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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

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Volume 4 Number 1

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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The value of this publication will be determined by what Forest Service officers, State forestry workers, and private operators 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, personnel management, 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.

Address DIVISION OF FIRE CONTROL
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CONTENTS

THE BURNED-OVER AREA AS A CLASSROOM IN FIRE-CONTROL TRAINING

ALVA A. SIMPSON

Fire Control, Region 3, U. S. Forest Service

The control lines and the burned cover on a cold fire can be read almost like an open book by a fire-control veteran. But in such a post mortem he always wishes he also had before him a clear record of the significant movements of men, planning, good thinking, mistakes, confusions, and wastes that were a part of the action. If he had such records in addition to what he can read on the ground he would indeed have an open book to study. However, who wants to provide an open book for the benefit of an analyst or inspector? Isn't there a more fruitful use to be made of it? The author says there is and tells of what has already been done in the Southwestern Region.

The answer to the question, "Will training leave the trainee with experience on which he can draw as a guide to proper action in the job he is going to do?" intrigues all those who engage in training directed at more effective methods of meeting administrative and management problems on the national forests. Any training program must be pointedly directed toward specific objectives. In fire control, training in fire prevention may be entirely different from training in preparedness or fire suppression.

In Region 3 an attempt has been made to train the permanent personnel in attaining better and more effective suppression action through the use of an actual burned-over area for the classroom. As has been frequently pointed out, the major losses in burned-over areas and the greatest expenditures are caused by a relatively small number of fires which fall into the classification of "extra period," or "over-300-acre fires." Likewise, the proportion of such fires to the total number extinguished is so small in Region 3 that on an average not to exceed one district ranger out of 25 will obtain actual experience in handling such a fire in any one year, or to express it in another way, the average ranger will experience a large fire about once during his period of service. Lessons learned even from experience are dimmed by the passage of time, and as an approach to a method for keeping knowledge more current in our minds, Region 3 has embarked on a training program by which the regular personnel responsible for fire control are given opportunity to see on the ground the situation which existed and the action which was taken to control a given fire. This is followed by free and open discussion of the "lessons learned," using the conference method. The problems which the fire presented are outlined in writing.

The classroom should ordinarily be of a size which will permit the group to see, within a 2- or 3-day period, including discussion time, all of the topographic features, cover types, and other elements which influenced the behavior of the fire. The conference room may be a point from which problems of the fire can be observed or some point where a critical attack was made or strategy developed. The group should include not more than 20 persons, a smaller number being preferable. The leader must develop his program on the basis of the situation which is being studied. This means that an extra-period fire may present problems which are different from a fire which has been controlled within the first work period. Preparation of the curriculum on the ground, in advance of the actual group training and provision of a good map of the fire are the responsibilities of the leader. A wide range of subjects may be developed. Wind movement as influenced by topography, slope, aspect, and cover; the fire behavior in different fuel types or as influenced by topography; the presence or absence of natural barriers; transportation and communication; the manipulation of manpower and equipment to secure most effective results; and many other factors will integrate themselves into a planned curriculum.

After the group has "sized up" the essentials of one or two of the problems presented on the fire which is being used as a classroom, they are stopped for conference discussion. After discussion, the leader sums up briefly the various viewpoints and gives step by step the action which appears to have been best for most effective control practices. Following this, prepared problems are read to the group and each member is requested within a specified time limit to write his answers to the questions. The problem presented to one group was:

This fire was discovered at 2:50 p. m. from – lookout, 4 miles distant.

Burning conditions:
- Wind, 30 to 35 miles, from southwest.
- Temperature 95°.
- Humidity 3 p. m.—10.
- Precipitation on 13 days between January 1 and June 15, with 0.47 inch since March 28.

Available manpower and travel time from fire:

Lookout fireman, Hillsboro Lookout	1 hour.
2 emergency firemen, Sawyer Peak	1½ hours.
Per diem guard and 20 men, Kingston	1½ hours.
Per diem guard and 25 men, Hillsboro	1¾ hours.
25 CCC, Mimbres side camp	1 hour.
25 men, Silver City	1½ hours.
State road maintenance crew, 3 men	¼ hour.
100 additional men available at Silver City by 6 p. m.	

Question: What would be your initial action with respect to dispatching men and what would be the priority of dispatching?

Following this question a second problem was given as: "Fire spreads to 40 acres within 1 hour, and is 1½ miles long and ½ mile wide in 2 hours. How would you plan attack and what methods of attack would you use? How many men would you order for follow-up and how would you dispose of them? How many camps would you establish and where?"

The questions were answered, of course, after a visit to the ground over which the fire burned had resulted in a very good size-up of what should be done to achieve control in the first work period.

Space does not permit speculation as to the extent of the subjects to which this type of training will apply. Results are measured, however, by the action of those who have been trained, and several persons engaged in the control of rapidly spreading fires during the extreme burning conditions of June 1939 credit on-the-ground training for the control of these fires in the first work period.

In preparation for such training, camps or facilities for taking care of the group near the fire area are necessary. Usually the fire camp can be occupied, giving an opportunity to examine critically the arrangement and facilities of the fire camp itself and to include in the program training in service of supplies and camp management.

A 1939 aerial picture developed and printed in a plane while over a fire. See article on aerial scouting by Clayton S. Crocker in the October 1939 issue of Fire Control Notes.

THE DRY-ICE TANKER TAKES TO WHEELS

A. B. EVERTS

Assistant State Project Director, Connecticut, New England Forest Emergency Project

The spectacular performance and unusual amount of publicity which has been given to this novel device have stirred up a great deal of interest in dry ice as a pressure medium in expelling water for fire fighting. Hundreds of questions have been asked and not satisfactorily answered. Here is the inventor's own description.

In 1644, a Dutch chemist, Belmont, recognized carbon dioxide as a distinct gas, differing from other gases in many ways. It was not until 1922, however, that the first cake of dry ice (CO_2) was produced commercially. The cost was prohibitive. Later various processes of producing "the ice without water" were perfected, and dry ice began to find commercial uses.

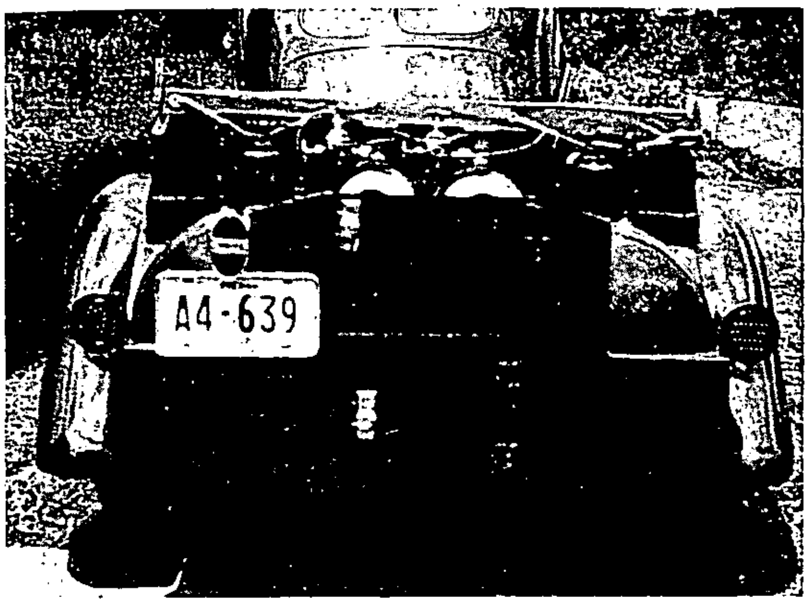
A few years ago an inquisitive chemist was intrigued by the vapors escaping from the mud volcanoes near the town of Niland in the Imperial Valley in southern California. Investigation proved that the vapor was carbon dioxide, 99.6 percent pure. An oil-well rig was set up and drilling started. When the drill had been sunk 600 feet, a pocket of gas was struck, and sand, water, steam, and gas were hurled high in the air. From this initial experiment what is probably the largest field of nearly pure carbon dioxide in the world has been developed. The price dropped from $150 to $35 a ton, and dry ice came into its own.

Meat packers use dry ice in refrigerating meat, manufacturers for shipping ice cream, motion-picture producers for producing fogs, engineers use it as a pressure medium in riveting steel, miners for blasting coal, mechanics for running motors. Others use it in ways too numerous to mention.

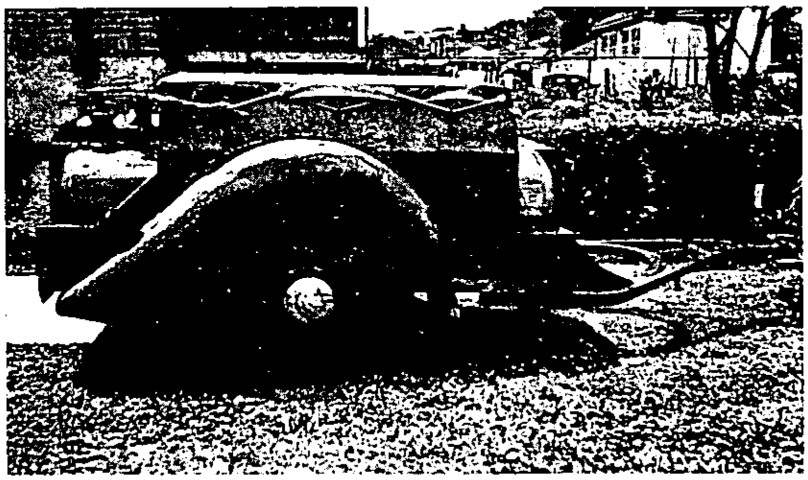
In 1937, while assigned to the Cleveland National Forest in southern California, the writer experimented with the use of dry ice confined in heavy steel cylinders, or convertors, as a pressure medium for expelling water from a tank. From this first crude experiment, conducted with a hot-water tank and a miscellaneous assortment of fittings on the dock at San Diego, the first dry-ice pressure unit was evolved.

This unit consisted of a 50-gallon steel pressure tank mounted on angle irons which could be inserted into the truck body of a ½-ton pick-up truck. On top of the tank a live reel was mounted for carrying hose. Two dry-ice convertors, each with a capacity of 25 pounds of dry ice, were used for producing the pressure.

The convertors weigh 70 pounds uncharged and have actually been tested at a pressure of 7,900 pounds to the square inch. They are equipped with soft blow-out safety disks which rupture at 2,800 pounds pressure. The dry ice is inserted into an opening in the top of the convertor and the lid closed. When dry ice in confined, it immediately creates a pressure against the lid which seals the convertor. The rise in pressure is very rapid up to 75 pounds, at which point the gas, as it sublimes from the solid, becomes a liquid. When all of the solid is melted, the convertor contains a liquid on the



End view showing the storage compartment door and the arrangement of the convertors and control valves. The convertors can be recharged without being removed. The taillight is connected by a cable to the stop light on the towing car.



Side view showing the canvas covering and the trailer hitch.

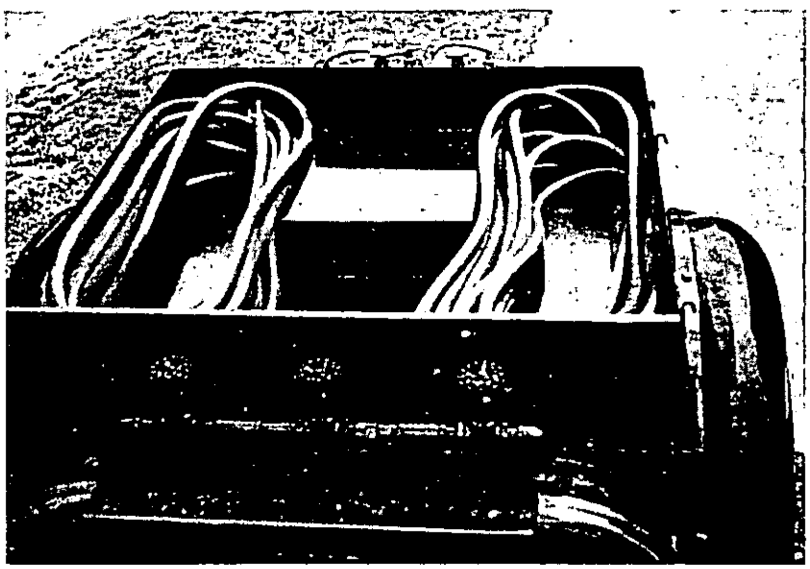
bottom and a gas on the top. At 77° temperature the pressure is 933 pounds per square inch. As gas is withdrawn from the top, enough liquid converts to gas to keep the pressure at 933 pounds until the last drop of liquid is gone.

This pressure is stepped down to the desired working pressure by means of a reduction valve and is carried through a copper tube to the pressure tank. This pressure then forces the water through the hose line. Tests made with the 50-gallon unit showed that the tank could be discharged from 7 to 10 times, depending on the temperature, pressure used, and size of nozzle opening.

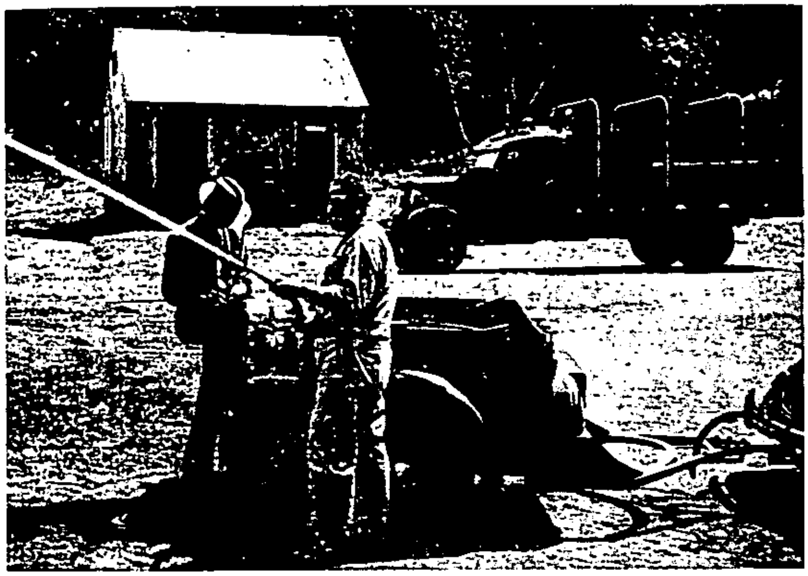
In January 1939, the writer was transferred to the New England Forest emergency project with headquarters in Hartford, Conn. Through the efforts of the State director and the encouragement of other officials from the Boston headquarters, funds were allotted to construct a new unit, this time on a larger scale.

