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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 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

FIRE CONTROL NOTES is issued quarterly by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., 15 cents a copy, or by subscription at the rate of 50 cents per year. Postage stamps will not be accepted in payment.

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

A STUDY OF THE VOLUME AND LOCATION OF THE FIRE LOAD AND THE DETERMINATION OF AN EFFECTIVE PRESUPPRESSION ORGANIZATION TO HANDLE IT.

P. D. HANSON, *Senior Forester, Region 5,* assisted by I. C. FUNKE, *Assistant Engineer,* and E. L. TURNER, *Junior Forester, U. S. Forest Service.*

One of the important things needed in forest fire control is a body of tested theories and methods for determining the number of presuppression men to employ and where to station them within a protection unit. The California Region has put originality and much work into an effort to develop something worth while along this line. The problem is not an easy one, and it would be surprising if the following article is not open to criticism at various points. Nothing could better promote the development of the needed theories and methods than a general discussion in Fire Control Notes of various angles of the logic and implications of this sample of what the California Region has done.

In transmitting the article, the regional forester writes:

"This particular article is a copy of the report of the study made for the Plumas National Forest and was selected at random from similar reports of studies prepared for the 12 northern California fire forests. Studies were also conducted on the four southern forests, but these followed a different procedure than that employed in the north.

"The presentation in this form, as the study actually applies to a unit of land, appears preferable to a presentation of the general procedures followed.

"The study embodies principles of previous planning developed chiefly in this region, including the determined travel time standards for the various cover types, the procedure of competing stations with each other as used in detection planning, and procedures and results obtained in transportation planning.

"The study is the result of an appreciation of need for some better method to evaluate fire business, so that a comparison between forests, ranger districts, or fireman units could be made. It has been a help to us in planning financial estimates, placement of crews, and equipment.

"With respect to the applicability of the scheme to other regions, it might be well to mention that a prerequisite to this study is rather sound information on travel time standards, preferably for rather large areas on which the fire characteristics are relatively similar. If these standards are available and area boundaries decided upon, it is a simple though admittedly time-consuming operation to compute the rate of perimeter increase of the free-burning fire from the individual fire reports, and the resulting average rate for all fires in the area concerned. After this is obtained and some simple techniques mastered, the study proceeds rapidly."

I. Objectives.

This study is an integral part of the Nation-wide fire replanning project and has as a main objective the determination of an effective presuppression organization of both personnel and equipment re-

quired to handle the fire business and, particularly for this region, to bring that part of the whole fire-control system up to a level more commensurate with the present development of the transportation facilities.

In order to obtain the main objective mentioned, it was necessary—

1. To devise a method of measuring forest fire business as it is reflected by the small free-burning fire and to determine the location and volume of this business within the forest.

2. To consider and to provide for changes in the location of the fire business which may be anticipated in the future as compared to the past.

3. To determine the best locations for presuppression stations to most effectively and economically treat the fire business, as previously determined, selecting the locations on the basis of coverage of fire business within prescribed time limits through use of the existing road and trail systems.

4. To consider and prescribe treatment where practical for areas not reachable within reasonable travel time limits.

5. To determine desirable size of crews for initial attack.

6. To determine the best locations for tank trucks.

II. Procedure Employed.

1. *To devise a method of measuring forest fire business.*—The potential fire perimeter in chains at the end of one hour of free-burning conditions, or in other words the rate of perimeter increase, was accepted as the unit of measurement of fire business. To this was applied the term "perimeter unit."

For any area under consideration it is possible to measure the number of perimeter units if the average rate of perimeter increase and the number of fires which have occurred are known, since the product of rate of spread in chains per hour multiplied by number of fires results in the number of chains of fire perimeter which occur during the first hour that fires burn.

