plowing is done.



Three-man crew operating tractor with middlebuster plow and water-spray equipment.

Tractors and plows are easily and quickly loaded on tilt-bed trailers for over-the-road transportation by towing behind the larger trucks. Loading or unloading consumes but a matter of seconds.

In addition to the machines mentioned, we now use small tractors equipped with bulldozers, water-tank trailers capable of transporting large volumes of water to fire areas, small portable pumpers with fire hose lines to facilitate mop-up work, and FM radio to provide communications between field men and their headquarters or with other supervisory personnel on major fires.

For scouting and reconnaissance work and to aid in directing ground suppression forces, we employ a skilled observer in our airplane. The plane is radio equipped, making possible immediate and positive communication to field men below. With this arrangement, proper machines are assigned where most needed. The result is faster and better control.

We have recently received our first 4-wheel-drive power wagon trucks. These vehicles are capable of moving over terrain which heretofore has been inaccessible to other trucks. We believe that with these trucks we can offer speedier fire control to isolated areas and also when road conditions are poor. They will be outfitted with water tanks and take-off pumps so that a small crew may take suppression action on fires.

In every instance, we consider chiefly apparatus which can be efficiently operated by a small crew. Our tractor and plow units can each establish as much control line as 50 men using hand tools in the same time interval. Our blitz water tanker units can apply water to equal the efforts of 50 men using back-pack cans for knocking down the burning edge of a running fire.

It is not uncommon for a crew of two or three men to proceed to the scene of a fire as the initial attack crew, rapidly suppress the fire, and return to their station without employing any emergency assistance. Delays in collecting large numbers of workers are eliminated in this method of attack.

During the 1947 fire season, 54 of 239 fires in one of the 4 existing forest protection areas were suppressed entirely by ranger crews without the aid of hired labor. On the remaining 185 fires, a total of 624 men, or an average of 3.3 men per fire, were hired to assist in actual suppression work. On many of these fires, men were hired only to patrol the burn after the running fire had been stopped.

Our fire action plan schedules how apparatus, machines, and supervisory personnel will move to any major fire area. Equipment of the particular fire district will be called first and that in adjacent districts or from our Tomahawk headquarters will follow if needed. Within a short interval our airplane is available for aerial reconnaissance and observation work, and radio communication can be functioning to all parts of the fire.

This trend toward fighting forest fires with mechanical devices will not, in fact cannot, completely eliminate our future need for the services of emergency fire wardens, key cooperators, and numbers of fire fighters on major fires. Our suppression commitments are so widespread that machines will never be able to entirely replace our manpower needs.

Your Wisconsin forest fire control program is in the hands of a fast-charging, hard-hitting group of rangers and their aides. An occasional fire may become temporarily out of control and burn over an appreciable acreage of valuable forest growth but by far the most fires will be put out before the general public knows they exist.

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THE RATE OF SPREAD—FUEL DENSITY RELATIONSHIP

W. S. DAVIS

Forester, Region 2, U. S. Forest Service

During a recent consideration of the value of fuel reduction as a fire control tool in the Rocky Mountain Region, a question was raised as to whether the density of fuel had any effect on the rate of spread of grass fires. The relationship between the rate of spread and factors such as wind, fuel moisture, relative humidity, and topography has of course been reasonably well established by earlier experiments; but no data could be found covering the problem in question. Casual observations of the behavior of prairie fires had created in some the belief that a fire would roll through sparse grass with the same velocity it attained in denser stands, although admittedly with a lesser intensity; whereas others held that a reduction in fire intensity would also lead to a slower rate of spread. To settle this interesting difference of opinion, it was decided to conduct some controlled burning on the Nebraska National Forest, where the rolling sand hill grasslands provide a good continuity of forage conditions.

Possibly the reason for the lack of data on the relationship between fuel density and the rate of fire spread lies in the fact that there is no convenient yardstick for measuring fuel density. In the Nebraska experiment it was decided to use the forage utilization of variously stocked range allotments as such a yardstick.

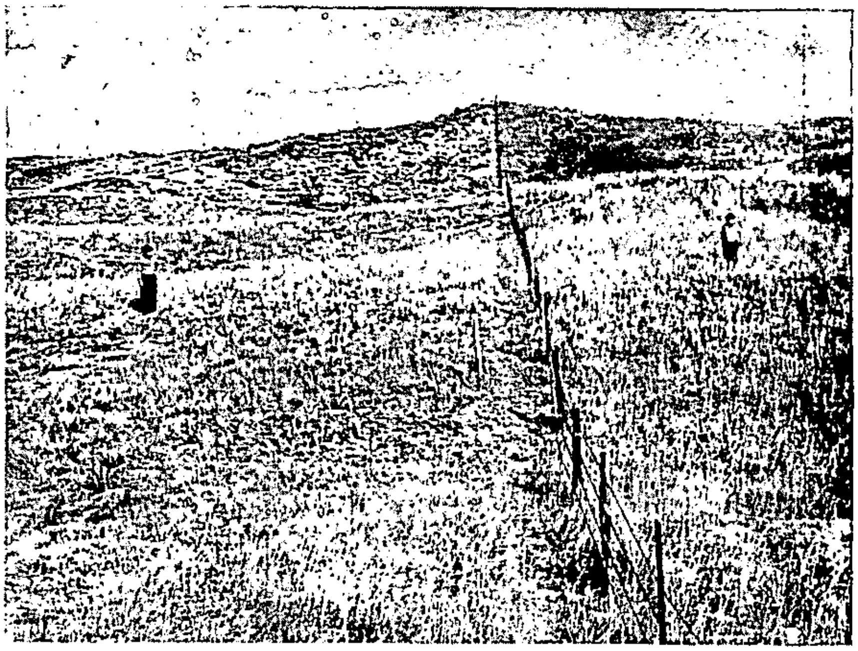
Two adjacent grazing allotments were then selected in gently rolling terrain. One showed an average forage utilization of 0.6 animal months per acre; the other was stocked only half as heavily. These two allotments were separated by a drift fence and a marked change in vegetation density was indicated on the fence line.

The forage consisted of a well-cured mixture of the following:

Turkeyfoot (sandhill bunchgrass)	*Andropogon hallii*
Dropseed	*Sporobolus* sp.
Prairie sandgrass (sand reed grass)	*Calamovilfa longifolia*
Lovegrass	*Eragrostis trichodes*
Sedge	*Carex* sp.
Hairy grama	*Bouteloua hirsuta*

Parallel plots, 500 feet in length and 100 feet wide, were established on each side of the fence and surrounded by adequate firebreaks.

The test was conducted in November. Some variance in temperature and relative humidity was noted, but the wind held at a steady 16 miles per hour throughout. The fires were allowed to run with the wind, and were set so that the lightly grazed and heavily grazed plots burned simultaneously, affording a good comparison. Stop-watch readings were taken on the rate of advance of the head of the fire in each plot. Since thermocouples were not available, the intensity of the fire was gaged by measuring the average height of the flames.



Portion of test area. Utilization: approximately 0.6 animal months per acre on left; approximately 0.3 animal months per acre on the right.

Finally, the fire was allowed to run with the wind from the lightly grazed to the heavily grazed area, in order to discover whether a rolling fire would be affected by thinner fuel.

All tests showed conclusively that the reduction of fuel density has a marked effect on both the rate of spread and the intensity of grass fires. Specifically, the average results were as follows:

Area:	*Frontal advance of fire (feet per second)*	*Intensity of fire (average height of flames in feet)*
Lightly grazed (0.3 animal months per acre)	1.56	5
More heavily grazed (0.6 animal months per acre)	0.53	1

Under the test conditions, in other words, the residual density of grass as represented by a utilization of 0.3 animal months per acre will allow potential fires to advance three times as fast and with five times the intensity of fires in areas that have been grazed twice as heavily.