Two 100-gallon tanks, each 6 feet long and 20 inches in diameter, were mounted on a light-truck axle. Around these tanks a superstructure of steel was built so that the tanks are entirely enclosed on the inside. Access to space between the tanks is provided by steel doors both front (not illustrated) and rear. This space can be used for carrying hand tools such as axes, shovels, etc., or for additional hose.

On top of the tanks a solid hose basket has been provided. At the rear and at the bottom of the basket a pipe leads through a 1½-inch gate valve to the hydrant cap filler plug. Thus, under field conditions, the hose can be used as a funnel in refilling the tanks. Tiny holes in each corner of the basket drain off excess water when the tank is full. The unit can be easily filled from a stream or water hole with canvas buckets. If filled from a hose, the 2½-inch hydrant cap is removed. Drain plugs in the front end of the tanks permit easy draining. A canvas top is lashed down to hooks on the side of the hose basket when the unit is not in use. One-inch pressure release valves are set at 110 pounds pressure, thus insuring safety if too great pressures are used.



Top view showing hose basket and valve arrangement. Two streams of water can be used simultaneously or the water from both tanks can be directed through either hose. Note the valve stems permitting the use of air in combination with or in place of CO_2.



The unit in operation. Six hundred gallons can be discharged before the convertors need recharging. At 100 pounds pressure each tank will operate for 10 minutes using a ¼-inch tip.

The valve arrangement on the front end of the tanks will permit two hose lines to be used at once or all the water (200 gallons) may be directed through one line.

Valve stems have been brazed to the tanks in the front so that either air or CO_2 or both can be used. However, if air alone is used, space must be left in the tank because air, unlike CO_2, will not be absorbed in the water. In combination they work very well, the CO_2 supplementing the air as the pressure goes down.

The CO_2 convertors lie on their sides, in a specially built compartment, with the valve outlets up. Thus the gas, and not the liquid, is drawn off. Each convertor is provided with its own reduction valve. With this arrangement two independent units are provided, and different liquids or chemicals can be expelled at the same time, as is necessary if foams are to be produced.

The unit can be hauled behind any car equipped with a ball-and-socket trailer hitch. A stand is provided for use when the trailer is detached.

Empty, but with two fully-charged convertors, the unit weighs 2,145 pounds. The additional weight of 200 gallons of water will bring the total to 3,805 pounds. This is about 200 to 400 pounds more than a loaded two-horse trailer. The use of lighter steel in the construction of the superstructure would easily lighten the weight by 500 pounds or more. The writer recently investigated a copper-alloy tank made of Everdur metal. These tanks withstand 300 pounds pressure and are lighter than steel tanks. They should be just what is desired for the use of chemicals. A 75-gallon tank costs $69. Two such 75-gallon tanks would handle well behind a pick-up or passenger car.

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The cost of the unit as constructed in Hartford was approximately $550 complete with hose anl fittings. Of this cost $300 was for the tanks, the steel, and welding alone. On an order of a dozen or more units the cost should not run over $400. Dry ice costs from 2½ to 6 cents a pound. Dry Ice Incorporated, Nu Ice, and several of the liquid carbonic companies are the biggest agents. Many ice-cream manufacturers and dairies offer it for sale. It can be shipped anywhere in the United States in 24 hours. There is, however, some shrinkage in transit.

In tests, we found that we could expel three 100-gallon tanks before the convertors were discharged. Tests were run at 100 pounds pressure, using a ¼-inch nozzle. It took just 10 minutes to discharge the tank. In the last 100 gallons there was a dropping off in pressure toward the end, but the effect upon the length of the stream was very little. I am inclined to believe that this occurred because of freezing in the minute opening of the reduction valve. Water was discharged for 50 feet throughout the test.

With this unit, control is automatic at the nozzle. That is, gas will flow into the tank at whatever pressure the gage is set until the pressure is equalized. If the nozzle is then opened and water is expelled, more gas will flow into the tank.

In conclusion, it must be stated that dry-ice units can never take the place of large-capacity tank trucks, or even small ones, where a large volume of water is needed. However, working on the theory that all fires are small when they start and considering that 8 or 10 of these units can be built for the cost of one-medium-sized tank truck, they would seem to have their place. With no pumps, no motors, no moving parts, they are simplicity itself. For estate and grain field protection, for speedy patrol in connection with logging operations, and for spraying various chemicals and liquids, their possibilities are beyond question.

The Ruidoso Training Session.—Sixteen rangers from 11 national forests of the Southwestern region gathered at the Bonnell ranch on the Ruidoso River, Lincoln National Forest, the afternoon of October 9. The next 2 days were spent on the Cedar Creek fire area, where a fire, endangering the residential section along the Ruidoso, occurred on June 15, presumably from hot ashes deposited on the forest floor.

The fire crowned within 100 feet of point of origin in a 20–40 year age stand and developed into a spotting fire which presented intricate problems to test the resourcefulness of the fire boss and his organization. Specific problems in camp layout, organization, and suppression technique were given to the rangers from strategic viewpoints where the area could be studied to advantage. With the written answers received, the proper action to take was fully presented by the instructor with ample opportunity for discussion on the ground.

A demonstration of backfiring technique with a supposed fire approaching a saddle was given by three of the rangers, showing the method of using buffer lines in bringing the crown fire to the ground. Backfiring will continue to be used and with increased confidence after viewing such a demonstration.

The final morning was spent in a study of the erosion-control work on the area. Contour strips had been planted to millet, brome, and grama grass seed. The planting was too late to permit maturing, although the millet was 6 to 8 inches in height. Eighty poles or logs per acre had been felled and placed on contours above trees or stumps in order to retard run-off and to help build up deltas to serve as seedbeds for vegetation.—Alva A. Simpson, fire control, Region 3.

CONSISTENT PLOTTING OF ADDITIONAL COVERAGE

KARL E. MOESSNER

Junior Forester, Superior National Forest, Region 9, U. S. Forest Service

Detection planners in relatively flat or gently rolling country have always been plagued by the difficulty of determining how much seen area would be added by different elevations to be obtained by towers. The author offers a mathematical solution.

The erection of a portable tower exceeding 60 feet in height is likely to prove a difficult job. In addition, the cost of using such a tower on a detection survey involving a large number of points would unquestionably be prohibitive. For these reasons, seen-area maps of unoccupied points in flat country are seldom made from a height equal to the tower which would actually be erected should the point prove acceptable.

Although fair results can be obtained by studying seen-area maps made from towers of varying heights, the detection planner is frequently asked to estimate the coverage possible from a tower higher than the one used by the field mapper. This additional coverage is especially important where the planner advocates:

1. The shift of an existing tower.
2. The use of an exceptionally tall (120-foot) tower.
3. The erection of a taller tower at a point already occupied.

Since these estimates may be the basis for spending a considerable sum of money, they should be conservatively dependable. Assumptions based on personal opinion will seldom be within the required standard of accuracy.

Eliminating the expensive remapping of the point from a higher tower or taking a chance and erecting a new tower without prior proof of its value, the planner is faced with the necessity of calculating mathematically the additional seen area.

A technique recently developed on Upper Michigan National Forest is offered as a consistent method of making this estimation of added coverage. The basis for this method is a mathematical calculation of the new length of each unseen area, along rays from the tower through each prominent mask. These rays are originally plotted by the field mapper, who records on the map the vertical angle to each mask as measured by his instrument.

The calculation is made on four known factors and can be summed up in the simple formula on page 11.

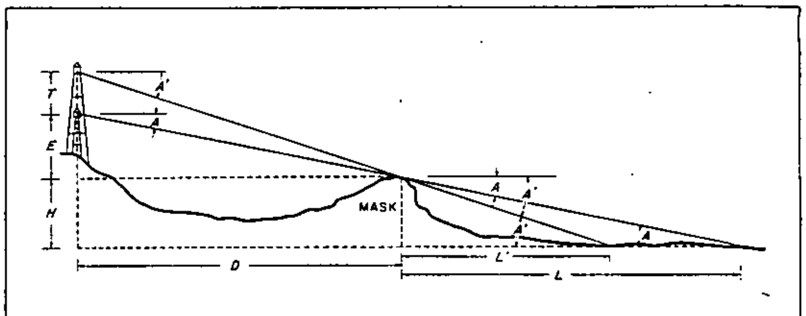


Figure I.

I. In the diagram:

A=the verticle angle, tower to mask, measured by the field mapper and recorded on his map.

D=the horizontal distance, tower to mask, as sketched on the field map.

L=the length of the unseen area as sketched on the field map.

T=the difference in height between the present or mappers' tower, and the one to be used at this point.

II. We can calculate by trigonometry:

A'=the verticle angle of the mask from the proposed tower.

H=the height of the mask above the extremity of the unseen area.

E=the elevation difference between the mask and the top of the original tower.

III. We wish to determine:

L'=the new length of the unseen area.

Substituting in the right triangle formula:

$$a=\frac{b}{\cot\ A}$$

$$E=\frac{D}{\cot\ A}$$

$$H=\frac{L}{\cot\ A}$$

And substituting in formula:

$$\cot\ A=\frac{b}{a}$$

$$\cot\ A'=\frac{D}{E+T}$$

And substituting in formula:

$$b=\cot A$$

$$L'=H\cdot\cot A'.$$

To reduce this formula to known factors, we substitute and get:

$$L'=\frac{L}{\cot\ A}\times\frac{D}{E+T}=$$

$$L'=\frac{LD}{\cot A(E+T)}$$

Again substituting, we get:

$$L'=\frac{LD}{\cot A\left(\frac{D}{\cot A}+T\right)}$$

And clearing, we get:

$$L'=\frac{LD}{T+D\cdot\cot\ A}.$$

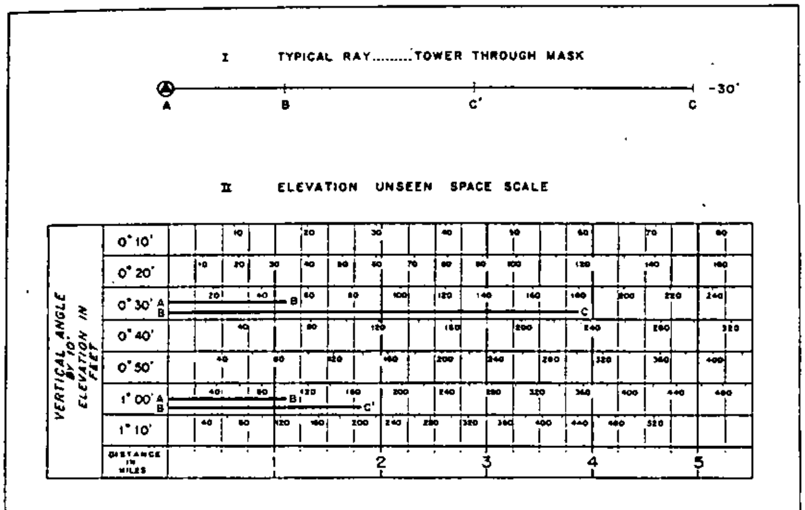


Figure 2.

I indicates a typical ray as shown on a seen-area map. A is the tower; B, the mask; and C, the far edge of the blind area. The figure 30′ at point C is the minus vertical angle measured from the tower. C′ is the new edge of the unseen area. II indicates the space scale readings used in this problem.

$$L' = \frac{LD}{D + T \cdot \text{Cot } A}$$

In this formula:

L = the length of the unseen area in feet as measured from the original field map.

D = the distance in feet from the tower to the mask as plotted on the original field map.

Cot. A = the cotangent of the vertical angle, tower to mask, as recorded on the field map.

T = the difference in height of the old and the proposed towers in feet.

L' = the new length of the unseen area.

The derivation and proof of this formula is given in figure 1.

While the computation by formula is relatively easy it requires the use of trigonometry tables which may not be available, and presupposes a working knowledge of trigonometry on the part of the planner. In addition, the calculations require some time.

For these reasons a simplified procedure has been worked out using the Elevation–Unseen-Space Scale,[1] which gives quick results of the required accuracy. Figure 2 illustrates this method.

1. On the 30-foot scale lay-off AB (1.12 miles) and read 55 feet, the elevation difference of the present tower and the top of the mask.

2. On the 30-foot scale lay-off BC (3.84 miles) and read 180 feet, the elevation difference of the mask and the far edge of the unseen area.

[1] Described in an article "Seen-Area Mapping—A New Technique," Fire Control Notes, October 1939, p. 18.