To obtain this, the rate of perimeter increase in chains per hour between discovery and arrival of the suppression force was calculated for all fires which occurred during the seasons of 1925 through 1937, inclusive.[1] All fires which did not spread, such as ignited snags, houses, and camp fires, were rejected in the process. The average rate of spread for those fires that had spread associated with them was computed for each of the major travel time zones on each forest. The zones referred to were those mapped and used in the transportation planning project for each forest. Travel time standards applicable to each zone will be discussed later.

Fire occurrence spot maps covering 10 years of man-caused and 20 years of lightning-caused fires were plotted. Each lightning fire was given the weight of one-half fire in order to keep the data on an even 10-year basis. With this basic material of rate of spread and number of fires in combination, it was possible to apply a numerical measurement to the fire business for any forest, ranger district, or guard unit desired. Each fire on the spot map was assigned the average rate of spread of fires on that area, which introduced a slight factor of

[1] A cooperative project with C. A. Abell, California Forest and Range Experiment Station.

safety and accounts for the term "potential fire perimeter" when referring to the definition of perimeter unit.

The unit of perimeter was used as a measurement rather than the corresponding man-hours necessary to control the unit of perimeter, because rate of line construction was found to be so dependent on such things as fatigue, size of crew, use of machinery, etc., that more reliable comparative figures could not be obtained through its use. This factor was taken into consideration through the application of judgment in manning positions.

2. *To provide for changes in the location of the fire business.*— Changes in the location of fire business are chiefly effected by changes in industrial occupancy. Anticipated changes are, of course, not subject to measurement. The matter was given consideration by applying the best judgment available in the selection of presuppression stations by forest personnel.

3. *To determine the best locations for the presuppression stations.*— As a result of the study by Show and Kotok [2] which prescribed travel time standards for the various major cover types in northern California and as part of a previous transportation planning project, all forests were zoned into logical cover type zones having travel time standard applied to them of 30, 60, and 120 minutes, respectively. These were the zones previously referred to for which the average rate of spread was computed.

Templets, or transparent maps, were prepared, showing the area covered from each potential presuppression station studied, within the prescribed travel time limits for the zone concerned. The number of perimeter units covered within time limits for each station was then computed. In tables to follow, this figure is referred to as the station's "gross value" in perimeter units.

After the gross value was computed for each station, the stations were placed in competition with each other, on the basis of their coverage of perimeter units, with the objective of building up that combination of stations which could most effectively cover the fire business within time limits and with as little duplication as possible. Procedure employed followed that used in a previous study of detection stations and described in U. S. D. A. Circular 449, entitled "Planning, Constructing, and Operating Forest Fire Lookout Systems in California," by Show and Kotok. Briefly, this consisted of selecting the station having the highest gross value and reducing the gross value of all other competiting stations by the amount of the coverage mutual to them and the first station selected, then selecting as successive stations in the system those that add the greatest perimeter unit coverage to the coverage of stations already selected. The net amount added by each station is called its "contributed value" to the system. (Tables to follow in referring to these figures use the term "contributing value" or "contributed station coverage.")

Technique of computing competition requires preparation of a composite map of station coverages from which a master sheet is prepared. From this sheet selection of a system of stations may readily be made.

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[2] The Determination of Hour Control for Adequate Fire Protection in the Major Cover Types of the California Pine Region, U. S. D. A. Tech. Bul. 209.

4. *To consider and prescribe treatment where practical for areas not reachable by a suppression force within reasonable travel time limits.*—Each such area was considered generally on the basis of fire prevention as being the only possible positive treatment. Provision for the necessary personnel was included in the prevention plan.

5. *To determine desirable size of crew for initial attack.*—Compilations for this study were handled under the direction of C. A. Abell, associate silviculturist, California Forest and Range Experiment Station, in cooperation with the author. The resultant report will be the subject of a future publication. The study shows clearly the necessity for crews of 5 to 6 men frequently placed in areas on which the average rate of spread is in excess of 12 chains per hour. Crews of from 3 to 4 men are required where spread conditions average 6 to 8 chains per hour. The reinforcing action of the second crew is essential to satisfactory performance.