The result of the test is further proof that the principle of fuel reduction is sound, from a suppression standpoint. This finding of course, does not alter established Forest Service policy of managing the range primarily in accordance with the needs of the soil and vegetation rather than as a means of reducing fuel hazards.

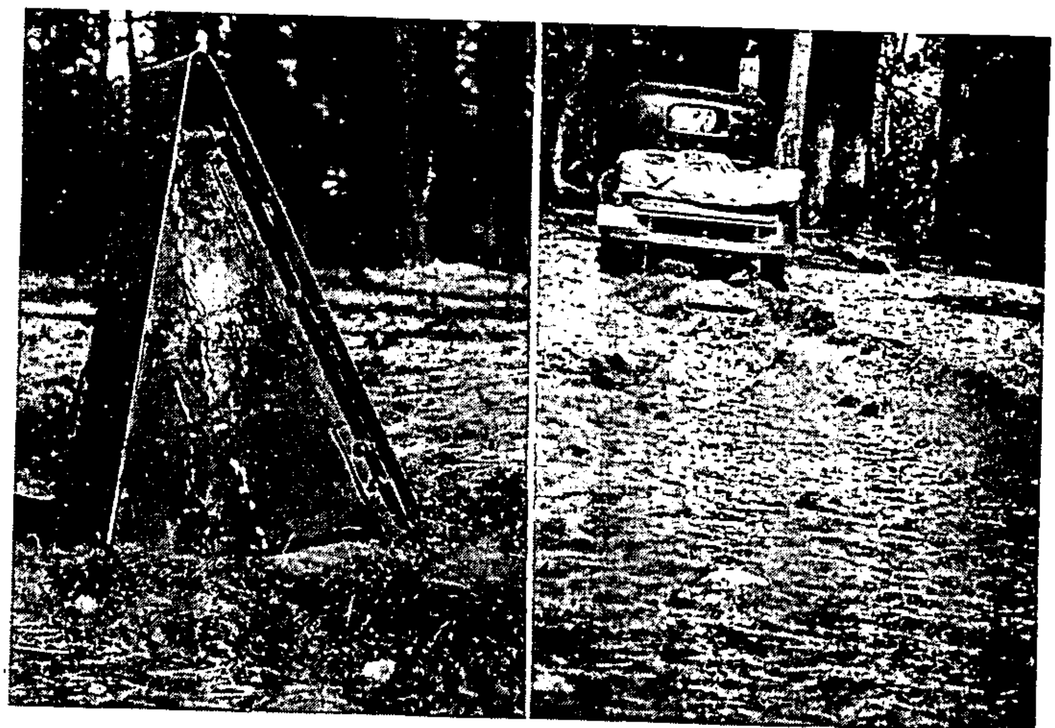
THE SUMMERFIELD V-SCRAPER—A FIRE LINE BUILDER FOR OPEN PINE FOREST

J. A. EGAN

District Ranger, Coconino National Forest

On the Long Valley District of the Coconino there are 175 fires a year (10-year average). It is not unusual for a single storm to start 20 to 30 fires. Under these circumstances anything that will increase the efficiency of a fire guard is mighty valuable. The V-scraper, developed by General District Assistant Henry Summerfield, is just such a piece of equipment. Under ideal conditions a fireman with a combination fire tool can build about 10 chains of fire line per hour. Under the same conditions (anywhere that a pickup can go) the V-scraper behind a pickup with a four-speed transmission will build *2 miles of fire line* per hour.

When the fireman arrives at the fire he unloads the scraper, hooks it to his bumper or trailer hitch, throws on a few boulders or a dozen shovels of dirt, and starts around the fire making a 30-inch fire line as he goes. On rocky ground or where there is reproduction there will be a few skips in the fire line. One man with a combination fire tool can complete the line where the scraper skips—or if the fireman is alone he will have to stop occasionally and check the line to see that it is clean—down to mineral soil.



Bottom view of V-scraper, showing construction; and V-scraper in action.

Just how many fires, that might have become large, have been kept small by the V-scraper would be hard to guess; but it is safe to say that each year two or three potential class D fires have been kept down to B or C size and a dozen potential class B's remained as class A's. The savings on this one district can be estimated at several thousand dollars a year.

The few materials needed to build one of these scrapers are one used 6-foot grader blade, 4 feet of 1-inch angle iron, a 30-inch square of old roofing tin or galvanized iron, one 3/8- by 6-inch carriage bolt, nine 3/8- by 1-inch carriage bolts, 6 feet of 3/16- or 1/4-inch chain. Place the grader blade in a vice about 6 inches from the middle and heat the middle with an acetylene torch. Have a second man pull the end of the blade around to form a V with the ends about 30 inches apart. Holes can be drilled or burned in the angle iron (to fit the holes that are already in the grader blade) and punched in the tin. Attach the chain low inside the scraper so that it pulls over the top of the point of the V and keeps the front of the scraper in the ground.

The accompanying photograph of the bottom of the scraper gives enough details so that one can be built without difficulty.

Reverse Flow Fan for Fire Plow Tractors.—On the Francis Marion National Forest we have always been bothered with our fire plow tractors running hot because of radiators clogging up with debris. Dry pine needles, leaves, and grass are sucked against the front of the radiator despite any kind of supplemental screen that we have been able to devise. Air circulation through the radiator can be retarded enough after only 2 or 3 hours of plowing fire line to make the motor overheat, whenever the weather is warm and dry. It is hard work to clean trash out of a radiator, especially on the fire line.

Ranger John T. Koen wanted to try a reverse flow fan. A number of tractor operators and salesmen insisted that a reverse fan would not circulate enough air to keep the motor operating cool. Nevertheless, we bought one for an International TD–9 in March 1948 for $5.60.

Although we have not had any fires on extremely hot and dry days since then to give it the "acid" test, we have used this tractor with reverse flow fan enough on prescribed burning to make us think we have solved our problem. The fan seems to push enough air through the radiator to keep it cool. The motor has not overheated. There is no clogging by debris on the radiator on the fan side. Whether the motor hood sides are on or off makes no apparent difference in air circulation or resulting heat of the motor.—C. S. Herrick, Jr., *Assistant Forest Supervisor, South Carolina National Forests.* (Reversed fans on tractors have also been used successfully in several instances in western regions.—Ed.)

VERTICAL WIND CURRENTS AND FIRE BEHAVIOR

JOHN S. CROSBY

Forester, Lake States Forest Experiment Station[1]

Forest fires are known to behave in a variety of ways, sometimes in quite unexpected ways. Prompt suppression requires that the fire boss, in estimating the probabilities of control within the allowable period, consider factors affecting the behavior of the fire as well as those fixed by the site.

The important variables not determined by the specific location are the weather factors, primarily moisture and wind. Estimates of fuel moisture and winds are made on the basis of weather forecasts, or through a knowledge of normal daily variation and past experience based on observation of weather reactions in the locality. Often the weather forecast must be interpreted in terms of local topography, or proximity to large water bodies, so personal observation may be invaluable.

Although fuel moisture is an important factor, the purpose of this paper is to point out certain wind features, particularly those in which vertical currents are concerned, and to present a few general rules for recognizing the probability of their existence. On the ground, the best information available about wind is its surface velocity and direction, both of which may be constantly changing, whereas little if anything is known of the action of the wind above the immediate surface and which may have considerable effect on the fire.

Wind is air in motion. The direction of motion taken is almost unlimited. Near the ground the wind customarily blows in gusts and lulls, seldom as a steady even flow. Because it cannot be seen, it can only be noted by its effect on various objects, and hence it is difficult to obtain a complete picture of the variations that characterize air flow. Watching the drift of smoke is one way to observe its motion; this is like observing somewhat similar currents in a river. Both water and air are fluid, though water is more limited in its freedom of motion. The water swirls around and over rocks, makes eddies around land projections, and tumbles over falls. It exhibits motion in many directions besides down stream. Likewise, air moves in a turbulent fashion near the ground while still following a general course.