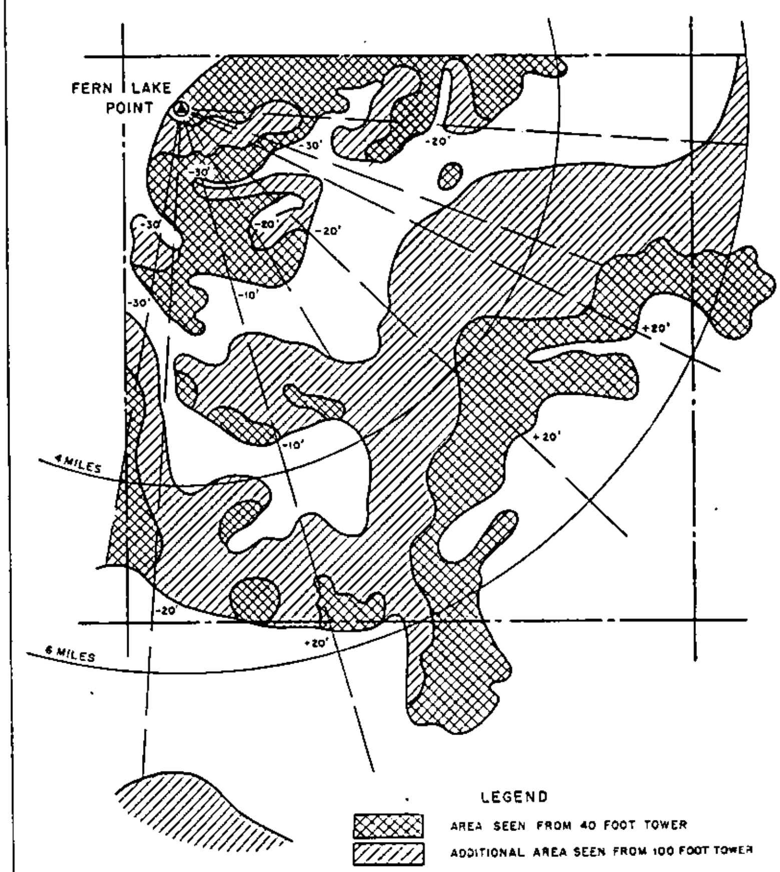


Figure 3.

The above sketch is part of a typical map made from a 40-foot temporary tower with estimated 100-foot coverage as sketched by the elevation—unseen space scale.

3. Assuming that the present tower is 40 feet high and that the proposed one will be 100 feet, the elevation difference of the new tower and the mask would be 55+60 or 115 feet.

4. Using distance *AB* and 115 feet, we find the new angle lies between 1° and 1°10′ and interpolating, we assume it to be 1°5′.

5. Using 1°5′ and a figure of 180 feet (see step No. 2) we again interpolate and read *BC′* (1.70 miles), the new length of the unseen area.

Substituting into the formulas, derived in figure No. 1

$$L' = \frac{LD}{D + T \cdot \cot A}$$

as a check, we find

$$L' = \frac{20{,}460 \times 5{,}940}{5{,}940 + 60 \cdot 114.6} = \frac{20{,}460 \times 5{,}940}{12{,}816}.$$

L′=95,040 feet.

L′=1.8 miles, an error of 0.1 miles, which on a number of rays will prove compensating and can therefore be ignored. After the new length of the unseen area is figured and indicated on each ray the outline can be sketched in on the map by connecting the plotted points.

Figure 3 shows the way a completed sector of the revised map would appear.

In using this method the planner may find that the outer unseen areas extend indefinitely and he therefore has no way of calculating the height of the mask. In such occasions the only available method is to estimate the probable height of the mask. The error so incurred is not likely to be dangerous, since the relative accuracy of any seen-area sketching drops decidedly beyond the 6-mile radius.

Prevent Forest Fires—It Pays.—What do we buy with our prevention expenditures, and how can we evaluate it? Well, here are some data from the Mount Baldy District of the Angeles for the Fourth of July holiday:

	Cars	People	Number	Percent	Cost
Registration	7,933	25,107			
Contacts other than by registrars		5,986		23.8	
Violations of fire and sanitation regulations			44	.59	
Personnel:					
Registrars (per diem)			6		$120
CCC (man-days)			60		90
Patrolman			10		178
Supervision					20
Travel					50
Total					458

SUMMARY

Total cost	$458
Total people	25,107
Cost per person (cents)	1.8

Weather conditions: Except for the first day conditions were normal. The fire danger classes of organization indexes were as follows: July 1, class 5 (first emergency); July 2, 3, and 4, class 4 (normal).

Results: There were no fires on the district during the holidays.

The field force reported that this crowd was very well behaved.

We do not claim any records of cost or any extra efficiency of personnel. These data are given just to show the effectiveness of registration and patrol in fire prevention. Since records for the Angeles from 1921 to 1938 show the average cost for fire suppression for individual fires to be class A $431, class B $1,403, and class C $35,900, we feel that the prevention costs were well worthwhile.—From the California Ranger, Wm. H. Maxwell, district ranger, Mount Baldy District, Angeles National Forest.

THE USE OF SMALL TANKERS IN FIRE CONTROL

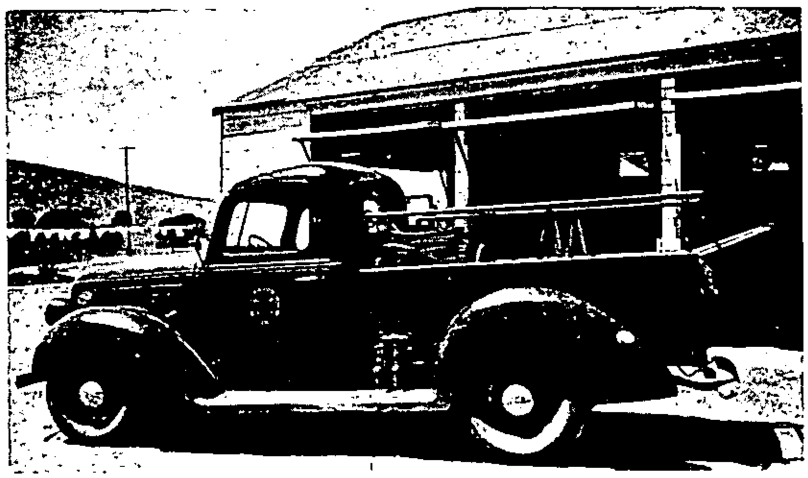
James K. Mace
Ranger, California State Division of Forestry

The greatest number of fires that do the most damage are man-caused and are usually started near roads or in areas which are accessible to small pick-ups. When fires can be reached by these pick-ups, the quickest way to bring them under control is to use water.

Calaveras County is considered one of the "hot spots" in the Sierra Nevada Mountains. Although the topography is rough, there are many county roads, CCC truck trails, and old abandoned roads, and many of the ridges and valleys can be covered by small pick-ups.

Before the 1939 fire season, two administrative ½-ton pick-ups with four-speed transmission were converted into small tankers. They are capable of carrying 65 gallons of water and five men with the necessary fire tools. The pump used is a Panama, with a capacity of 15 gallons per minute at 100 pounds pressure; 100 feet of rubber-covered hose is used.

In use, the small tanker goes into operation on arrival whenever the fire is burning in grass, bear clover, pine needles, or short brush. As soon as the head of the fire is stopped, the small crew that accompanies the tanker or pick-up starts building trail and throwing back the hot spots left behind the tanker. If the fire cannot be stopped by direct attack, a backfire is started just ahead of the main fire, the pick-up being used to put out the backfire away from the main fire. The crew follows, making the trail safe.



The San Andreas ½-ton tanker.

Although the amount of water available for first attack is small, by economical use, many fires are checked until the larger tankers arrive or until the arrival of additional suppression crews. In this particular area it is very important to stop the head as soon as possible, and if this can be accomplished by the small tankers, it is a relatively easy job to tie up the rest of the fire.

When a fire reaches large proportions, again the pick-up is very valuable as it makes equipment available for the hot spots.

This type of equipment is much cheaper than the standard tanker, and it makes possible several units on a fire, which gives a better chance for control than when only one or two of the large tankers are available.

The administrative pick-up has been used as a small tanker in this area only during the current fire season but its practicability has been proved and the units have paid for themselves many times over in controlling fires.

Cooperation on the Coronado.—As an example of good work in nonshotgun application of prevention pressure, we quote the following from the Coronado Per Diem Guard Bulletin. Patterning the effort to cause-class or group got results:

"Last spring a check-up on man-caused fires, during a period of 5 years, indicated that 32.5 percent of such fires were caused by prospectors and miners. This information came to the knowledge of Mr. Ed. Bohlinger, prominent legislator and mining man of Patagonia, Ariz. Mr. Bohlinger very kindly offered his cooperation and saw to it that the Small Miners Association of Arizona was duly informed of the facts. As a result, during the 1939 forest fire season to date, out of the 17 man-caused fires on the Coronado Forest, only 3, or 17.6 percent, were caused by prospectors and miners. Assistance such as that rendered by Mr. Bohlinger and by the numerous miners and prospectors with the national forest is of the highest type of cooperation in the war to protect the nation's natural resources."

Why Stop Them?—What the residents of Van Buren, Mo., think of the value of fire prevention was answered last week in a leaflet entitled, "Forest Fires. Why Stop Them?" Sponsored by the Progressive Forum and the Conservation Federation of Van Buren, several well known citizens were asked to contribute short statements concerning the benefits resulting from keeping the fires out of Missouri woodlands. Farmers, merchants, doctors, housewives, lawyers, and stockmen, all residents of Carter County, responded with their statements which were published in the leaflet.

Supervisor Kelleter said the leaflet was an index of the aroused and effective interest on the part of residents in the vicinity of Van Buren.

Brodie White, a farmer living near Van Buren, said that preventing forest fires would result in "better water supply, more hog range, better timber, and less erosion."

Brad Greene, another farmer, said, "Fires on my land do me more harm than good."

This statement was made by Carl Hudson, Social Security director at Van Buren: "Had our forefathers dreamed that as they burned over our forests year after year they were creating unemployment conditions that would eventually cause their grandchildren untold suffering, undoubtedly they would have desisted from the practice. Taking a lesson from them let's help our children's children and stop burning the woods."

Clark Forest officers were optimistic over the human interest angle used in the fire-prevention campaign of the Van Buren citizens. There were comments to the effect that the statements in the leaflet were made by local citizens, all long-time residents of the community. They would be read by others. It was said that other communities would follow the same approach to reach the local resident.—Daily Contact, Region 9.

189203—39——3

USE OF OZALID PAPER FOR MAKING COMPOSITE SEEN-AREA MAPS

VERNON E. HICKS
Junior Forester, Region 6, U. S. Forest Service

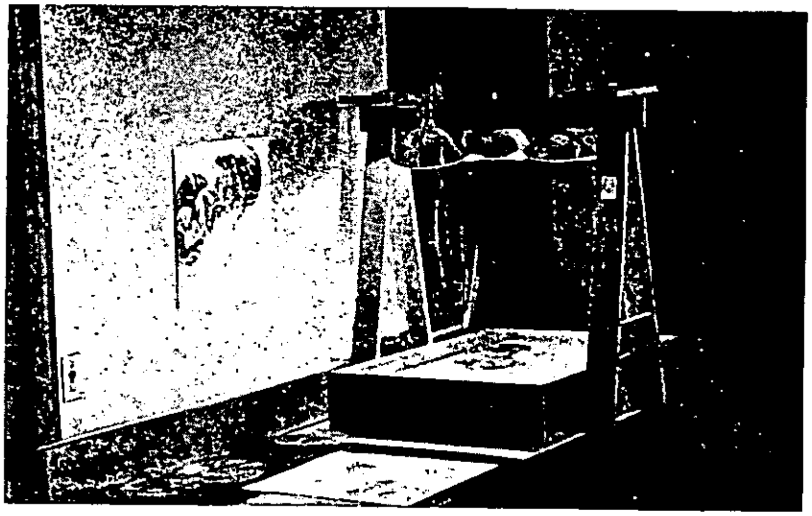
In the preparation of a detection plan for an area, it is often desirable to make several composite seen-area maps showing coverage obtained by using differing combinations of lookouts. Preparing a composite seen-area map by use of a vellum overlay and colored pencil is a time-consuming process, requiring 2 to 4 hours for a ranger district. The use of Ozalid paper makes it possible to produce a comparable map in 15 to 20 minutes.

Ozalid paper is a sensitized paper having the following advantages:

1. May be exposed by natural or artificial light.
2. Requires only ammonia fumes for developing.
3. Print is exactly the same size as original.
4. Paper is not sensitive enough to require the use of a dark room and may be handled in the subdued light of any room into which the sun does not shine directly.
5. Relatively inexpensive.
6. Cannot be over-developed.

In this region, visible-area disks have been prepared on Plastacele for 5-, 8-, and 15-mile radii for most present and potential lookout

Visible-area disks oriented and taped to vellum overlay.



Three photoflood lamps with reflectors are used for exposing. Distance from lowest part of bulb to Ozalid paper is 25 inches; exposure time, 6 to 9 minutes.

points. Visible area is shown in different colors for different points. Tests show that light blue and pink print poorly; yellow, orange, dark red, and green print very well. Disks which do not print well may be stippled with a fine brush and black ink on the opposite side from the color. Ink may be washed off later if it would in any way impair the value of the disk.

Assuming that the ranger district is the unit of area used in planning, the main points in the procedure for obtaining a composite seen-area coverage map are:

1. Prepare a vellum overlay showing the following:
   - (a) District protective boundary.
   - (b) Location and identification of each present or potential lookout point; this should be done with ink.
   - (c) Any information desired which it is felt will influence the location of lookouts; i. e., fuel type, fire occurrence, etc. This should be shown by cross-hatching, preferably with ink or orange pencil.

2. Select by any method desired lookouts which appear to give the best detection system.

3. Orient disks for lookouts selected and held in place on vellum overlay with transparent cellulose tape, see illustration.

4. Place piece of Ozalid paper on table or in frame, emulsion (yellow) side up.

5. Place overlay and disks over Ozalid paper and cover with piece of glass sufficiently large to completely cover map; this is done to hold papers and disks tightly together. See illustration for arrangement used to expose with artificial light.