6. *To determine the best locations for tank trucks.*—For each forest a map was prepared showing the area within 500 feet of all roads and within 500 feet of all places that a loaded tank truck could reach, traveling across country. This area was considered as the zone of influence of tankers.

The perimeter units on this area subject to this treatment were computed for the forest as a whole and for each of the proposed presuppression stations. This provided a basis for planning this type of equipment. See tables 3 and 4.

III. Definition of terms used in tables to follow.

1. *Perimeter unit.*—Each chain increase in perimeter per hour for free-burning fires is a perimeter unit.

2. *Perimeter unit value.*—The product of the number of fires that have occurred in an area over the 10-year period multiplied by the average rate of perimeter increase in chains per hour for fires that have occurred in the area concerned.

3. *Gross value.*—The total number of perimeter units on an area which can be reached within prescribed travel time limits from the station concerned.

4. *Contributed value.*—The number of perimeter units that can be covered from a station within travel time limits and which have not already been covered by stations ranking higher in the system.

5. *Unduplicated value.*—The number of perimeter units covered within time limits and common only to the one station under consideration. This applies only to coverage from the final selected system.

6. *Initial attack value.*—The number of perimeter units in the area which can be reached more easily and quickly from the station concerned than from other stations in the selected system. This rating is subdivided into perimeter units which can be reached within time limits and those that require extended travel time to reach.

IV. Application to the Plumas National Forest.

1. In applying the foregoing to the Plumas National Forest, the average rate of initial perimeter spread of fires occurring in the various travel time zones was determined to be as follows:

Zone	Maximum allowable travel time (minutes)	Perimeter spread (chains/hour)	Basis number of fires
I	30	16. 9	698
II	60	10. 1	366
III	120	6. 5	65

The area, the number of fires, and the perimeter units in each travel time zone are shown on table 2 of this report.

2. Since the fire occurrence considered is on a 10-year basis, the ratings obtained by multiplying occurrence by the proper rates of spread are also on a 10-year basis, i. e., perimeter unit ratings are for 10 years.

3. A conference held in San Francisco on February 2, 1940, was attended by the regional forester, members of his staff and the following forest personnel: D. N. Rogers, forest supervisor; John Grey, assistant forest supervisor; Keith MacDonald, fire chief; and Ernest L. Turner, fire replanner. At this conference the results of a preliminary study were presented. A series of maps, overlays, and tables was used in this presentation to show the presuppression value of each location studied. Selection of locations to be manned by presuppression forces was influenced by administrative and other considerations as well as the computed perimeter unit ratings. The tables, some of which have been recomputed by the elimination of certain stations, are included in this report.

Decisions made at the conference regarding the selection and manning of stations and the distribution of various sizes of tank trucks are shown in table 4.

Notes on the selection or rejection of stations which were influenced by factors other than their perimeter unit ratings follow:

Portola.—The fire occurrence as shown on the maps for the 10-year period concerned in the immediate vicinity of Portola was not considered to be a fair representation of conditions as they now exist. These fires, for the most part, are small camp fires and smoker fires started by itinerants along the railroad. The trouble has now been greatly reduced by a program of hazard reduction. Therefore, it was decided to consider a reduction of this number of fires by 75 percent for the purpose of this study.

Mooretown.—This station in reality is more important than its contributing value indicates. It is in the center of an area previously protected by the State. Because of this, its ratings as shown in this study are based only on fires upon which the Forest Service took action and the records of which were in the files. If records of the total occurrence for this area had been available, a conservative estimate indicates that Mooretown would have had a contributed value of approximately 500 perimeter units with 50 percent of them being unduplicated. All this area falls within the boundary of the Raker Act.

Cascade guard station.—Because a large area requiring one-half hour travel time will be opened up by the completion of the Millsap Bar Road, this station was approved. It covers more of this area within time limits than any other station. Also it has prevention value.

Boulder Creek guard station.—Although its contributing value is low, it was retained in the system on the basis of its importance from a prevention standpoint, especially during the hunting season, and also of anticipated logging activity in that vicinity.