The general flow of air is determined by the air pressure gradient and is modified by the effect of the earth's rotation and the friction caused by the passage of the air over the earth's surface. The direction becomes clockwise around high pressure centers with a slight drift outward, and counterclockwise around low pressure centers with a slight drift towards lowest pressure. At any fixed location

[1] Maintained at the University farm, St. Paul 1, Minn., in cooperation with the University of Minnesota.

the wind direction changes as the pressure systems migrate and take up new positions in respect to that point.

Many reactions are superimposed on the flow of air, particularly near the ground, to modify the pressure flow. Aloft the wind is stronger, and more steady, being changed only by strong reactions.

Up and down air currents may exist in the lower atmosphere in a great variety of intensities and steepness of rise or fall. Small eddies in a light wind may be only a few feet in depth, whereas strong convection currents may extend several miles into the atmosphere, or the gentle lift caused by a warm front may amount to 10 feet in a mile, but extend over 1,000 miles.

At ground level the wind tends to parallel the surface; that is to say, because the wind cannot penetrate or go through the solid earth, its larger up and down currents must change to a motion along the surface on reaching the surface, though the direction may be variable, and small eddies still persist.

Sustained vertical motion of the air is more prominent at some distance above the surface where, of course, it is more difficult to observe. When a vertical motion, such as an eddy or convection current, is superimposed on the existing wind, the result is alternately to speed up and slow down the wind making it gusty and stronger.

The stronger the horizontal wind, the more turbulent it becomes in its passage over a rough surface, thus creating stronger eddies and more gustiness with frequent changes in direction. Turbulent, gusty winds affect fire behavior by fanning the fire in spurts from varying directions, and by carrying heat and embers to fresh fuels.

The motion of the air is also strongly affected by the heat it gains from the earth on sunny days. Air in contact with the ground then, because of the additional heat, becomes lighter than air above and tends to rise. The rising warm air sets up convection currents. A forest fire also sets up such currents locally because of the intense heating of the air by the fire.

The earth's surface is not uniformly heated. Water surfaces are cooler than land, and forested land cooler than exposed soil or rocks, so the surface air is not of uniform temperature. Warmed air tends to rise in streams usually localized over the warmer areas, or hills may help to start the warm air upward.

Down-drafts occur as complements to up-drafts. Both currents have their effect on a forest fire. While an up-draft in a favorable atmosphere has the effect of pulling on the rising smoke column, thus increasing the air feeding into the fire, the down-draft increases the surface wind velocity, making it more gusty and turbulent.

Once started, convection currents may be accentuated or depressed by the atmosphere, depending on its condition of stability. If stable conditions exist (where the temperature decrease with elevation in the atmosphere is slight) the convection currents will be damped. However, in relatively unstable air (where decrease of temperature with elevation is great) convection currents are increased in speed and depth. Convection currents sometimes rise to 8 or 10 miles in the atmosphere and develop great vertical velocities.

With night-time cooling, the air is stabilized at low levels, and the convection currents subside. This change is a part of the daily variation in stability. In flat country the wind then dies down. In mountainous country the wind stops flowing up-slope and begins to flow down-slope. Along larger water bodies the daytime landward breeze changes at night to a seaward breeze. These changes are normal only when the pressure gradient is weak.

The stability of the air layers both near the surface and aloft greatly influences fire behavior. Very large fires generate intense heat and may enable the heated air to penetrate moderately stable layers and join or set up vertical currents aloft, thus giving a new impetus to the fire, causing it to flare up unexpectedly. A study of large fires in relation to air stability conditions aloft might throw new light on unexpected fire behavior, and provide a new tool for better forecasting fire behavior.

When there is marked air stability even during the daytime, the height to which convection currents may rise is of little consequence, and the diurnal variation in wind is not important. Thus, a strong daytime wind may not die down much at night because it is driven by the pressure gradient alone, and it will decrease only as the pressure gradient decreases.

These considerations are useful only insofar as one is able to plan for them and hence a few very general rules may be helpful.

While the actual stability of the air and the pressure gradient are basic, they are not subject to convenient observation at a fire. Indirectly, however, the condition of stability shows itself in several ways.

Cloud formations.—Cumulus type clouds are always an indication of rising air currents, and often indirectly of instability. In mountainous country, the rising currents may be due to lift over a ridge, while in level country it is almost always a result of convection if not associated with a front. For these clouds to form there must be sufficient water vapor present in the rising air so that it is cooled to its saturation point before the lift ceases. If the cloud bases are low it is an indication of abundant moisture; if high, water vapor is scarce. This condition is indicated at the ground surface by high or low relative humidity respectively. The height of the cloud tops indicate the height to which the convection currents extend, and show also the stability of the air as the currents do not penetrate stable air layers. Flat-topped cumulus clouds, therefore, indicate stability aloft.

Often, however, vertical currents exist without formation of cumulus clouds as the water vapor content is so low that it cannot be carried high enough to condense. Under such conditions, when the sky is mostly clear, evaporation is speeded, resulting in faster drying of fuels.

When relative humidity is low and temperature high, strong currents may exist to considerable elevations without clouds forming. A further check can be made by watching the rise of temperature during the morning. A sharp rise early that flattens out and remains high substantiates the prospect of deep vertical currents, assuming nearly clear skies. Small whirlwinds or dust devils also indicate unstable conditions, though they may exist only near the surface.

Thunderstorms and very large cumulus clouds indicate instability extending to great heights with strong vertical currents. Thunderstorms with high bases may be dry storms, that is, the rain evaporates into the air before it reaches the ground, and hence lightning strikes are more dangerous.

Stratiform clouds (fog-like clouds or layer clouds) indicate stable conditions at least at the level of the clouds though stratocumulus may often form in turbulent surface air even though the turbulence is shallow. In general, the lower the stratus clouds, if they persist, the more stable the air, and the less possibility of vertical currents. Low stratus clouds in the morning, however, often are a better indication of good moisture conditions than of continued stability during the day for they may have formed in a shallow layer of stable air that will rapidly change to an unstable layer during the heat of the day.

Visibility.—Good visibility is often a sign of unstable air in which vertical currents may develop. In unstable air the impurities are carried aloft and away, while stable air traps impurities and holds them in a shallow layer of air.

Air mass.—Cool air masses following cold fronts during the fire season east of the Rockies tend to rapidly develop instability in passing over warmer areas. This instability at first is not deep, but increases with time. The cool air is also dry air, and visibility is good. It is usually recognized as coming in with fresh northerly winds.

Winds.—Gusty winds with a noticeable decrease in velocity at evening indicate the possibility of strong convection currents during the day. Turbulence and gustiness are more readily started in unstable air. Such gusty winds usually are accompanied by frequent changes in direction. The direction may vary through 45 or more degrees rapidly, back and forth, or more moderately within periods of an hour or so.

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HOUSING REMOTES FOR VHF RADIO

North Pacific Region

U. S. Forest Service

Postwar expansion in the use of radio in the North Pacific Region developed a need for inexpensive housing in which to mount radio equipment located remotely from its point of operation.

Most of our new radio equipment is in the very high frequency (VHF) range (30 to 40 megacycles) which is quite line-of-sight in its propagation. Many of the headquarters in which we wish to set up radios are down in holes or otherwise shielded by terrain so as to be ill suited to good transmission or reception of VHF signals. This difficulty may be overcome by setting up the radio antenna, transmitter, and receiver on a convenient high point and operating the station from the headquarters it serves over a pair of telephone wires.