6. Expose and develop in ammonia chamber. (A home-made chamber can be made at very little expense by using a tin map tube

The final print.

6 inches in diameter over an open container partially filled with ammonia and covered with screen to prevent the map from getting into the ammonia.)

It must be remembered that visible area shown in colors which print well may block out some of the information on the vellum overlay; e. g., protective boundary. However, any areas not covered by seen area show up clearly and the overlay may always be used with the print over a light table if necessary or desirable. If transparency is desired, a thin Ozalid paper similar to vellum may be purchased, or prints made on the ordinary grade paper may be made as transparent as vellum by applying oil or wax.

With such a rapid and economical means of producing composite seen-area maps, it is possible to have on file the coverage obtained from different combinations of detection facilities which may be used under various conditions during the fire season.

RANDOM NEWS NOTES FROM THE FOREST SERVICE RADIO LABORATORY

Since preparing the last résumé of Radio Laboratory activities for Fire Control Notes the entire technical staff of the laboratory has put aside development work several times to accumulate some first-hand field information on going fires. The ability to keep both feet on the ground and remain entirely practical comes only through these intimate contacts with the Forest Service type radio equipment at work and from comments and suggestions from the users.

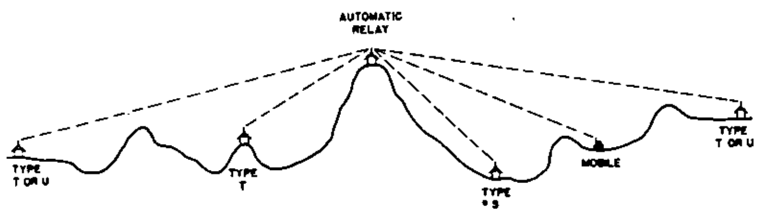
We solicit and welcome reports on the operation of existing types of radio equipment. Although the average user will perhaps not be in a position to make highly technical suggestions for the improvement of the radiophones, his operating experience may suggest possible features of improved mechanical design or more convenient packaging. If some part causes recurrent trouble, we would like to know it so that corrective measures can be taken to eliminate the source of such trouble. It is only through a blending of ideas that we can provide the field with radio units having wide application and high reliability.

Current Projects and Completed Assignments

Equipment Inspection.—From June 1 to September 15, 1939, the Radio Laboratory has handled the technical end of procurement and inspected 353 completed radiophones, in addition to inspecting individual high-frequency radio receivers and miscellaneous test equipment. During the period the distribution by types was: 102 SPF, 4 I, 11 M, 73 S, 103 SV, and 60 T. The total number of completed radiophones inspected since January 1, 1939, is 433 units.

Metal Detecting Device for Saw Timber

The development of this special device for use by NETSA was mentioned in the previous Radio Laboratory news notes, Fire Con-



This sketch illustrating the physical applications of ultra high frequency relaying was omitted from Random News Notes from the Forest Service Radio Laboratory, Fire Control Notes, October 1939. The numerous possibilities of such a relay system are readily apparent from the sketch.

trol Notes, October 1939. The completion of this instrument was delayed both by the recent large quantity of equipment inspection and by several unforeseen difficulties in design. The completed device is being installed in its carrying case as this is being written. In its final form the metal detector will reveal the presence of a tenpenny nail at a distance of about 4 inches from the exploring loop. Larger metal objects such as a 6-inch spike can be detected at a distance of about 12 inches.

Cooperation With Aerial Fire Control

The aerial fire control project, now active in Region 6, recently called on the Radio Laboratory for assistance in developing a special switch and associated electrical circuits for use in connection with the dropping of fire-extinguishing chemicals. It was discovered that even light gage metal cans, containing liquid chemical often failed to burst upon striking the ground. Time-delay electric blasting caps were inserted in each can and the problem presented to the Radio Laboratory was that of providing an electrical system and switch which would prevent the application of current to the caps until the cans of chemical had cleared the trap doors of the dropping chute in the airplane. A special heavy duty switch and link mechanism was constructed in the laboratory shop, and this together with audible and visual warning signals have been installed on the airplane.

Design of Ultra-High Frequency Mobile Radio Receiver

The need for and aims of this project were discussed in Fire Control Notes, October 1939. This project is now current and has progressed to the point of constructing the first mechanically condensed model. Crowding of the component parts to produce a practical size has resulted in somewhat unstable operation. The remaining portion of the job is the coordination of mechanical and electrical features.

Radio Handbook Material and Service Data

Service data on the type T model D radiophone has been completed and will be ready for distribution about October 15, 1939. Service data for the new type M model D is in the process of assembly. Complete service data and a discussion of the applications of the ultra-high frequency type A test set has recently been completed and will be distributed as an addition to the Radio Handbook.

Automatic Ultra-High Frequency Relay

Automatic relaying of ultra-high frequency radio signals was discussed in some detail in the October 1939 issue of Fire Control Notes. The experimental relay which was put into service at the Radio Laboratory in June was taken out of service after approximately 2 months of highly satisfactory operation and taken into the field for trial on a going fire. As the relay was to be put in service to relay a group of type S radiophones the automatic turn-on portion was not used (see discussion in Fire Control Notes, October 1939). The sole purpose of this field test was to obtain the reaction of field men to the possibilities of such a device. Undoubtedly the man most favorably impressed was the head ground scout of the Region 6 scouting unit, who was able to communicate directly from the base camp with his scouts working from 2 to 8 miles away in extremely broken and mountainous country.

The relay has again been set up for full automatic control and is now operating on an experimental basis from a 4,000-foot prominence about 22 miles east of the laboratory in Portland. The entire apparatus, housed only in a wooden chest, has been set out in the open near the top of the mountain where it will be subjected to an extreme range of temperature and humidity. Valuable information has already been obtained relative to precautions necessary to prevent these factors from causing false operation or failure.

Development of the automatic relay does not yet appear on the work plan or job lists of the Radio Laboratory. The automatic relay idea as applied to forest communication originated in the Radio Laboratory, and until we have a further expression of opinion from the field it will be impossible to assign a position of priority to the project. So far the development has been on the basis of borrowing a few minutes for it whenever possible.

Drops From the Grid Leak

Mr. Headley has suggested that this news letter contain an occasional interesting episode relative to radio and its uses in the field. This, together with those items of interest to technicians or those connected with communication planning, will constitute "Drops From the Grid Leak."

It seems fitting that we should first define the type of individuals who carry on the work at the Radio Laboratory. A radio engineer is a man who knows a great deal about very little and who goes along knowing more and more about less and less until finally he knows practically everything about nothing. A radio mechanic starts out knowing practically everything about everything, but ends in complete confusion because of his association with the radio engineer.

Every service man who has anything to do with Forest Service ultrahigh frequency radiophones should be equipped with the type A test set. This instrument is fundamentally a grid dip oscillator, but has been provided with a form of self modulation and a means of employing the device as a rectifier wavemeter for neutralizing and other operations. The type A test set carries a frequency calibrated scale which, though not intended for frequency measurement work, is invaluable in adjusting antennas and matching sections.

Technicians should note that conventional methods and instruments cannot be used in adjustment of the type T model D radiophone receiver. Because of the extremely broad I. F. band in this receiver, which is necessary to receive modulated oscillator transmitters such as the type S, it is imperative that the Forest Service type D oscillator channel marker be used for any adjustment of the I. F. channel. The type D instrument will be included in the radio equipment bulletin, and a detailed discussion of its application and operation appears in the service data for the type T model D radiophone in the Radio Handbook.

To avoid confusion resulting from a duplication of type designation on two distinct types of radiophones; i.e., the type I mobile and type I semiportable, the type I mobile will hereafter be known as the type K radiophone. Type I semiportable will be known simply as type I radiophone.

Observations Bring Results.—On September 3, a fire was reported in Boulder Creek on the Descanso District of the Cleveland. Protective Assistant William Clark was dispatched immediately and upon arrival discovered that it was a "set." He preserved the evidence with due precaution and proceeded to corral the fire with the aid of one man, calling in reenforcements for the mop-up. This fire reached about one-half acre in size in flash-chamisal type of fuel. The control of this fire on a hot day by two men was, in itself, quite an accomplishment.

The next day, accompanied by Ranger Ed Grant, Clark returned to the fire, and tracks were found leading up the bottom of a small canyon. Great care was taken by the perpetrator of the violation to insure, so far as possible, that the tracks would not be left visible. By very close observation and by working slowly, the tracks were seen in grass, leaf mold, and even in the centers of small bushes, broken twigs and limbs being all that could be seen in several long stretches. After 2 to 3 hours, and about 1 mile of tracking, the tracks intersected the main trail and were obliterated by the tracks of the suppression crew members. This point, however, was within 100 yards of a ranch house.

Because of darkness and rain the investigation was postponed, while a call was placed for Rawleigh Taylor, fire prevention officer on the San Bernardino. Upon his arrival the investigation continued. A call was made at the sheriff's office and also at the city fire marshal's office in San Diego where the type of set was partially identified as being possibly of a figure 4 variety, operated with the use of rubber bands and rigged up with paraffin so that the sun's rays would release it. Sandpaper was used to strike a match to ignite the powder and set off the brush. (Test of sandpaper on the "set" proved nitrates present.)

With this information, we returned to the ranch and carried on. Sandpaper of the same make and texture was found; then galvanized nails were found of the same size and type as those used in the "set." Next a can of black powder was found. In a corner of the shed, near the work bench, was a pile of shavings. All of these shavings were collected by Taylor and placed in a sack. Next morning a minute inspection of the shavings uncovered several small bits of wood which appeared to have been whittled off of one board in the "set." So far, all of this had been principally circumstantial evidence.

We felt we knew our man. Another trip was made to the sheriff's office for aid, which was promptly furnished by Mr. Carnes who was quite expert on wood identification. We needed particularly to know whether our "chips" fitted the board from the "set" or not. While Mr. Carnes worked with the microscope on the "chips" and the board from the "set," the sheriff with Taylor accompanying, returned to the ranch and brought in their man with a "full confession," a ranch hand who has to answer charges in a Federal court at Los Angeles for a felony and at present is out on $1,000 bail.

Mr. Carnes brought in a report that the chips came from the board, while the suspect informed us he did go down and up the canyon where we found the tracks and that the "set" consisted of two boards, matches, powder, rubber bands, and wax, so arranged that the sun melted the wax, one board holding the matches rubbed them across the board holding the sandpaper and powder, and this in turn set off the brush he had piled around the "set." Our deductions were close, especially as to ingredients used.

The story is long but the moral is short. Always remember that each fire may be a "set," and that it is our job to enforce the fire laws with the evidence present, which means we must watch for, preserve, and use it wisely.—E. A. Grant, ranger, Cleveland National Forest.

DOGS AS A FIRE-PREVENTION TOOL IN THE SOUTH

W. R. Paddock

Senior Forester, Division of Operation, Region 8, U. S. Forest Service

Hounds were used with some misgiving for years. It was feared that the net public reaction might be unfavorable. Experience has shown these fears to be groundless. In one instance, not cited by the author, fire-prevention activity for a district hound practically stopped because there were no more man-caused fires. But the animal was still used in cases of burglary and other depredations with the result that its prevention influence continued because its exploits in other forms of law enforcement were widely known.

Region 8 has about as many fires occurring each year as any other national forest region, and 85 to 90 percent of them are man-caused. Although there has been a favorable reaction to fire-prevention educational and publicity work, 25 percent of the fires on the average are still caused by smokers and 40 percent by incendiaries. In order to prevent the fires caused by chronic carelessness or malicious intent, law enforcement must be resorted to at times. Trailing dogs (blood-

Fire-prevention "bloodhounds" at 6 months of age in Mississippi. These dogs are a cross between the English bloodhound and "Red bone" breeds. The combination produces excellent man-trailers. The dogs were in training when the photograph was taken.

hounds) were introduced into the region more than 10 years ago as a preventive measure, and it was thought that the history, experiences, and conclusions reached might be of value to other fire-control organizations which were considering the use of dogs.

The first dog used in Region 8 was on the Ouachita Forest in 1928. She was a black and tan American hound, named "Donnie," trained as a man-trailer. Later she was used on the Ozark Forest and in 1932 was brought as far east as the Cherokee Forest in east Tennessee and north Georgia. Donnie was owned by a deputy sheriff in Hot Springs, Ark., and had a wide reputation for successful work on all types of criminal cases. About a year ago she died of old age, but her reputation lives on both within the Forest Service and among forest residents where she was known. The exceptionally long chase she gave a firebug in north Georgia is still a topic of conversation in that section.

Certain characteristics of this dog "Donnie" are mentioned here as an example of what a fire-prevention dog should be. Of pure blood lines, distinctive in appearance, she was well trained and had a record for bringing about successful convictions in criminal cases. Later her work was also instrumental in obtaining successful convictions in many fire cases. Her appearance was such that when carried around the country, people took it for granted that she was a man hunter, which unquestionably prevented many fires.

In 1935 two English bloodhounds were purchased by a fireguard on the Cherokee Forest and were available for fire use. These dogs were used successfully for about a year, but died of disease. Later, on the same forest, a chief foreman in a CCC camp obtained a dog and, although it is not known that it was ever actually used, the incendiary fires suddenly stopped in that camp area.

Ranger Roscoe Nicholson of the Chattahoochee Forest obtained a hound trained for man-trailing about 1935. This dog has worked on the eastern part of that forest and also on the Nantahala Forest since that time. She has been a successful trailer, and incendiarism has become a minor cause on the districts where she has been actively used.

The Pisgah Forest purchased a pair of bloodhounds in 1938. Already these dogs have been instrumental in enforcing the law in a number of game and fire trespass cases.

The Mississippi Forest purchased two young bloodhounds from Mr. Gant of Crystal Springs, Miss., who helped train the dogs. He also taught the Forest Service fireguard how to handle them. A point which is important in connection with these particular dogs is that the laws of the State of Mississippi provide that dog evidence is admissible in any court in the State if obtained by dogs that are from Gant's stock and trained by him.