Prattville.—Although it has a higher contributing value than some of the stations selected it was rejected on the basis that crews at Almanor Dam and at Chester (a Lassen station) could sufficiently protect this area.

Black Mountain lookout.—This station is classed as a primary lookout in the detection plan but has been used as a lookout-fireman. Its continued use as a fireman will not be necessary in the planned fire control system.

Bear Ranch Hill lookout-fireman.—This was left in the system for its detection value to the Lassen Forest and now becomes a primary lookout.

Red Hill lookout-fireman.—Although its contributing value from a suppression standpoint was zero, its detection value was considered enough for it to remain in the system.

Red Mountain lookout-fireman.—This station remains in the system as a lookout-fireman, primarily for detection.

Three Lakes lookout-fireman.—This station's contributing values in both suppression and detection were so low that it was dropped from the system.

V. Maps Prepared.

1. *Fire control stations—Travel time zones and fire occurrence map.*—This map shows by appropriate symbols the location and function of all planned fire control stations, the classification of the area to be protected as to travel time allowances and the location of occurrence of lightning fires from 1917 to 1936 and of man-caused fires from 1927 to 1936. For some forests the original travel time zone boundaries have been smoothed or generalized to eliminate small details, thereby reducing the amount of unnecessary detail work in completing this study.

2. *Initial attack and multiple coverage map.*—This map shows the theoretical limits of the areas within which each suppression unit could make the first attack on fires. It also shows by color legend the area that can be reached within allowable time limits from one, two, three, or more planned suppression stations. Areas that are reached within time limits from stations having only one man are cross-hatched.

3. *Existing road map.*—This map shows the locations, travel speeds, and distances between important points and road intersections for travel time in minutes between important points and road intersections. This map was prepared for the regional office files only.