Radio equipment of the kind used for headquarters stations usually comes in a vertical floor mounted cabinet about 24 by 24 by 74 inches with doors for servicing on both front and back. We decided that the housing need be no more than is necessary to protect this equipment adequately from the weather and vandalism. We also required that the housing be semiportable for ease of installation and to comply with regulations governing installations on leased or other nongovernment land. The building also had to be cheap and require a minimum of maintenance.

Out of these specifications our shop personnel and radio engineer developed a welded steel building approximately 3 by 3 by 6½ feet with arched roof and with doors on two sides opposite the doors of the radio cabinet which it houses. One-quarter inch steel plate is used for the bottom, arched roof, and two sides of the building. The remaining two sides are composed largely of watertight steel doors salvaged from the deck houses of scrapped ships. Air inlets are provided low down in the two sides and a thermostatically controlled exhaust fan mounted in the overhead. A receptacle for receiving the 1½-inch pipe that supports the antenna is welded onto the roof. Angle iron flanges are welded to the bottom and drilled to receive hold-down bolts for mounting on a concrete slab or other convenient foundation.

The entire structure weighs about 1,100 pounds and can be carried in the back of a pickup truck. Utilizing the ships' doors at junk prices of $7.50 each, the houses cost $242 complete with exhaust fan, thermostat, and 18 feet of 1½-inch pipe for antenna support. They could be fabricated by any small welding and metal shop at that price if convenient to a shipyard wrecking area where the doors can be obtained.

HAULING CONSTRUCTION MATERIALS FOR LOOKOUT TOWERS BY HELICOPTER

MASON B. BRUCE, *Assistant Supervisor*, and CARL H. CRAWFORD, *Forest Engineer, White Mountain National Forest.*

The White Mountain National Forest had the problem of transporting some 26,000 pounds of building materials and equipment to a new tower location on Mount Pequawket (elevation 3,268 feet) near Conway, N. H. The job involved building a 3½-mile tractor road to within a half mile of the summit and then back-packing the materials from there to the top, the summit of Pequawket being so ledgy as to make the use of horses or tractors impractical. Lack of cover and high winds keep the snow pretty well blown from the ledges and make the use of a snow road to the top out of the question. After careful study, it was estimated that the transportation job could be done for $3,033.

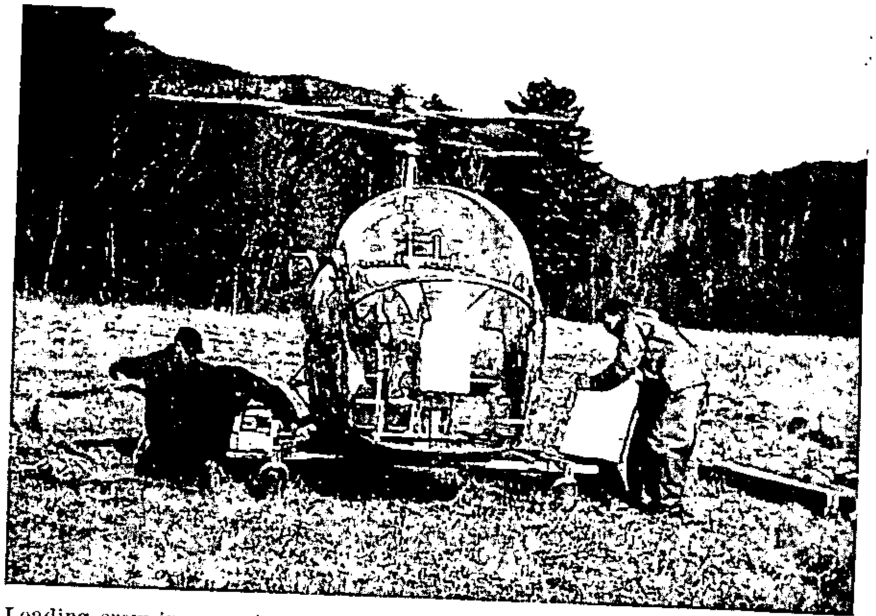
It was decided to investigate the possibility of hauling the materials to the summit by helicopter. The difference in elevation between the nearest roadside clearing and the point of delivery was 2,500 feet; airline distance was 2¼ miles. The material to be hauled varied in nature from treated timbers 2 inches by 10 inches by 20 feet, to metal window casings measuring about 3 by 4 feet, and bulky cartons of insulating bats measuring some 2 by 4 by 4 feet. A quantity of sand and cement was also included.

Bids were solicited from all known helicopter owners in the New England area. New England Helicopter Service, Inc., of Hillsgrove, R. I., agreed to do the job at a uniform rate of 9 cents per pound, which brought the cost of transportation to $2,372.49 for 26,361 pounds. Loading and unloading were done by Forest Service personnel under the direction of the pilot.

Two helicopters were used, Bell models 47B (1947) and 47D (1948). Each was equipped with two tubular aluminum crosspieces attached to the landing-gear supports. Lumber and other long and bulky material were secured firmly to these cross members. Items smaller in over-all size were carried in the cab. There was no significant difference in the results obtained from the two models used.

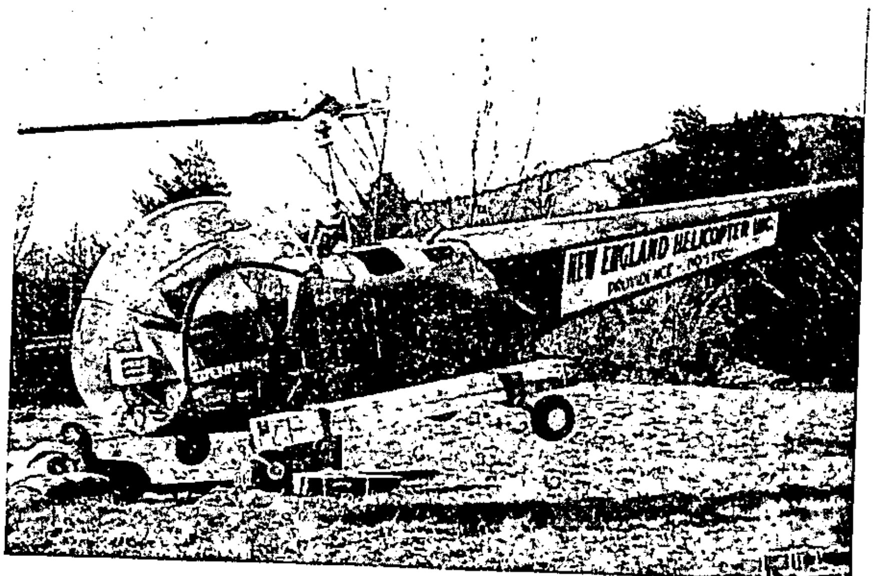
A small field, less than a quarter of an acre in size, was ample for a loading point. For a landing point on the top of the mountain, it was necessary to level off an area roughly 25 feet square with small stones and dirt. The particular helicopters being used had no wheel brakes and could not land on sloping surfaces. No clearing of trees or brush was necessary since the mountaintop was barren.

Loads varied from 250 to 425 pounds, depending upon temperature and wind. Carrying capacity increases as temperature drops, and winds up to 40 miles per hour have a definite favorable effect. Average loads, exclusive of pilot, were 300 pounds. A loading crew of two men



Loading crew in operation. Lumber was secured with straps; small materials were carried inside.

at the foot of the mountain sorted, weighed, and bundled the materials. An unloading crew of two men at the top detached the loads and stored them. These were the minimum size crews necessary at each point. At times, they were hard pressed to keep up with the flow of materials.



Helicopter taking off with full load.

During the best day of operation, an 8½-hour day, 13,000 pounds were carried by the Model 47D. Round trips, including loading and unloading, averaged about 12 minutes each. Several individual loads were completed in as little as 8 minutes each. Extra help was necessary in loading and unloading during this day.