The conclusion reached concerning the use of dogs are:

1. The dogs should be of recognized good breeding, preferably from a breeder who works his stock and has a reputation based on successful convictions.

2. The value of the dog in preventing fires lies both in solving fire cases and in the fact that local residents know the dog is available for use. The dog should be taken around the forest in an automobile and shown off frequently.

3. The dog should have a trained, skilled handler and preferably should work with one master. Some dogs will work for any handler. "Donnie" of the Ouachita was one of these, but they are in the minority.

4. The value of a dog in tracking a man is not necessarily in catching up with him. The fact that the law-enforcement officer is led over the violater's trail makes it possible to pick up any evidence along that trail. Also, knowing the route of travel of the person hunted is often important.

5. Personnel in Region 8 favor the use of dogs of the bloodhound trailing type. These dogs are respected by local residents, and it is doubtful if dogs of the "police" breed would be as successful. Writers on the subject state that the percentage of such dogs with a very keen trailing sense are in the minority. It could be serious if a dog were used that was not dependable.

The use of dogs is on the increase in the Southern region, and most forest officers regard them favorably. Where used, dogs have apparently been a definite deterrent to the firebug. Their use is recommended where other measures fail and conditions are comparable to those in the South.

Fighting Fire in the Mud.—The first man to arrive on the Camp Branch No. 16 fire on the De Soto, found a 50-acre fire burning on an exposed site before a 20-mile wind. He had five men on a "hot shot" pick-up, equipped with 55 gallons of water, and knew that reenforcements would arrive within a short time. He attempted to drive the truck through the rough to the head of the fire and got bogged down. He got the truck out and made another attempt to reach the head, only to get bogged down again. The truck was finally abandoned, and the crew started at work on the west flank of the fire. The man in charge of this crew did not reach the head until it had burned out.

I personally tried to take a short cut and got bogged down on a road I knew was bad the week before. Had this not occurred I could have arrived at the fire at approximately 3:40 p. m., instead of 5:25 p. m.—J. J. Welch, district ranger.

Who Did It First and Did the Angeles Develop Pictures During the Flight?—With reference to Clayton Crocker's article on aerial scouting in the October 1939 Fire Control Notes, this method of scouting was used very effectively on the Angeles, San Antonio fire of November 1938. This fire burned into the San Dimas Experimental Forest with a very irregular line and long fingers in very steep country. The pictures told a better story than any ground scout could possibly give.—W. V. Mendenhall, forest supervisor. (This is apparently the first time we have ever been able to publish a comment on something contained in the preceeding quarterly issue. The October number came out ahead of schedule. Perhaps the one-lick method has reached Washington.—Ed.)

TRENCHER FIELD TESTS

H. T. Wicklund

Senior Automotive Mechanic, Region 1, U. S. Forest Service

About 40 Bosworth trenchers have been built by the Forest Service in the machine shop in Missoula and distributed to various sections of the country. During the past summer they have been subjected to rigorous use and field tests, calculated to bring out all the faults and induce possible failures. The author of this article has dug deeply into these mechanical problems and presents a most interesting report of his findings. Fire Control Notes solicits constructive criticism of these findings and will publish any other reports which will tend to expedite the development of this promising fire tool.

The success of the trencher depends upon a lightweight unit, and I think the weight should be held as closely as possible to 100 pounds. As far as I can determine, the Bendix motor is the lightest motor obtainable which will deliver anywhere near the maximum of 5 horsepower. The vertical crankshaft permits the simplest possible adaptation to the trencher and the best distribution of weight, getting it as far forward as possible so that a larger percentage is carried on the wheel than by the operator.

The motor has shown power enough to make a satisfactory trench in any kind of material we have encountered—matted brush and roots, deep white-pine duff matted with roots, heavy cedar duff crisscrossed by roots, bear grass, rock, gravel, sod, etc. At times when the going is tough and the machine has to be eased into the work, slowed up or backed up to allow the motor to pick up speed, it might be criticized for being too slow or not having enough power. Those who would so criticize it, probably would not stop to think of its speed as compared with the speed of clearing construction ahead of any kind of trenching work. Even at its slowest pace, it can more than keep up with a clearing crew. The machine has its limitations no matter how it is powered. If we applied more power to the present construction, I doubt if the other parts would stand the strain; therefore, more power would call for an increase in the weight of the entire machine, possibly to the point of cutting down its efficiency of operation.

Each motor which went into service out of the Missoula shop has had no less than 14 hours of running in, 12 hours with the motor only on a motor stand, and 2 or more hours running in of the completely assembled machine at a motor speed of 3,000 r. p. m. Only one motor gave us any trouble. It was shipped back to the factory and was replaced with a new motor.

Some trouble has been experienced here and in other regions with the breaking of the lower connecting rod of the motor.

At the demonstration near Libby on June 13, one of the men was making a trench across a light-grassy opening, cutting into the ground only 1 or 2 inches. This was not enough to hold the motor speed down to its maximum, and within a minute or two the motor choked and stopped. We took the motor apart and found that the lower connecting rod had seized the crank shaft enough to blue and score it. This motor was designed for continuous running under maximum loads at a maximum speed of 4,000 r. p. m. It stands up well in boat operation under these conditions.

In adapting the motor to the trencher operation we work it under a different condition. We have no way of holding our speed constant except by judging the speed of the motor by its sound and making it work just enough to keep it at its proper speed. When the hammers are withdrawn from the ground, the motor keeps building up speed, helped along by the flywheel action of the swinging hammers, until it reaches a speed beyond which it is designed to run. Because of extreme friction and the inability of the lower connecting rod bearing to get the proper supply of oil it heats and expands until it seizes the shaft. This will either slow the motor down and stop it, or break the rod and cause other damage to the motor. When the hammers are raised out of the ground or lifted until the work is so light that the motor increases in speed beyond its limit, the throttle should be shut down to regulate the motor's speed.

When given the proper instructions, even a beginner will have no trouble in operating the trencher. On my recent trip one trencher was given 16½ hours running in almost every kind of material and under differing conditions in the forests. At each demonstration the men were carefully instructed as to how to start, regulate, and handle the machine. It was then started and worked a few minutes to demonstrate its operation. The machine was then turned over to them. On some of the forests as many as 32 men, who had not even seen the trencher before, operated it without having one moment's trouble with the motor. This leads me to believe that much of the trouble experienced has been caused by improper operation and care, rather than inherent faults in the motor.

A few minor things about the care of the motor are: The flywheel may loosen if the nut is not kept tightened; the vibration sometimes loosens the gas-line connection; when the carburetor extension is fastened on with the regular carburetor cover screws it has a tendency to vibrate loose—probably bolts and nuts should be used. When using spark plugs other than factory equipment, care should be taken to see that they are not longer than the original plugs. If they are too long, they will strike and break the insulating fiber when the door is closed. A narrow strip of 0.020 metal should be furnished with each machine to gage the gap in breakerpoint adjustment.

From the service given by the driving gears, shafts, and housing assemblies under the extreme conditions of the tests, it is indicated that the general construction is satisfactory. However, some changes are imperative.

The mounting of the drive-shaft housing in the lower gear case by threading showed plenty of strength, but the jam nut for locking will not keep it from loosening and turning on the threads when in hard use.

One pinion shaft twisted ⅛ inch in the splines and the gear broke up; four teeth were completely gone, six teeth were broken off for ⅜ of an inch from the heel of the gear and there were three sound teeth left. The markings on the sound teeth indicated that they were not getting a bearing the full length of the teeth. The remaining teeth were still delivering power to the hammers when I stopped the machine to locate the noise. The ring gear teeth were in good condition except where the broken teeth of the pinion slipped over them and rounded the edges. The work the trencher was doing when the gears broke was the hardest it had ever encountered to my knowledge. It worked 4 hours pounding against hard hemlock roots in deep duff soil.

The strain of the work done by the gears and hammers is too much for the mounting of the gear case covers with 1/4 by 1/2-inch fillister head screws. It is impossible to keep them tight. After they are tightened a few times, the threads strip out of the aluminum case. During the last part of the trip there was no way to keep oil in the case. I had to stop the machines occasionally and put oil in so the gears would not run dry.

The 1/8 inch, No. 17 Garlock packing, used as an oil seal between the gear case housing and the driving flange, makes a very poor seal and cuts out after a few hours' service.

The method of driving the hammer hubs through friction against a flange which is keyed to the shaft is satisfactory. We were troubled a little with the hub nuts becoming very tight, but we were not troubled with any slipping.

The hammers broke up badly in the harder material—36 hammers on the trip. Twelve showed a distinct flaw in the casting at the joining of the shank to the cross head, and the others showed clean breaks in different parts of the shanks. The case-hardened bolts on which the hammers are mounted stood up fine, showing only a good polishing where worn by the hammers. The threads had not been annealed and they broke off badly in the nuts.

The general construction of the frame and mounting of the motor are satisfactory. There is a little tendency for upper motor mounting bolts to loosen up, but they can be watched and tightened with a screwdriver when they come loose.

There are two things wrong with the mounting of the handles on the square rear-frame tubing. When operating the trencher the handles can't be tightened enough to keep them from working down the tubing, making the operation difficult and constant readjustment necessary. With the present mounting, the handles do not extend from the machine at the proper angle. When the motor mounting plate is horizontal, the handles should also be horizontal, or they would be even better if they were above the horizontal line. At present they set at about a 7° angle below horizontal.

When operating with the hammers throwing to the left, a lot of the dirt is thrown up within a few inches of the air cleaner, causing it to fill up much faster than it should. Ordinarily the air cleaner is very efficient and keeps practically all the dirt out of the motor.

Self Service.—We left immediately for the scene of the Plantation No. 24 Fire on the De Soto and arrived 10 minutes later. We tried to use a three-path road through the fire to get to the head, but because the smoke was so thick and hot we had to drive out of the burn-over and get into the rough. When we got into the rough we noticed our gasoline tank was on fire. We immediately turned the hose on the fire and in about 30 seconds had it out.—G. R. Boddie, project superintendent.

LESSONS FROM LARGER FIRES OF 1939—TAKEN FROM REPORTS ON FIRES OF OVER 300 ACRES

Edited by Roy Headley
Division of Fire Control, U. S. Forest Service, Washington, D. C.

The July and October 1939 issues of Fire Control Notes carried "Lessons Learned" from the larger fires of 1938. In this issue, the larger fires of 1939 in the Eastern, Southern, and North-Central national-forest regions are reviewed. Eastern fire-control men will thus have a chance to benefit from 1939 experience in preparing for the spring season of 1940. The fact that a "lesson" is quoted does not necessarily mean that the editors agree. It is possible to learn the wrong thing from an experience. Lessons learned in Western regions in 1939 will be reported in the April and July issues of Fire Control Notes. Statistical summaries for 1939 should be available for the July issue.

Eastern Region

George Washington—Trout Pond Fire—890 acres.—(This national forest is noted for the cooperation which has been built up. Cooperators are relied upon for detection as well as suppression on the million and a half acres under protection. In this case, however, the fire occurred in a gap and was not visible to local residents until it had become a fairly large fire. This emphasizes the limitations of cooperative detection. The forest report says the lesson here is to provide another tower and another regular lookout man. But the regional forester says of the fire that it is "primarily a dispatching failure following detection. Demonstrates a need for more thorough training in follow-up of suspected smokes. Corrective action has been taken." His reason for such a statement is that the report shows that the fire was seen from a lookout tower 4½ miles away, an hour and 4 minutes before the first cooperator discovered the fire. The lookout man and the district ranger both failed to require a definite check on this smoke, thinking it was probably an expected case of controlled brush burning. A cross shot from another lookout tower would have disclosed that it was not, but so would have "the all-important check of every smoke threatening Government land." The obvious lesson here is not to take chances with reported smokes which may be wild fires.—Ed.)

A moving-picture tour of the district had just been completed and all sawmill operators and prospective debris burners had been contacted. This smoker fire occurred after a rather intensive fire prevention campaign aimed at this particular area and woods operation.—Unsigned forest report. (Showing that, try as we may, our prevention efforts sometimes fail to impress sufficiently the one man we need to reach.—Ed.)

Because of the fact that it was crop planting time and good weather, all of the wardens and warden crews in that vicinity were at work in the field and were not instantly available. This resulted in delayed action of first-line suppression crews. The only action available under these circumstances is the establishment of paid standby crews which is hardly justifiable on the basis of past fire occurrence in this section of the forest.—Unsigned forest report. (The cooperator assembled eight men and got away in 50 minutes after receiving the report of the fire.—Ed.)

George Washington—Chestnut Ridge Fire—872 acres.—This fire on March 9, under very serious burning conditions, was probably caused by children living in the vicinity.

A prevention campaign in that area had not been initiated, largely because of the rapid transition from safe conditions to high danger. Ten thousand people live within and immediately adjacent to the district.

This fire caught the preparedness organization of the district napping. Towers were not manned. Weather stations and district fire truck not in operation, and the district ranger not in touch with his dispatcher. Failure to recognize emergency conditions and to build organization on the basis of emergency conditions results in fires of this class.

Once organized the suppression action was satisfactory. However, because of lack of preparedness it required 3½ hours to get the suppression organization to the fire. The result was a large fire, and the lessons learned by all concerned are that regardless of previous weather, conditions may change very rapidly during the early spring, and that the field organization must be kept on its toes.—Unsigned forest report.