VI. The following figure and tables are self-explanatory:

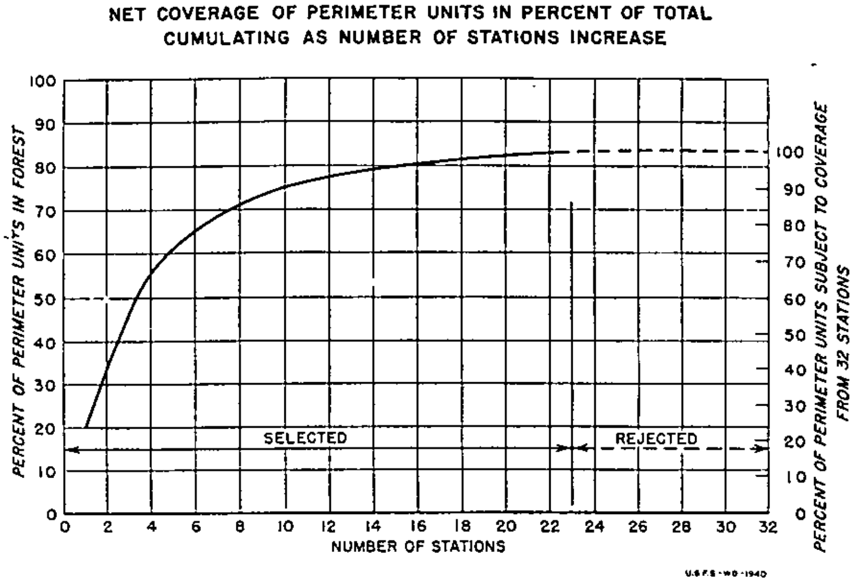


TABLE 1.—*Plumas National Forest—Suppression station locations studied*

Station Names	Location—Mount Diablo meridian			In detection plan	In transportation plan	In present suppression system	Remarks
	Section	Township	Range				
Almanor Dam	28	27 N.	8 E.	-------	-------	-------	
Bear Ranch Hill lookout-fireman.	13	23 N.	5 E.	x	-------	x	
Black Mountain lookout	8	26 N.	15 E.	x	-------	x	Used as a lookout fireman.
Boulder Creek guard station	15	27 N.	12 E.	-------	x	x	
Brush Creek ranger station	7	21 N.	6 E.	-------	x	x	
Bucks Lake guard station	3	23 N.	7 E.	-------	x	-------	
Cascade guard station	10	21 N.	7 E.	-------	x	x	
Challenge ranger station	20	19 N.	7 E.	-------	x	x	
Crocker guard station	33	24 N.	14 E.	-------	x	x	
Engel Mine	17	27 N.	11 E.	-------	-------	-------	
Fagan Saddle	36	23 N.	5 E.	-------	-------	-------	
Gansner Bar guard station	17	25 N.	7 E.	-------	x	x	
Genesee	9	25 N.	11 E.	-------	-------	-------	
Greenville ranger station	3	26 N.	9 E.	-------	-------	x	
Jarbo Gap guard station	26	22 N.	4 E.	-------	-------	x	Lassen N. F. Station.
La Porte guard station	16	21 N.	9 E.	-------	x	x	
Laufman ranger station	1	26 N.	14 E.	-------	x	x	
Lights Creek guard station	33	28 N.	11 E.	-------	-------	x	
Meadow View guard station	8	25 N.	16 E.	-------	x	x	
Mohawk ranger station	9	22 N.	12 E.	-------	x	x	
Mooretown	14	20 N.	6 E.	-------	x	-------	
Portola	36	23 N.	13 E.	-------	-------	-------	
Prattville	11	27 N.	7 E.	-------	x	-------	
Pulga	31	23 N.	5 E.	-------	x	-------	
Quincy ranger station	14	24 N.	9 E.	-------	x	x	
Red Hill lookout-fireman	10	25 N.	7 E.	x	-------	-------	Used as primary lookout.
Red Rock lookout-fireman	11	28 N.	11 E.	x	-------	-------	
Spring Garden	31	24 N.	11 E.	-------	-------	-------	
Squaw Valley	3	25 N.	13 E.	-------	-------	-------	
Strawberry	29	20 N.	8 E.	-------	x	-------	
Taylorsville	34	26 N.	10 E.	-------	x	-------	

TABLE 2.—*Plumas National Forest—Tabulation of area fires and perimeter units*

Ranger districts	Zone I—½-hour travel time, 16.9 chains/hour							Zone II—1-hour travel time, 10.1 chains/hour						
	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.
	M acres	Percent	Number	Percent	Number	Percent		M acres	Percent	Number	Percent	Number	Percent	
Merimac	91.5	5.6	126.0	6.7	2,129	8.8	23.3	58.2	3.6	37.0	2.0	374	1.5	6.4
Quincy	79.9	4.9	245.0	13.1	4,140	17.1	51.8	89.7	5.5	76.0	4.1	768	3.2	8.6
Greenville	76.2	4.7	145.0	7.8	2,450	10.1	32.2	173.1	10.6	198.5	10.6	2,005	8.3	11.6
Milford	52.0	3.2	25.0	1.3	422	1.7	8.1	274.0	16.8	185.0	9.9	1,868	7.7	6.8
Beckwith	119.1	7.3	226.5	12.2	3,828	15.9	32.1	145.7	8.9	120.0	6.4	1,212	5.0	8.3
La Porte	108.2	6.6	176.5	9.5	2,983	12.4	27.6	134.6	8.3	104.0	5.6	1,050	4.4	7.8
Total	526.9	32.3	944.0	50.6	15,952	66.0	30.3	875.3	53.7	720.5	38.6	7,277	30.1	8.3