Some unusual cost was involved by the New England Helicopter Service, Inc. The carrying cross members were fabricated for this particular job and experimental expense was entailed in their development. The Helicopter Service had to carry on rather time-consuming negotiations and tests with the C. A. A. and their insurance company before permission could be obtained to go ahead with the operation.

Officials of the Helicopter Service reported the operation to be a practical one and indicated active interest in bidding upon similar jobs. This was the first operation the concern had attempted in mountainous country.

The results of the project indicate that helicopters are practical for transporting certain types of construction material and equipment to points made inaccessible by elevation and lack of roads. Their use should be given serious consideration in planning transportation to such locations.

Aerial Fire Detection.—During the last week in August and the first week of September 1948, a series of dry lighting storms occurred on the Poudre District of the Roosevelt National Forest in Colorado. Five fires, the forerunners of 12 in a 6-day period, had been started. These had been located by lookouts or by local people and were in all stages of being suppressed.

On August 31 the lookout on West White Pine Mountain spotted what he thought was a smoke in the vicinity of Crystal Mountain. Local ranchers were immediately dispatched to the area but could not locate the fire. On September 1, I hired a plane from a local air service company to fly over the area in an endeavor to locate the lost fire. Upon approaching the locality where the smoke had been seen, we ran into another dry lightning storm. The air became exceedingly rough and we were forced to climb to an altitude of 13,500 feet.

While we were flying at this altitude, in the Luscombe two-place plane, a bolt of lightning seemed to flash past, and almost immediately we saw a large ball of white smoke puff up from a ridge top south of Crystal Mountain. Immediately following this smoke a tree burst into flame. The plane was not equipped with a radio so upon determining the exact location of the strike, we headed for the airport near Fort Collins. Thirteen minutes after the strike had occurred it was reported to the supervisor's office and suppression action was immediately started. The fire was held to an area of approximately 50 square feet.

The area in which the strike occurred was only indirectly visible from the nearest lookout tower 6 miles distant, and the lookout failed to see the smoke until long after suppression action was started. The use of a plane in this case quite likely prevented the fire from developing into a much larger one, since fire danger was high.

In areas where a regular air detection system is not set up or justified, a short patrol after each dry lightning storm may well be worth the cost.—HOWARD W. STAGELMAN, *Forester, Roosevelt National Forest.*

MOBILE REFERENCE MAP

Ed. J. Smithburg
District Ranger, Los Padres National Forest

Need for a readily accessible map for reference when learning a new district led to the use of a map mounted on a window blind above the windshield on a pickup. The arrangement proved so handy that the writer has used one for about 8 years, transferring it from car to car, and putting on new maps when changes of station made it necessary. Time saved at intersections has been considerable, and the map has proved of value for follow-up dispatching while enroute to a fire.

The cost of the blind is negligible: installation is easy, but must differ slightly for each type of vehicle. The regular brackets furnished with the blind work very well. It is usually possible to use two of the machine screws holding the windshield channel to hold the forward edge, and a couple of metal screws to hold the rear edge of the brackets. When the blind is in place it is well to squeeze the bracket together so the blind won't jump out. Leave the stick at the bottom of the blind longer, so the blind can't accidentally unroll and spin. Gluing the map to the blind is not necessary. To install the map on the blind, unroll both, place the map on top of the blind and

roll snugly together. Fasten the bottom edge with scotch tape and staples, then unroll and fasten the top similarly. Do not fasten the sides. Tension when pulling the map down keeps the map smooth and straight, and the blind prevents the light from shining through.

We plan this year to equip all tankers with water maps showing the location of all water supply sources, together with the amount, and method of drawing water. All routes of travel will be shown, including accessible ridge tops. All patrolmen will be equipped with human use maps showing points of public contacts and types of hazards present.

Accident Experience of Smoke Jumpers, Region 1, 1948.—Clyde Blake, safety officer for Region 1, reports that 142 jumpers completed training and 758 jumps were made, 580 training, 164 on 41 fires, and 14 on rescue mission. Only 3 disabling injuries occurred. Two of these, a sprained foot and a sprained back, were the results of hard parachute landings; the third, a broken leg in a felling accident.

Accident Experience of Smoke Jumpers, Region 4, 1948.—A report of the accident experience of smoke jumpers at 2 bases, McCall and Boise, revealed that in 500 jumps by 63 jumpers only 3 accidents occurred. Two of these were minor jumping accidents involving no lost time that occurred during training jumps. The third, resulting in broken bones, happened during a jump to a fire and caused a loss of 144 man-days. Statistics were given for age groups as follows:

Age:	*Jumpers*	*Jumps*	*Accidents*
24 and under	47	403	3
25–29	13	80	0
30–34	2	10	0
35 and over	1	7	0

One of the minor accidents occurred to a jumper weighing less than 150 pounds; the other two, to jumpers weighing more than 150 pounds. At the McCall base there were also nine minor accidents such as ax and saw cuts and bruises. Two of these occurred in fire suppression work, the others on project work.

Safer Single Edge Brush Hooks.—Marvin D. Hoover of the Southeastern Forest Experiment Station, in a good suggestion on single edge brush hooks says, "Very little or no cutting can be done with the extreme point of the blade or the heel, and these edges become very sharp with repeated filing of the blade. At the same time these are the parts of a blade most likely to cut men. We have dulled about one-half inch back from the point and rounded and dulled the heel.

"In actual use the workers found no objection to this change and we all believe it is much safer."

The Forest Service specification for single edge brush hook, revised in 1947, includes this safety provision.

STRIP MAP FOR USE IN OBSERVATION PLANE

T. A. Pettigrew

Control Dispatcher, Trinity National Forest

For 3 years the Trinity Forest has been using strip maps in plane observation while scouting fires, etc. They are prepared from ½-inch scale forest maps and have been found convenient and serviceable. The instructions for cutting, folding, and mounting should be followed step by step.

1. Mark off map vertically into three strips with the center strip 1 inch wider than the combined widths of the outside strips. The outside strips should be same size. Make these marks solid lines, as they will be cut later; number the lines 1 and 2 as on the accompanying drawing.

2. Draw three vertical broken lines through the center section dividing it into fourths, number lines 3, 4, and 5; later the map will be folded on the broken lines.

3. Draw a vertical broken line through each of the outside strips, one-fourth inch off center toward the outside of the map. These lines will be numbered 6 and 7. This operation completes the vertical division of the map.

4. Measure the distance from the first horizontal line above the range numbers at the bottom of the map to the top of the map and divide into three equal sections by drawing two solid horizontal lines between vertical lines 1 and 2 and from lines 6 and 7 to the edges of the map. Complete these lines by drawing broken lines from vertical lines 6 to 1 and 2 to 7. These lines are numbered 8 and 9.

5. The map will be cut into nine sections so at this time letter the sections; the cuts will be made on lines 1, 2, 8, 9. Starting at the upper left corner letter the sections A through I.

6. Divide each of the first two horizontal tiers of sections, A, B, C and D, E, F, with a broken horizontal line in the center of the sections. Number these lines 10 and 11.

7. Draw a broken horizontal line through the bottom tier of sections, G, H, I, halfway between the line above the range numbers and the top of the section. This is line number 12. This completes the marking of the map.