A complete failure of district ranger to recognize degree of fire danger and plan accordingly. Corrective action has been taken. The most valuable lesson in this case involves the continuous daily use of fire-weather stations to determine degree of danger following rain. Very rapid changes involving only a few hours from no danger to high danger are to be expected during March, April, and May.—R. M. Evans, *regional forester.*

George Washington—Hartman Knob Fire—768 acres.—The area in which the fire occurred was classified as a high incendiary risk, a medium smoker risk, and a medium debris-burning risk. District ranger had made 49 prevention contacts, and had employed a patrolman for the area who had made more than 100 prevention contacts. Motion picture on fire prevention had been shown in the schools adjacent to the area during the month prior to the fire. At least 75 percent of the residents of the area had been contacted immediately prior to the fire. On the day of the fire a patrolman was located within this area to supplement local residents in detecting fires. A suspect list for the incendiaries of the area had been prepared, but none of the suspects listed were responsible for the fire unless in an indirect way which investigation did not disclose. All individuals on the suspect list had been contacted.

Because of the large number of sets, it was handled as four separate fires. Coordination was difficult because of the large amount of smoke, the topography, and the search for the incendiarist.—Unsigned forest report.

Supervisor Howard got the firebug while he was still setting fire, and he got 2 years.—D. W. Beck, Fire Control, R-7. (It would be helpful to know the motives of this individual incendiarist. Looking through the hindsights, could the aggressive prevention campaign have been altered so as to reach this particular man?—Ed.)

Suppression action good under the circumstances. Had supervisor, assistant, and district ranger been equipped with radio, it would have aided in planning, coordination of crew efforts, and speeding up suppression action on the large number of fires. District ranger took too long to get to fire. Corrective action has been taken to avoid future like errors.—R. M. Evans, *regional forester.*

Southern Region

Appalachicola—Five fires burning a total of 3,059 acres on Wakulla Ranger District.—(This district which was only placed under national forest protection this year illustrates what forest officers are up against on new units. The number of incendiary sets covered by each of these 5 reports is indicated respectively as 3, 5 or more, 6, and in each of 2 instances 20 or more. In one instance District Ranger McCullough says, "The initial crew arrived in good time, but the fires were still being set after the arrival of the first crew. The scattered nature of the sets made it impossible to attack them all at once. This fire showed that our fire-fighting set-up on this unit was still unable to cope with the incendiary situation in spite of mounted patrolmen and additional equipment." His comment on another report is, "It seems that the cattlemen are determined to burn sufficient area to graze their cattle. The scattered and well-timed and spaced number of sets convinces us that whoever is setting these fires is an expert. Increased effort is being made by the personnel both in watching for the responsible parties and in public-relations work." In a third case, where the number of sets was 20 or more, he says, "Found that the person setting the fires would continue to do so all night." Of the fourth fire, he reports that, "This fire brought out the fact that even our cooperators could not be trusted. Suspicion for this fire falls on one of them. It seems that even at the risk of life or limb, the cattle must have burned woods." The use of bloodhounds is repeatedly referred to.—Ed.)

This area has always been burned off, and although intensive prevention work has been carried on, there are still many who will set fires. As to the tactics on these fires, they were about as good as can be expected, considering the fuel types, equipment available, and the fact that the fires were set in many places. In such cases some of these fires will get above 300 acres.

Ranger McCullough's statement that law enforcement and the use of bloodhounds are needed is true. Arrangements were made to obtain dogs from the State penitentiary in April. They were called on a fire in early May and caught an incendiary. The case is now in Federal court, and there have been no incendiary fires since.—H. O. Stabler, *acting regional forester.*

Ozard—Tie Fire—385 acres.—Two things are significant as a result of this fire. First, the timber-stand-improvement areas on this district are increasing the fire hazard. The bark on the treated trees has broken and most of it is hanging to the standing trees in shreds or flakes. The sapwood on the treated trees that are standing is decayed and a part of it is clinging to the snags in shreds. The fallen treated timber is dry, most of it does not lie flat on the ground, and it burns fast and hot. This fallen timber delays line construction.

The second significant thing is that a period of years of no incendiary activity is not always indicative of progress being made in the prevention of incendiary fires. The prevention work which had apparently been successful must be harder and of greater intensity.—Fred G. Ames, *district ranger.*

Holley Springs—Concord Church No. 49 Fire—400 acres inside, 10,000 outside.—(Although over 4 inches of rain fell during March when this fire occurred, it is classified as an "unusually dry" month. The fire "had been going for several weeks outside and had neither been surveyed nor worked until it entered the forest." Visibility was almost zero because of smoke from many fires. This fire was corralled about midnight the first night and left without patrol. It broke out the next day.—Ed.)

With due regard for the fact that this fire was the ninth in a series of fires and false alarms on the Holley Springs unit on March 23 and that it entered from the outside, the following irregular action and failures occurred:

1. Plans had not been made to provide manpower in excess of regular CCC.
2. With a fire of this size burning south of the boundary and moving toward it, some patrol should have been dispatched to the road near the boundary.
3. Men should have been left on the fire overnight as a patrol.
4. When the fire was found going the next morning, it should have been scouted to determine the amount of work to be done, and the dispatcher promptly notified of conditions.

Shortage of manpower and transportation brought about by an emergency condition beyond our planning and expectation was responsible for the size of this fire.

Plans to provide manpower and transportation beyond our regular CCC manpower should make the recurrence of the Concord Church fire impossible.—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Plantation No. 24 Fire—1,682 acres.—(When discovered 5 minutes after known time of origin, this incendiary grass fire was 3 acres. Report and get-away took 5 minutes. Three miles of auto travel, 10 minutes. When reached by the first crew of 17 men, 20 minutes after origin, the fire was 20 acres. But it burned 1,682 acres, including 870 acres of plantation, before it was corralled 10 hours and 25 minutes after origin. In one place, wind velocity is reported as 2–19 miles; in another, 25–38 miles. Five days since last rain of 0.28 inch. Number of chains per man hour, 2.3. Much confusion and disorganization on the line. Maximum number of men engaged, 65.—Ed.)

The underlying cause of this fire was ill feeling between two residents, and a desire to involve the Forest Service in their personal affairs. Which family caused the fire was not determined. Another possible cause was to destroy cattle rustling in the path of the fire, or to throw blame on another resident, as it is generally accepted by local residents that the feelings are strained between this man and the Forest Service.—Lester P. Schaap, *district ranger.*

The fire tractor arrived at the fire around 9:30 a.m., but no one was left to direct it where to go. In the process of getting where the driver thought best, the tractor got hung up on a stump and stayed there for nearly 2 hours.

The initial dispatch of manpower and supervision was sufficient, considering that they were backed by special equipment and the fire was relatively small upon arrival. There was, however, a serious delay in sending reenforcements after the fire had definitely gotten away from the first crews. It was not until 5 hours and 35 minutes after arrival of the first crew that adequate reenforcements arrived on the fire.

The initial tactics used by the fire boss were correct for this fire, and had the heavy equipment functioned properly, the fire would have been held to less than 100 acres.

The failures and irregular action in suppression may be summarized briefly as follows:

1. The fire was not scouted to determine amount of work to be done and manpower needed.

2. There was no contact or coordination between suppression units on the fire.

3. Communication was not satisfactory between the fire line and dispatcher until after the arrival of the ranger with the mobile I radio set.

4. Reenforcements were not sent soon enough. This was the direct result of the fire boss' order via radio at one time to send no more men. With the high values in this area (plantation) there should have been no attempt to economize on men, especially when the manpower was available and no other fires were going.

5. District ranger should have contacted the dispatcher earlier in the day because of the high danger and the chance that he might need to leave the other work he was on.

6. The district organization of men on the fire line does not provide for bucket men (what are they?—Ed.) and it is noted that the "water gave out" at a crucial moment.

7. The firebreak along the plantation boundary had not been maintained, and as a result offered no barrier to the fire spreading out of the plantation—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Leaf No. 35 Fire—416 acres.— (Fire was 75 acres when discovered 2 hours and 17 minutes after guessed time of origin. It spread 25 acres during the 53 minutes required for report, get-away, and the travel.—Ed.)

Low visibility accounts for the size of fire when discovered.

There were five sets and the purpose of the fire was to provide sheep range. The exposed ridge site and high winds made suppression difficult.

A fire usually occurs in this location about the same time each year. Next year it is planned to patrol these areas closely in an effort to prevent the fire or catch the incendiary.—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Convention No. 46 Fire—319 acres.—(This incendiary fire with five sets was discovered 22 minutes after the guessed time of origin and at that time was estimated to be 25 acres. It spread 50 acres during the 43 minutes required for report, get-away, and 18 miles auto travel.—Ed.)

This fire was discovered by a competent leader with four men while on patrol. However, safety regulations prevented attack of the fire until arrival of a qualified foreman some 40 minutes later. (If this sort of thing is really necessary under the CCC safety regulations, surely it could be changed upon proper recommendation to CCC authority.—Ed.)

Full use was not made of all power equipment available. The fire tractor was not put into action, although it was on no other fire.

Failure to hold line after it was built contributed to the acreage on this fire.—V. B. McNaughton, *fire assistant.*

De Soto, Leaf River District—Derrick No. 36 Fire—961 acres.—(This stockman, grass, incendiary fire with five sets was 50 acres when discovered 1 hour and 35 minutes after guessed time of origin. It spread 50 acres during the 1 hour and 10 minutes required for report, get-away, and 18 miles auto travel. First crew dispatched included 17 men. First reenforcements reached fire 17 hours and 40 minutes after discovery. Output of held line per man-hour was 3.5 chains.—Ed.)

This fire occurred during a period when sickness in camp and high fire occurrence seriously reduced available manpower and supervision. As a result, the fire was undermanned. It was discovered by an enrollee leader and fire crew before it was picked up by the lookout man, but attack was delayed until a "qualified" foreman could arrive at the fire to take charge. This action was to comply with CCC safety requirements.

The chief lesson to be learned from this fire is to develop reserve supervision and manpower for those peaks of occurrence and hazard which happen annually.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—University No. 28 Fire—1,238 acres.—(Another grass, stockman, incendiary fire but with only one set. This time the lookout man snapped in with discovery within 4 minutes after guessed time of origin, when the probable area was one-tenth acre. But report took 42 minutes. In the 65 minutes required for report, get-away, and 9 miles auto travel, the fire spread to 350 acres. Wind velocity reported as 13 to 18 miles per hour when fire was first reached and during biggest run.—Ed.)

This was one of six fires which occurred on the Biloxi on March 16. It was an outside fire which entered in spite of the efforts of a State Forest Service crew. United States Forest Service manpower had been depleted by the unexpected occurrence to a point where this fire was somewhat under-manned.

Adequate planning to provide extra manpower during these peaks of occurrence and hazard will be made before next season.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—Bluff Creek No. 26—393 acres.—(Another stockman, incendiary, grass fire, but with 10 sets, while wind velocity was 13 to 18 miles per hour. The towerman with 5 men started work 15 minutes after discovery, but the fire had grown from 2 acres when discovered to 30 acres.—Ed.)

This was one of 6 fires which occurred on March 16 on the Biloxi. This unexpected occurrence depleted manpower resources to a point where it was not possible to man fully all of the fires.

Even with adequate manpower, 10 sets in this location and fuel type would mean a large fire under hazardous weather conditions.

Close watch on known suspects and planning for extra manpower will help prevent these fires and insure adequate strength of attack during hazardous weather.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—Biloxi River No. 25 Fire—518 acres.—(Another stockman, incendiary, grass fire with 14 sets during a 13- to 18-mile per hour wind. Although discovered in 5 minutes after guessed time of origin, when fire was 1 acre, it reached 200 acres during the 1 hour and 10 minutes required for report, get-away, and 20 miles auto travel.—Ed.)

The 14 sets were strung out over 1½ miles. The fire had made its run by the time the crews arrived.

The fire was man-caused for grazing purposes. A very few individuals will attempt to get their "burn" each year in spite of intensive educational work and law enforcement. There are very few accidental or careless fires in this vicinity. Therefore, prevention work is being concentrated on the known suspects.—V. B. McNaughton, *fire assistant.*

De Soto, Biloxi Ranger District—Camp Branch No. 16 Fire—419 acres.—On this fire, if the one-half ton pick-up which was equipped with a Panama pump and 55 gallons of water had not bogged down, a successful attack could undoubtedly have been made on the head.—V. B. McNaughton, *fire assistant.* (Illustrating why Region 8 is interested in four-wheel drive trucks.—Ed.)

The fire was not scouted and no one reached the head until it had burned into the forks of the creek about 1 mile south of where the initial attack was made.

This fire illustrates what happens when the initial action on fires in this country is wrong. The climatic conditions and fuel types favor an extremely rapid rate of spread on practically all of our fires, and it is imperative that we get a crew on the head of the fire as soon as possible.

For this reason we dispatch a small crew on a "hot shot" pick-up and follow this unit with a 20-man crew. The small crew, upon reaching the fire should go to the head and take whatever action is necessary to check it. As I see it, there are only two possible conditions present; either (1) they can hold the head by direct attack, or, (2) they can't. In the latter case, their only alternative is to backfire against the head and depend on the follow-up crew to handle the flanks.

The mistakes made on this fire were discussed at a personnel meeting. It was brought out that we were not adequately equipped to construct a line through sedge grass from which to backfire. The council tools were not effective in deep grass, and it is hazardous to attempt to backfire in the open with a small crew without some sort of a break in the cover type.

With this in mind we tried using a grass cutter blade to cut a line through heavy grass. This proved to be very effective, and it is planned to incorporate a blade as part of our fire-fighting equipment.

The cause of this fire has not been definitely determined. Evidence of wood haulers being active in this vicinity at first led to the belief that it was started accidentally by someone getting wood. Later investigation, however, brought out the possibility that it may have been started by a local firebug who has not been identified to date.—J. J. Welch, *district ranger.*

Bienville—Ludlow Fire No. 20—1,056 acres.—(The report shows that the fire started one-half mile outside the boundary. Discovered at 10 acres, 1 hour and 14 minutes after guessed time of origin, and reported to dispatcher. But report time is 45 hours and 6 minutes. Hence, with 5 minutes get-away time and 1 hour and 5 minutes for 4 miles travel on foot, a total of 46 hours and 16 minutes elapsed from discovery to arrival. The fire was 500 acres when reached. It did not enter the forest until the second day after it started.—Ed.)