8. Cut the map on vertical lines 1 and 2.

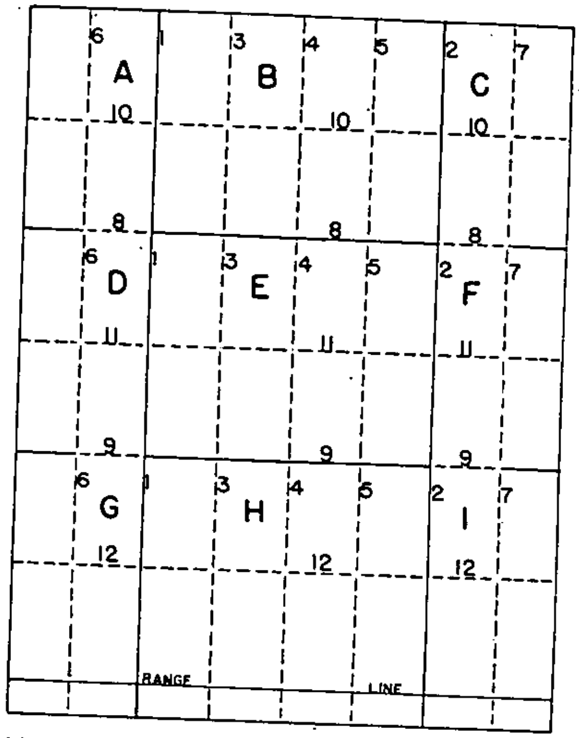
9. Remove the center strip of the map; slide the two outside pieces together and join by using a strip of 1-inch linen tape on the back of the map.

10. With the face of the map up, fold the edges of the map up on lines 6 and 7.

11. Cut the solid portions of lines 8 and 9 on the two outside strips and also on the center strip.

12. Take the outside strips which have been fastened together and fold up on lines 10, 11, and 12, and fold back on lines 8 and 9.

13. Using a manila folder for a cover, open the folder and place the outside strips with horizontal line 10 on the fold of the manila folder. Take four pieces of 1-inch linen tape, 7 inches long, fold them 2½ inches from the end, and stick the glued sides together. This is done to prevent this part of the tape from sticking later. Fasten the exposed glued edges to the back of the map between lines 6 and 7. Make sure line 10 is parallel to the fold of the cover and staple the top end of the four pieces of linen tape to the folder.



Method of marking, cutting, and folding map in preparing strip map; cut on solid lines, fold on broken lines.

14. Place line 12 of the outside strips over the fold in the folder and staple the bottom edge of the map between lines 6 and 7 to the folder.

15. Fold the bottom sections of map attached to the folder to expose sections A and C. Unfold these sections to their full width.

16. Take section B and with it folded up on line 4 lay this fold on the joint of lines 1 and 2 and fasten it in place with a strip of transparent scotch tape along the entire length of the joined edge. Now fold this section to the other side and run a strip of tape on as before.

17. Now fold the edges of sections A, B, and C up on lines 6 and 7 and back on lines 3 and 5 and open at line 4. Now fold up on line 10 to expose sections D and F.

18. Insert section E using the same method as applied for section B.

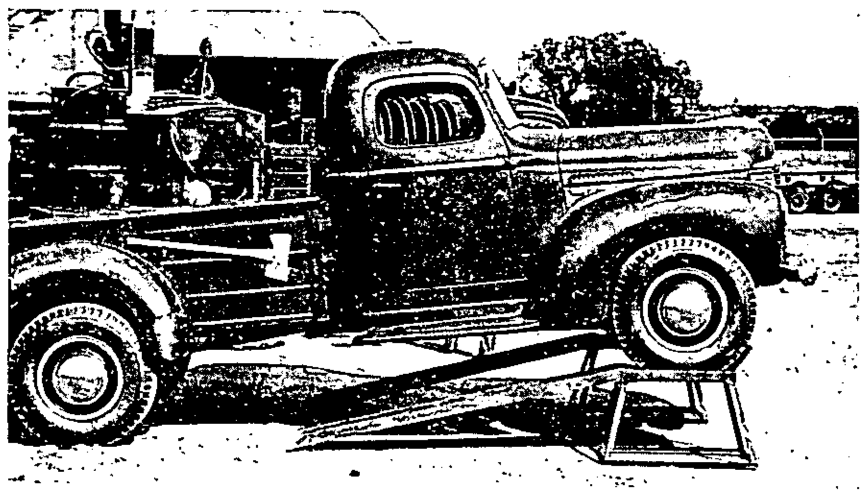
19. Fold up on line 11 and insert section H. Fold up on line 12 and this completes the operation.

FIELD EMERGENCY SERVICE RAMPS FOR VEHICLES

L. K. Gardner

Inspector of Engineering Equipment and Materials, Region 5, U. S. Forest Service

In fire camps and other temporary work camps, it is difficult to properly service those types of vehicles, such as sedans and pickups, which have limited ground clearance. The serviceman is forced to work at complete disadvantage and the quality of service performed is expectedly inadequate. To facilitate the lubricating of vehicles Region 5 has developed portable service ramps.

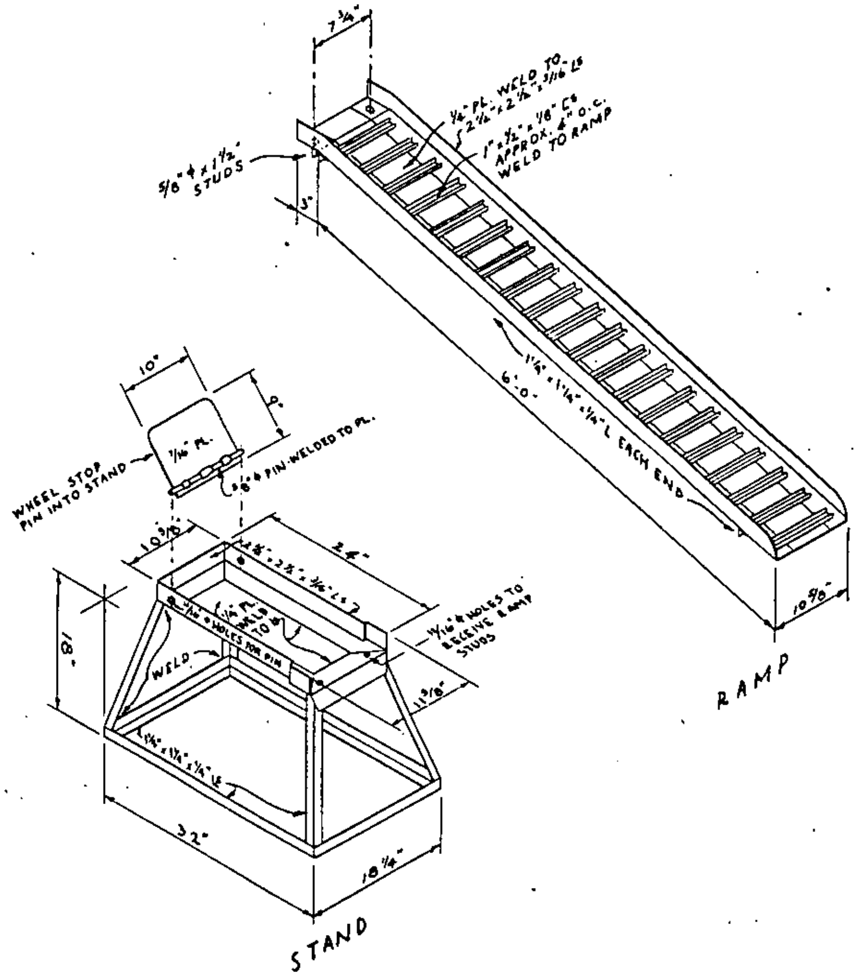


Ramp and stand in use.

These ramps, upon which one end of the vehicle can be driven, will provide adequate ground clearance. Raising one end of the vehicle 18 inches permits freedom of movement and greater accessibility to all the under parts.

In use, the ramps are set up in the most suitable location, preferably level, hard ground, and spaced in accordance with the tread width of the vehicle. Either end of the vehicle can then be run upon them. Wheel stops prevent overrun and wide bases of the stands afford stability to prevent overbalance or upset. After one end of the vehicle is in position on the stands, the incline ramp can be temporarily removed to permit increased accessibility.

As a safety precaution, placement of blocks under the wheels on the ground is recommended to prevent possible rolling of the vehicle.



Portable emergency service ramp and stand.