It is known at this time that a crew should have been dispatched to the smoke shortly following discovery. It does not hold, however, that this procedure can be followed on all smokes, the number and places of occurrence making this prohibitive.

It is planned to adopt a policy of closer investigation of doubtful smokes on days of poor visibility when no crossing-out is possible, even at the risk of increasing the false-alarm cost. Better a false alarm than a 600-acre fire!

Every fire training meeting or conference stresses the need of exercising good judgment in all phases of fire control. It is a little unfortunate that this qualification must attend an individual's every action in fire control. Very often, certain action which has merited commendation because of its practical application in hundreds of previous cases, falls down in a particular case, and the cry "poor judgment" is raised and not altogether unjustifiably, as with this fire.

The lesson to be learned from the Ludlow fire is definitely this, in my opinion: Where the slightest doubt exists in the mind of a dispatcher or towerman as to the location of a smoke, because of poor visibility or any other reason, prompt investigative action should take place. Although it was known that debris burning was being done in the affected area, too great a chance was taken on these particular hazardous days to let a smoke of this nature, never definitely located until the third day, go uninvestigated. Out of this lesson should come an unqualified policy of action on smokes which literally cry out: "I need investigating!"

It is recommended that some authorization be granted whereby fire guards may be dispatched to investigate or suppress endangering fires without incurring personal transportation costs.—W. W. Bergoffen, *district manager.*

THE BIG FIRE OF THE YEAR

Everyone remembers the famous Tillamook fire of 1933 which burned over a net area of 267,000 acres between Portland, Oreg., and the Pacific Ocean. More than two-thirds of this area was virgin timber, estimated to contain 12 billion board feet. The total estimated loss to industry, labor, and the public was $350,000,000. National-forest land was not involved.

On August 1, 1939, came the news that the old burn was on fire again. Later in the month it definitely threatened the Siuslaw National Forest and the protection area to the east of it. On August 31, with the fire practically controlled, Region 6 summed up the situation in a telegram as follows:

The Tillamook fire started 1:30 p. m., August 1, Sec. 14, T. 1 N., R. 6 W. at logging operations. Reported either spark from moving donkey or careless smoker, probably an employee. Present area estimated 200,000 acres. Covers south two-thirds of 1933 burn and extends on east and south 1½ to 4 miles beyond 1933 burn.

South side all controlled by Forest Service. About 50 miles fire line including spots. Using maximum 1,350 FF men and 150 CCC enrollees. Reduced to 200 FF and 50 CCC.

East side and east half north side controlled and held by association and loggers. Maximum number of men north and east side of 225 WPA, 775 loggers paid by operators, 200 CCC, 350 civilians paid by association. Monday reduced to 50 CCC, 125 loggers and 115 association. West and northwest 250 WPA and 50 civilians, 100 CCC have made control section reasonably safe. Mop-up continued. Uncontrolled section dangerous but probably does not threaten Siuslaw Forest protection area. Damage to new area burn on south severe. Nearly all timber killed. Damage east about 25 percent all large second growth. No national forest land burned. About 3,000 acres protection area burned. Estimated expenditures FF to August 30, $168,000.

In the September 1939 issue of "Six Twenty Six," Thornton T. Munger, of the Pacific Northwest Forest Experiment Station, wrote the following which he entitled "It Hurts My Eyes."

Such was the comment of a Portland business man about the forest fire smoke that invaded our city last month—it hurt his eyes. But did he stop to think how much those fires hurt? Did he think of the destruction of forest capital, of the killing of seedlings and saplings that would have been the forests of the future, of the soil wastage and erosion that will follow, of the ruination of roadside scenery, of fishing streams, and happy hunting grounds? Every million board feet of mature trees destroyed beyond salvage in this fire means the immediate loss of 1 man-year of labor, and many millions of feet have been destroyed already.

The reburning of the Tillamook and Wolf Creek burns, much of which had already become restocked naturally with young trees, put off indefinitely receiving any forest income from these productive hillsides. Every 100,000 acres of seedling and sapling forest destroyed means an annual reduction of perhaps 50 million board feet (enough to supply one good-sized sawmill) in the industrial production of some community in the years to come. Truly smoke hurts the eyes and it will later hurt the eyes of our visiting tourists to see these scars on our landscapes. But it also hurts our pocketbooks, and those of our children, when we as a people build campfires in dangerous places, discard cigarettes in the woods, and do land clearing in an irresponsible way.

FOREST SERVICE LANDING FIELDS

F. W. FUNKE
Fire Control, Region 5, U. S. Forest Service

The increasing use of aircraft in fire-control work, coupled with the transition to larger and faster ships, has focused considerable attention on the factors which finally determine the usability of landing fields. A recent survey of private landing fields adjacent to national-forest areas in Region 5 reveals the rather astonishing fact that very few are suitable for use by Forest Service contract aircraft.

A discussion of landing-field requirements involves examination of many technical questions which, while apparently complex, in reality are quite simple if the basis is understood. Incidentally, many of the technical questions have little relation to our problem, since necessities of the job and limitations of the site will usually determine what can be done.

Forest Service landing fields may be grouped rather loosely in three classifications:

Class 1.—Field suitable for landing and take-off with capacity loads, using multimotor ships.

Class 2.—Field suitable for capacity load landing and take-off by reconnaissance ships up to 4,500 pounds gross, and capacity load landings but light take-off by multimotor ships.

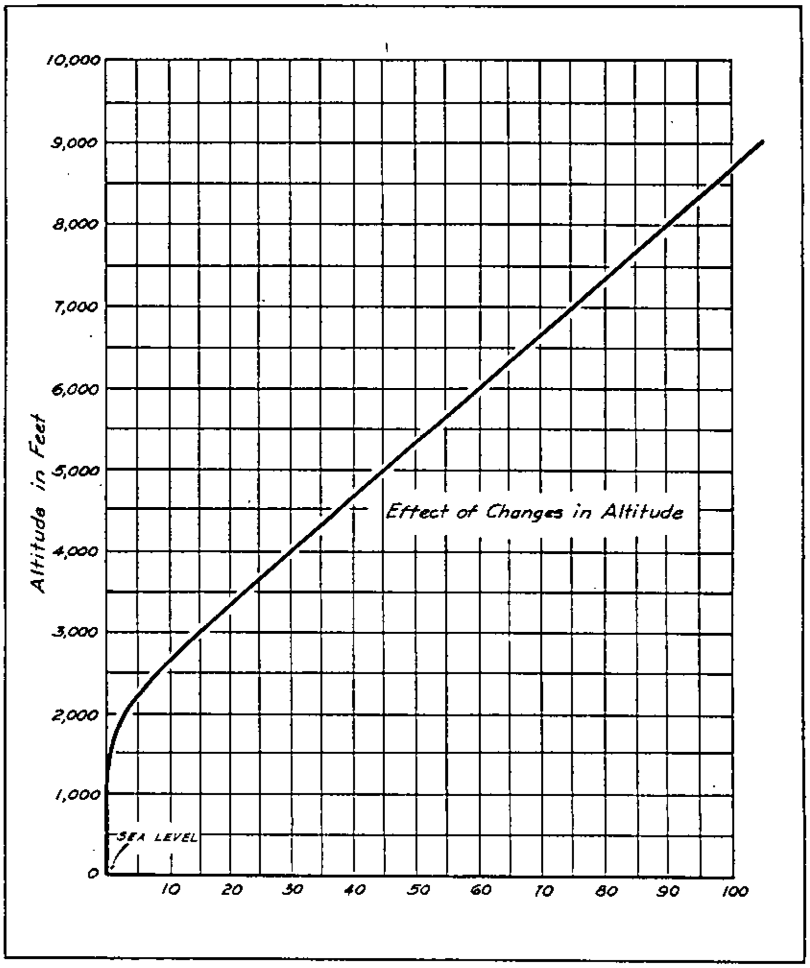
Class 3.—Emergency landings only.

The Relation Between Gross Weight, Horsepower, Propeller Type, and Runway Length

The average layman thinks of an airport or landing field as any flat area on which is parked one or more small ships of the Taylorcraft type having a gross weight of approximately 1,400 to 1,600 pounds. Such fields usually are less than 2,000 feet in length regardless of the altitude at which they are located. However, the length is entirely adequate for small ships. Depending on the type, such ships are equipped with motors developing 40 to 65 horsepower, resulting in a gross weight-horsepower ratio of approximately 20. Flight under adverse air conditions is seldom attempted, and in most cases flights are made in the light condition. Capacity loads are the exception rather than the rule.

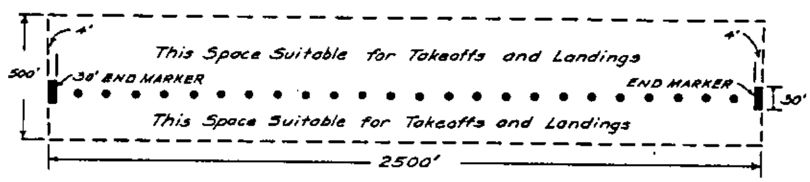
Forest Service reconnaissance ships used in Region 5 have a gross weight of approximately 4,500 pounds and are equipped with 320 horsepower motors, representing a ratio of approximately 14 pounds of weight per horsepower. This ratio is normal for many commercial aircraft in this weight class and may be accepted as the ratio in most ships which will be used in Forest Service work for some years to come. Several multimotor ships in the transport class have a ratio of 9 pounds per horsepower.

The trend pointed out is indicative of a number of things. High-speed wing sections usually are smaller than the low-speed air foil. Actual load carried on the high-speed wing is much greater per



The above graph indicates the approximate increase in effective landing strip or runway length necessary to accommodate aircraft operations from airports at various altitudes above sea level. Factors affecting landing strip or runway lengths, other than altitude, have been taken into account in establishing minimum lengths for operation at sea level.

LANDING AND TAKEOFF RUNWAY



Solid lime dots 4 feet in diameter spaced at intervals 100 feet. End markers 4 feet wide, 30 feet long, solid lime line. Landing strip area 2500 feet long, 500 feet wide. Smooth and clear crushed white rock, if available, will provide permanent markings.

square foot than on slower types. Higher cruising speeds require greater horsepower per pound of weight carried.

In the small sport-type ship, the wing loading is relatively light with the result that the ship will take off at low air speeds. However, because of larger wing surfaces and consequent head resistance, cruising speed is low and the horsepower required to drive the ship at a given speed is somewhat out of proportion when considered in the light of the performance of higher speed aircraft.

Conventional designs are required to take off in 800 feet of run at sea level and have a landing speed of approximately 65 miles per hour. This is an ideal performance, but is seldom attained in actual practice because of atmospheric conditions. However, for small ships having cruising speeds of approximately 80 miles per hour, the load carried by the wings is so small that the ship will take off at speeds of 40 to 50 miles per hour, which, of course, is quickly reached in a short run.

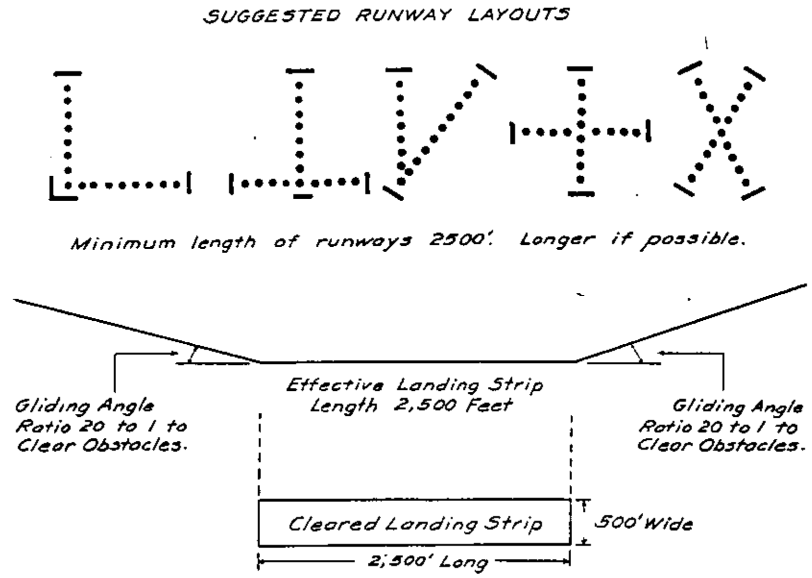
Heavier ships with increased speed ranges, having smaller wings and heavier loading per square foot of wing area, depend on increased speed to get the lift necessary to take off. Ships of this type can be pulled off at speeds of approximately 60 miles per hour, but rarely have reasonable control until at least 80 miles per hour is reached. Again, greater power and longer run is required to start a heavy ship and reach take-off speed.

Three types of propellers are available—the fixed-pitch, controllable-pitch, and the constant-speed unit. The fixed-pitch is the cheapest and more common type. Pitch is usually determined for best performance under one of two conditions. High pitch gives best speed and economical operation once in the air. Low pitch gives best performance in getting the ship off the ground but is not efficient once in the air. For this reason practically all operators have fixed-pitch propellers set for speed performance in the air, a very undesirable setting for take-offs with capacity loads at altitudes above sea level, since the full power of the motor cannot be developed. The controllable-pitch propeller provides a manual control so that low pitch is instantly available when needed either on take-off or in vertical currents, and high pitch is available for cruising. The constant-speed unit, the most recent development and the best, automatically varies the pitch of the propeller so that maximum traction is taken for the horsepower being used.