The ramps are made in pairs, each consisting of a substantial stand and detachable incline ramp, forming a compact unit during transportation when not in use. Although purposely designed of light materials for portability, structural strength is adequate and safe for all ordinary purposes up to and including the front end of an unloaded 1½-ton stakeside. No attempt has been made in the design to accommodate dual wheels. The rear portion of a truck has sufficient clearance and exposal of parts to present no problem of accessibility.

In most instances, the ramps are set up alongside a luber unit. Service of a concentration of vehicles can be greatly facilitated with such a combination.

The ramps were originally devised for lubrication purposes, but it has been found that considerable advantage is offered for repair purposes, or for any reason the extra clearance is desired.

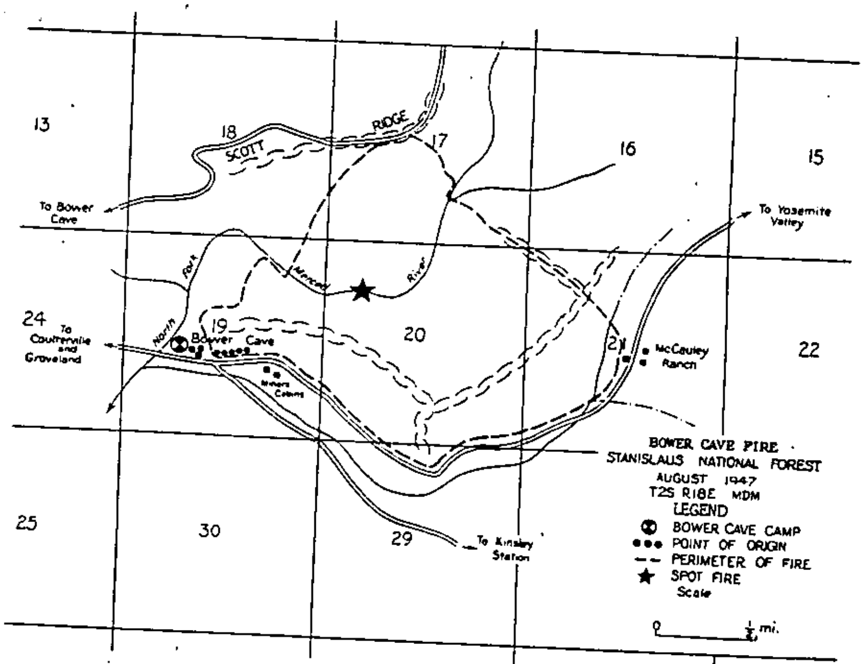
THE BOWER CAVE FIRE

LEON R. THOMAS

Fire Control Officer, Sequoia National Forest

The Bower Cave Fire of August 13, 1947, on the Tuolumne District of the Stanislaus National Forest is being reviewed to show how a fast-moving fire, which was burning in steep terrain and in heavy cover, was readily and quickly controlled, after the first attack had failed, by effective use of modern equipment, and by the local people and trained Forest Service personnel working effectively as a team.

August is a most dangerous fire month in this area. The weather is normally hot, fuel moisture is low, and rapid spread of fires can always be expected. At the time of this fire normal weather conditions prevailed throughout the district and no important changes were forecast. It is estimated that there was an up-slope wind of 8 miles per hour blowing at the fire when the first crews arrived. It increased in velocity during the day but never blew hard. There is a normal downdraft at night with increase in humidity.



Map of Bower Cave Fire, Stanislaus National Forest, Calif.

Bower Cave, a former resort, is located near the old Coulterville-Yosemite road where the road crosses the North Fork of the Merced River. The ridge between Bower Cave and McCauley ranch and Scott Ridge to the north of the river have moderate to steep slopes and are covered with scattered ponderosa pine and black oak with a heavy ground cover of manzanita and scrub oak. Elevation ranged from 2,350 feet at Bower Cave to 3,400 at the higher reaches of the fire perimeter. The sets were on a grassy, pine-oak flat with the steeper slopes and heavier cover just to the north.

For many years there has been an incendiary problem on this part of the ranger district. Sets are always in high hazard types; and several severe fires have been the result. This fire appeared to be another of that type.

The first report was received in the district ranger's office at 9:25 a. m. August 13, 1947. The ranger, fire control assistant, and the district clerk-dispatcher were in the office when the report was phoned in by the caretaker at Bower Cave. He reported that there were several small fires burning on the upper side of the McCauley road between Bower Cave and the miners' cabins one-half mile up the road. The area is blind to all lookouts and not until 9:40 a. m. did the lookout on Pilot Peak report smoke coming up over the ridge that blanked out the area for him.

The Kinsley Station crew, being the nearest organized fire suppression crew, consisting that day of two men and a light pickup tanker, was immediately dispatched. They arrived at the fire at 9:48 a. m. The fire control assistant and one fireman arrived at 9:56 a. m.

The ranger station crew of two men and a tanker was dispatched as was the third organized fire crew on the district, the McDiarmid Station crew of four men and a tanker.

The district ranger helped the clerk notify the central dispatcher and a few local people and was at the fire by 10:05 a. m. with a radio-equipped pickup.

The Kinsley crew found five separate fires burning on the upper side of the road within a distance of about 100 yards. Two Pacific Gas & Electric Co. power line construction employees, who had seen the smoke while working on a nearby line, were already putting a line around the fire nearest Bower Cave. These two men corraled this fire, the smallest of the five, at about one-tenth of an acre in size. The Kinsley foreman left his one man on the second fire and attempted to handle the other three alone with the aid of the light tanker. These three fires were the largest of the five and were rapidly burning together. They were burning in the grass and pine needles and were working toward the steep slope above.

Little, effective control work had been accomplished on the upper four fires when the fire control assistant arrived at 9:56 a. m. He and the one man with him joined the Kinsley foreman in attempting to cut off the head of the main fire at the toe of the steep slope. The Bower Cave caretaker had also arrived and was assisting the foreman.

The fire was burning very hot and was spotting badly up the steep slope when the ranger arrived at 10:05 a. m. He fell in with the other men in attempting to cut off the head and control the spots. The fires which had now burned into one were just too hot to handle and the light tanker was ineffective.

By 10:15 a. m. it was fully realized that the initial attack had failed. The heavier tankers from the ranger station and the McDiarmid Station did not arrive until too late to be of value on initial attack.

The ranger and the fire control assistant made plans for and immediately started a flanking action to keep the fire narrow and possibly pinch it out on the ridge above, should sufficient help arrive soon enough. There was a very good possibility of control on top of the ridge above Bower Cave since once the fire reached the top it would have to burn along the ridge or downhill for a considerable distance. The cover was also lighter along the ridge and on the north slope.

The dispatcher was notified of the situation by radio and a request was sent in to the supervisor's office to have the fire and the area scouted from the air. Orders were sent in to get all the help possible from the local sawmills, woods crews, Pacific Gas & Electric Co. construction crew, and the local ranchers. Two 15-man district road construction crews and a 50-man district blister rust crew were also ordered. A fire camp was to be set up at Bower Cave. It was calculated that this number of men could corral and hold the fire on the ridge that afternoon with an estimated area of about 200 acres. After 10 a. m. the men began to arrive rapidly, as indicated by the number on the fire in the following tabulation:

Time:	Men on the fire: Local labor	Forest Service personnel	Cumulative total
9:25 a. m.	0	0	0
9:30	2	0	2
9:48	1	2	5
9:56	0	2	7
10:05	0	2	9
11:00	81	40	130
12:00	21	0	151

The forest fire control officer flew the fire at 11:15 a. m. in a conventional aircraft and reported to the ground by radio that the flanking action was making good progress and that it had a very good chance for success by the early afternoon.