The Relation Between Altitude, Atmospherics, and Runway Length

A 2,500-foot runway clear of obstructions is considered to be the normal requirement for landing fields at sea level. Altitudes above sea level require additional length because of lighter air and the greater rolling speed which must be reached for take-off. Field surface determines to a great extent the ground speed which can be developed for take-off. Loose sandy surfaces are termed "slow;" hard compacted surfaces are "fast." Runways should in all cases be free of rocks and unevenness insofar as possible. The illustrations indicate the percent increase in effective runway length required for various altitudes.

The air drainage in the vicinity of a landing field is extremely important in limiting the loads which can be carried off the field.



A 2,500-foot runway clear of obstructions is considered to be the normal requirement for landing fields at sea level.

Vertical currents or cross winds also are important. The Truckee and Beckwith fields in Region 5, while having sufficient length for all purposes, are so affected by unstable air that it is impossible to take off with more than about 40 percent of normal load. Even in the light condition a ship must be pulled off, after which the ship mushes or staggers along without making altitude until sufficient air speed is reached to permit control. This is extremely uncomfortable, aside from the fact that it is far from safe. A wheezy spark plug which would cause the motor to momentarily drop 100 or 200 revolutions per minute would cause a crack-up, since it would be impossible to keep the ship in the air.

High temperatures, particularly when accompanied by low humidity, make take-off difficult even with light loads. In a number of cases during the current season it was necessary to restrict loads to approximately 50 percent of the capacity of the ship, in order to insure safety in take-off. If, however, additional runway length had been available it would have been possible to carry greater loads. From the standpoint of flight control it is perfectly safe to pull a ship off the ground before it reaches the normal sea level take-off speed. However, sufficient runway should be available ahead of the take-off point so that if the ship does not lift and settles back to the field, the pilot will have enough field to bring the ship to a stop without ground-looping.

Safety in flight should be paramount. Obsolete or poorly maintained equipment should never be used. No fire or fire-control job is of such importance as to risk life in unsafe equipment. Fixed-pitch propellers have little or no place in fire-control work where it is necessary to fly close to the earth and subject the equipment to turbulent vertical currents. The fixed propeller will seldom be able to pull a ship out of a strong down draft without considerable loss of altitude. As a companion to good equipment, the landing fields should be of sufficient length to give the pilot a chance. The great hazard in flying is the possibility of losing power on the take-off. Usually there is no place to go. Once altitude is reached there are usually several possibilities for a landing.

Are We Cooperating?—In several of the less thickly inhabited areas of the Clark National Forest in the southeastern Ozark area, wolves have been increasing in number. Local residents have reported serious and continued losses of livestock as a result. Requests for the cooperation of the Forest Service in handling the situation have also increased. In most cases the local residents in asking this cooperation claim, and perhaps justly, that the increase in wolves has been largely in those areas where the woods have not been burned. The cooperation of local residents with the Forest Service in not burning the woods has increased the chances for young wolf cubs to grow to maturity. Therefore, these people believe that it is justifiable to request the Forest Service to do something positive and constructive to control and destroy the wolf packs. Usually these requests are accompanied with the statement that "if the Forest Service can't help us kill the wolves, we will burn the woods next year."

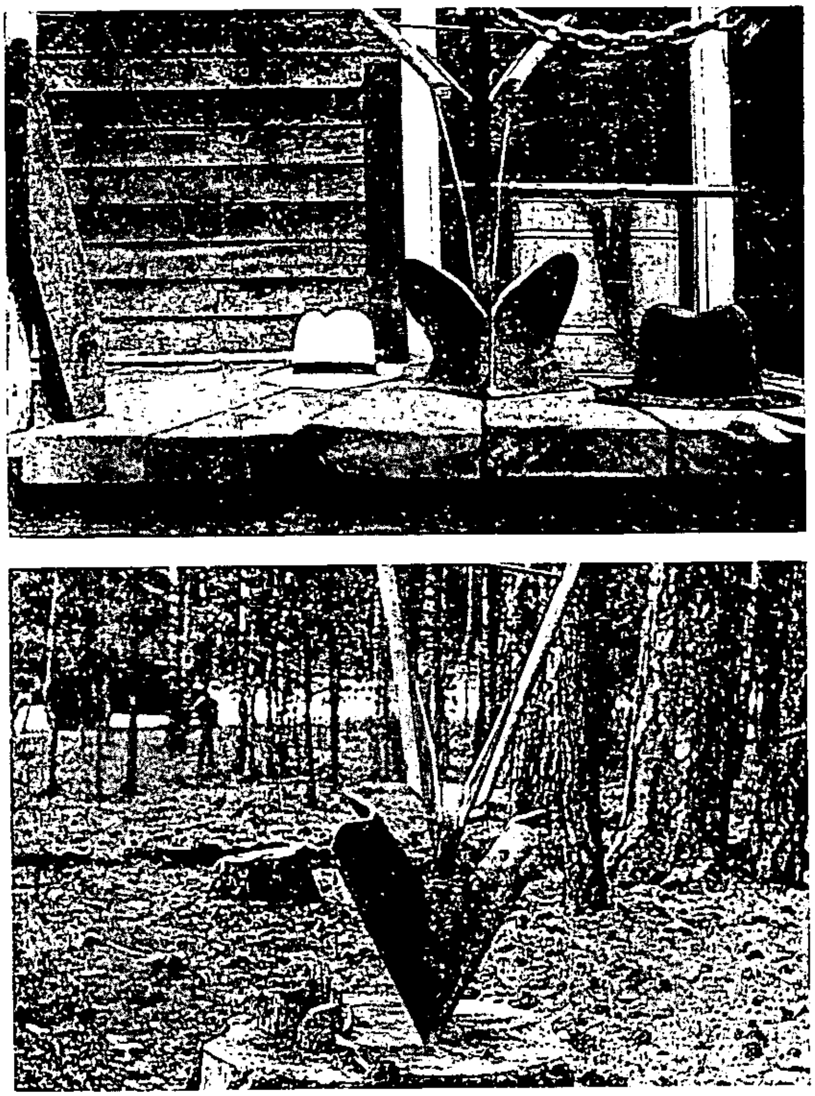
There is considerable justice in this request for cooperation. The Forest Service has asked for, and in many cases is securing, the cooperation of local residents in prevention of the common practice of "burning the woods." What are we doing to help them solve one of the major problems that has arisen as a result of fire prevention? In some cases an effort has been made to have the junior forest guard devote a small portion of his time to killing wolves. In other cases the matter is referred to the United State Biological Survey. The forest guard finds that the limited time he can give to this work does little good. The Biological Survey pleads lack of available funds for hiring men for this work and suggests that the local residents band together and raise funds to hire someone to kill the wolves. This is out of the question, because the residents of these areas do not have the money.

The efforts of the Forest Service up to this time have not convinced the local residents of the forest units that it is doing its utmost to cooperate with them in the elimination of predatory animals. Consequently, should we be surprised if the following season brings a series of woods fires in these areas? What solution is there to offer that will not only prove that the Forest Service wants to cooperate, but also that it will cooperate to the extent of bringing constructive help in those areas where wolves have increased rapidly because the cub litters have not been destroyed by wholesale burning of the woods?—F. S. Wolpert, clerk, Camp F-18, Clark National Forest.

THE HERBERT FIRE PLOW

E. A. Snow
Forest Supervisor, Harney National Forest, Region 2, U. S. Forest Service

During the past few years efforts have been made by various mechanically minded individuals in the Forest Service to adapt various machines to the job of building fire line. Plows of various



The Herbert fire plow: Above, front view; below, underside view

The kind of furrow produced by the Herbert fire plow when conditions are favorable.

sizes and shapes have been tried out. Some of them have proved very worth while and are being used extensively at the present time. The greatest drawback in the use of most plows is their excessive weight and the consequent necessity for horse or machine power to operate them.

Early in the spring of 1939, Walter D. Herbert, a construction and maintenance foreman at the Custer F–12 CCC Camp, obtained permission to set up a project for the development of a light plow to be pulled by manpower. He was encouraged to go ahead. With the help of Ralph Smith, another foreman, the necessary materials were assembled (at very little or no cost to the Government) and work was started. Most of the work, of necessity, was done in the evenings or on Saturdays and Sundays. The plow itself was hammered out of ⅜-inch sheet steel, and it was necessary to shape and reshape it several times before it was satisfactory. The plow beam was made out of an old buggy axle. When the plow was finished it weighed 40 pounds, or 55 pounds with drag-chain and hand-holds.

Using 8 or 10 CCC enrollees for power, this plow will make very acceptable fire line at a surprisingly rapid rate of speed. Tests through various types of ground cover, such as grass, needles, kinnikinnick, etc., have produced an average of about 60 chains of line per hour.

The advantages of this sort of plow are:

1. It is light in weight.
2. It can be carried by hand by two men.
3. It can be used with safety any place a man can walk.
4. Neither horses nor mechanical power are required to operate it.
5. It is ideal for the ponderosa-pine type.
6. Both its initial and maintenance costs are low.

It Can't Happen Here—I Wonder.—Let no one deceive himself that catastrophic fires are a thing of the past. The conflagrations that all but wiped out the Presque Isle State Forest in lower Michigan in the spring of 1939 could have occurred anywhere under similar conditions. No lives were lost or homes destroyed because the area in question was practically uninhabited. As it was, nearly 40,000 acres were burned over and approximately 15,000 acres of plantations destroyed before the fires could be brought under control, in spite of the fact that the area, for the most part, was grid-ironed with fire breaks and the protection organization functioned with exceptional efficiency.

Starting at 9 a. m. on May 6, the main fire crowned almost at once and, swept along by a strong southwest wind, traveled some 15 miles by 5 o'clock that night. At its peak, cross shots from lookout towers along the way indicate that it advanced 3 miles in 40 minutes. This fire was headed that night, but the following day another fire starting 10 miles to the south, under equally severe conditions, burned north until it met the main fire. In spite of this and the fact that a number of other fires of threatening proportions sprang up in the vicinity, all fires were definitely under control by the evening of May 8, when a hard rain ended the drought that had prevailed since April 21 and extinguished what fire remained.

What can be done to prevent such catastrophies in the future is a question. Obviously, firebreaks are not the answer nor is it practicable to maintain at all points the organization and equipment necessary to meet such emergencies. In the present instance, it was known that conditions were critical and the protective organization was on the alert, but not knowing where or when fires would occur no mobilization was possible until a fire actually started. The first fire to start was discovered promptly and a crew of 20 men from a nearby CCC camp was on the ground within 20 minutes of the time the fire was reported. The fire, however, had been set at intervals along a mile front and was beyond control of the initial attacking force when it arrived. Reenforcements were immediately called for, and in 24 hours more than a thousand men were on the line and reserve equipment and overhead from as far away as Marquette and Lansing had been brought in. Headquarters was established on the State forest, a radio central set up, portable radio outfits distributed to various towers and points on the line, and an observation plane was flown up from Lansing. The fire was driven by a 30-mile wind, however, and direct attack except on the flanks was impossible until night. Even flank attack was extremely hazardous because of the intense heat and shifting winds which in a number of cases forced crews to retire to save their lives and equipment. At one time, the State forest headquarters was completely surrounded by fire, and only heroic efforts on the part of the men there saved the buildings. As it was, the telephone and power line went out, and an emergency crew had to be rushed in from Alpena to restore communication.

The fact that none of the fires, with one minor exception, spread after the first day and that no men or equipment were lost speaks well for the effectiveness of the protective organization and the efficiency with which the work was handled. Even so, the loss sustained is appalling. What it would have been had organized protection not been in effect can only be guessed. Certainly the area burned would have been much larger and losses proportionately greater.—J. Alfred Mitchell, Lake States Forest Experiment Station.

COOPERATIVE MEADOW BURNING

A. L. Roe

District Ranger, Superior National Forest, Region 9, U. S. Forest Service

Each spring the Mesaba District of the Superior National Forest has faced the problem of meadow burning and the carelessness with which it has been handled. Many of the farmers, when they were all alone, touched off meadows and frequently did not even have a shovel or any other equipment with which to suppress the fire when the desired area was burned off. The result has necessitated the sending of suppression crews to control the fire after it has broken away and the initiation of law-enforcement cases which are disagreeable and at times result in lessened public cooperation.

It seemed that better public relations could be maintained by assisting the farmers in burning over their meadows safely as well as by preventing additional burned area with the resulting necessity of law-enforcement action.

The problem was discussed with the county agent, and he suggested the organization of burning rings similar to threshing rings, etc. The farmer understands this type of organization and is ready to adopt it since he feels that he is actually helping himself.

A "burning ring" was organized in the spring of 1938 at a township meeting of Great Scott Township on the Mesaba District. Seven of the farmers present had meadows which they desired to burn over. These men were called together in a separate group and organized by selecting one of their members to serve as a foreman. The foreman's function was to call the group together when one of the members desired to burn his meadow and make arrangements for needed equipment. This system insured the presence of a suppression crew at each burning and lessened the possibility of a fire breaking away. Each member of the ring was repaid for his efforts by getting his own meadow burned over safely. The Forest Service assisted by offering the use of equipment, such as back-pack pumps during the burning.

All the meadows in this township were burned over under this system during the spring of 1938 and 1939 a total of 14 burnings without a single break. The system has several advantages which are of importance to the farmer as well as to the Forest Service:

1. Permits for burning meadows and grass may be issued with greater confidence.
2. The farmer has protection against the necessity of law enforcement.
3. The contact that a ranger makes in such an organization is important since it proves to the farmer that he is interested in the farmer's problems. (The presence of the ranger on at least some of the burnings is well worth while.)
4. The farmer is accomplishing a job which in his mind is an absolute necessity and is doing it safely.

In presenting the idea to a group of farmers it is well to emphasize the protection that it gives them.

The ring can also include debris burning on a large scale in connection with land clearing.

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 technique may flow to and from every worker in the field of forest fire control.