At 12 noon the ranger and a local rancher scouted the ridge in front of the fire and kept in communication with an SX radio. At 12:16 p. m. the lookout on Pilot Peak reported a smoke in the bottom of the Merced River about one-half mile to the northeast of the original fire. In a few minutes the ranger could see the smoke from his position on the ridge. It appeared to be burning on both sides of the canyon and spreading toward Scott Ridge and the McCauley ranch as well as back toward the original fire.

The forest fire control officer again scouted the fire from the air at 2 p. m. The ranger in the meantime had gone around and scouted the new fire from the Scott Ridge side. Through radio discussion with the fire control officer in the plane and with the ground scouting information, it was determined that the fires would burn together before they could be controlled. It was then decided that both fires should be handled as one.

The cause of the spot fire was not determined. It may have been another set. No attempt was made to send men to it as it was spreading rapidly when first discovered and an initial action crew would have been ineffective.

It was realized now that control lines would embrace an area of a thousand acres or more and that a good deal of the line on Scott Ridge and the McCauley area was a bulldozer show. Additional tractors were ordered. Two D–7 caterpillars were walked to the McCauley ranch from a nearby Forest Service road construction job. One D–7 caterpillar was trucked in from another Forest Service road job on the district and a TD–14, the Forest Service fire stand-by tractor, was trucked in from the supervisor's headquarters. Two bulldozers were already on the fire, a D–6 from a nearby gold dredge and an AC tractor from a nearby sawmill. These last two arrived early but were of little use on the original fire.

All effort was now turned toward handling the two fires as one along the following plan: The hand line that had been constructed along the west side of the fire above Bower Cave was to be dropped in to the river to the north and held. The front of the fire on Scott Ridge was to be headed and a line dropped to the river along each flank. The line on the west side was to tie to the hand line at the river. Each of the lines from Scott Ridge was a bulldozer show until they reached the steep river slope. A line was to be built from McCauley's over the ridge to the north and then to the river and tie to the east line from Scott Ridge. The road from the McCauley ranch to Bower Cave was to be backfired. Four of the bulldozers were walked to Scott Ridge where two were to work on each of the lines from Scott Ridge to the river. Two tractors were to operate from McCauley's.

The camp was now in full swing and all incoming men were organized into crews with sufficient Forest Service overhead for good management.

The fire control officer and the forest supervisor came into the camp at about 4 p. m. With the aid of scouting information and aerial photos the final control routes were determined. The fire was divided into four divisions and the division overhead personnel were briefed on the construction and the backfiring plan. By 6 p. m. all crews, tractors, and other equipment were on the line and prepared for a night operation.

The plan went according to schedule and the night work was so efficient that by midnight most of the lines had been built and burned out. Many of the dangerous snags were felled by power-saw crews before the backfires were started. This was an important factor in reducing the possibility of spot fires as well as cutting down mop-up and patrol work later. The fire was declared to be under control by 9 a. m.

A look at the available Forest Service manpower in the early evening indicated that there was not enough for the mop-up job the next day. Needs were calculated and an order was placed for one division team from another forest and 150 off-forest laborers. The division team was flown in from the Sequoia Forest and the 150 laborers were picked up at Stockton in the San Joaquin Valley. All were at camp in time for the next day's shift. The Sequoia team did an excellent job on a division unit and returned to their home forest after one shift.

Mop-up proceeded rapidly during the early morning and the next day with tractors widening lines, with tankers working along the bulldozer lines and the roads, and with power saws felling the remaining snags. Especially important on mop-up was a 4 by 4 blister rust spray rig. This four-wheel-drive unit with its long light hoses reached many places that were inaccessible to the conventional tankers.

Two Pacific marine portable pumpers and hose were taken into the river on the east side of the fire by pack horses and were used very effectively on mop-up on the river slopes. The fire boss was equipped with a jeep and a portable radio during the mop-up period. He was able to cover all of the fire lines in the jeep except the steep river slopes. The fire was declared to be officially out on August 23.

There were many factors working together that contributed to the control of the fire prior to the burning period of the second day. The most outstanding ones are listed in the following paragraphs.

The early and efficient dispatching of personnel and equipment by the district and the central dispatcher was an important factor. Men and materials were ready to go. Sufficient experienced Forest Service and local men were readily available. Exceptionally good cooperation was received from the local people—labor from the sawmills, woods crews with power-felling equipment, electric power line construction employees, and experienced local ranchers. There were 210 men on the line during the night shift and 272 on the line during the next day. Men were released rapidly after the end of the second day's shift.

The effectiveness of the work during the first night was an outstanding factor in the early control of the fire. Control could not have been effected by 9 a. m. the following morning, however, even with the manpower available had it not been for the efficient work of the tractor operators in the heavy manzanita cover. Lights on the six tractors enabled them to work all night. Wide effective lines were the result. Total perimeter of the fire was 598 chains handled as the following tabulation shows:

Type of line:	*Line constructed* (*chains*)	*Line backfired* (*chains*)
Hand	160	50
Tractor	200	200
Road	238	238

Excellent radio communication during the entire fire made administration fairly easy. The radio net centered around the Pilot Peak lookout who used a T set for receiving and relaying messages. Division bosses were equipped with portable SX sets. A mobile unit and then an SX set were used by the fire boss. A mobile set was used in the fire camp.

A telephone connection was made to a nearby line and run to the fire camp. This took a load off the radio net.

The use of aerial scouting and aerial photos for plotting the fire and the control line aided greatly in early control. This combined with limited ground scouting proved very effective.

The camp was well located near the fire and was rapidly put in full operation by experienced personnel. Lunches, lights, water, and other equipment were always ready to go before departure time scheduled for crews. Adequate transportation was available and ably coordinated under the camp boss.

This fire, burning in steep heavily covered terrain, was readily controlled before the second burning period at 1,223 acres because of the effective use of modern fire fighting equipment, the excellent cooperation of local people; and the efficient work of Forest Service personnel.

Fire Camp Food Order.—On large fires, service chiefs, camp bosses, and supply officers transmit long food order messages that tie up telephone lines or radio channels for some time. These food orders often interfere with radio or telephone communication on the fire line that is of first importance. We have devised a method of transmitting food order messages that has proved to be accurate and considerably faster than heretofore.

When the fire boss determines that he will need a fire camp set up our practice is to dispatch a 100-man camp outfit which includes food for 100 men for three meals. From that time on the camp boss orders food according to what he has on hand and what he needs. He uses a food order list on which each food item is given a number. The camp boss lists the quantity of food needed and turns the list over to a telephone or radio operator. The operator transmits the requisition by calling off the item number followed by the quantity desired. Thus there is no need to use the item name. For example: "Fifteen forty" means "forty pounds of sausage." Here two words replace four.

The form is letter size. Its heading and some of the items of food are shown below:

FIRE CAMP GROCERY ORDER

Order received ______ A. M.______________________________ Fire Camp
Time out ________________ Received by: ____________________________
Truck No. ________________

1. ______ lbs. bacon	80. ______ btls. catsup
2. ______ lbs. butter	89. ______ oz. pepper
15. ______ lbs. sausage	105. ______ ctns. matches
28. ______ boxes apples	114. ______ boxes soda
72. ______ lbs. rice	116. ______ ctns. towels, paper

In addition to the saving in words the list eliminates all writing by the receiving officer except that of merely entering the quantity figure in the appropriate space. This elimination of pencil work speeds up receipt of the message and makes for greater accuracy.

Items 1 through 40 are all fresh or perishable items and are listed together to simplify ordering from merchants or loading from the walk-in refrigerator.

This list also serves the cook and camp boss as a check against overlooking items needed.

A supply of the forms is provided forest officers who may be concerned with ordering food and a quantity is placed in camp boss boxes at the beginning of each fire season.—ALVIN EDWARDS, *Storekeeper, Mendocino National Forest.*

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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 illustrations. 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 (blackline 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.