Ranger districts	Zone III—2-hour travel time, 6.5 chains/hour							Agricultural areas						
	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.
	M acres	Percent	Number	Percent	Number	Percent		M acres	Percent	Number	Percent	Number	Percent	
Merimac	34.2	2.1	23.0	1.2	150	0.6	4.4							
Quincy	19.1	1.2	7.5	0.4	49	0.2	2.6	------	------	------	------	------	------	------
Greenville	27.4	1.7	31.0	1.7	202	0.8	7.4	4.4	0.3	24.0	1.3	------	------	------
Milford	23.5	1.4	14.5	0.8	94	0.4	4.0	12.7	0.8	17.0	0.9	------	------	------
Beckwith	43.0	2.6	26.5	1.4	172	0.7	4.0	1.7	0.1	1.0	0.1	------	------	------
La Porte	59.9	3.7	41.5	2.2	270	1.1	4.5	2.1	0.1	14.0	0.7	------	------	------
Total	207.1	12.7	144.0	7.7	937	3.8	4.5	20.9	1.3	56.0	.30	------	------	------

Ranger districts	All zones						
	Area		Fires		Perimeter units		Perimeter units, 10 M ac.-yr.
	M acres	Percent	Number	Percent	Number	Percent	
Merimac	184.0	11.3	186.0	10.0	2,653	11.0	14.4
Quincy	193.0	11.8	352.5	18.9	4,957	20.5	25.7
Greenville	289.4	17.8	391.5	21.0	4,657	19.3	16.1
Milford	351.2	21.5	225.5	12.1	2,384	9.8	6.8
Beckwith	309.9	19.0	387.0	20.7	5,212	21.6	16.8
La Porte	302.7	18.6	322.0	17.3	4,303	17.8	14.2
Total	1,630.2	100.0	1,864.5	100.0	24,166	100.0	14.8

TABLE 3.—*Plumas National Forest—Relative need for tank trucks by ranger districts*

Districts	Total perimeter units on district	Reachable by tanker		
		Perimeter units	Percent of district perimeter units	Percent of forest perimeter units
Merimac	2,653	1,346	51	10
Quincy	4,957	3,130	63	23
Greenville	4,657	2,691	58	19
Milford	2,384	696	29	5
Beckwith	5,212	3,388	65	25
La Porte	4,303	2,466	57	18
Forest Total	24,166	13,717	57	100

TABLE 4.—*Plumas National Forest—Gross, contributed, and gross tanker values and conference decisions for all stations studied; and initial attack and unduplicated values for each station selected*

	Gross value perimeter units	Contributed value		Gross tanker value perimeter units	Undup. value perimeter units	Initial attack value			Conference decisions approved for—	
		Perimeter units	Cumulative percent			Perimeter units covered	Perimeter units not covered	Total perimeter units	Men	Tanker
1. Quincy ranger station	4,650	4,650	19.2	3,354	757	2,626	439	3,065	10	1 standard.
2. Portola	4,300	3,529	33.8	3,570	226	1,399	323	1,722	5	Do.
3. Greenville ranger station	4,451	2,972	46.1	3,284	223	2,113	250	2,363	5	Do.
4. Challenge ranger station	2,475	2,475	56.4	1,813	1,124	1,597	313	1,910	10	Do.
5. Gansner Bar guard station.	3,021	1,101	60.9	1,920	866	1,755	250	2,005	5	Do.
6. Brush Creek ranger station.	961	934	64.8	811	802	820	186	1,006	5	Do.
7. Laufman ranger station	1,043	853	68.3	568	320	605	161	766	5	Do.
8. Strawberry	2,029	643	71.0	1,648	311	1,090	135	1,225	3	Do.
9. Lights Creek guard station.	1,463	629	73.4	785	150	787	41	828	3	Do.
10. Genesee	2,435	429	75.4	1,802	142	612	143	755	3	Do.
11. Bucks Lake guard station	743	282	76.5	389	242	481	99	580	1	None.
12. Crocker guard station	2,382	241	77.5	1,896	111	811	195	1,006	5	1 standard.
13. Mohawk ranger station	3,979	216	78.4	3,330	162	1,789	180	1,969	5	Do.
14. Fagan Saddle	507	195	79.2	348	110	196	152	348	3	None.
15. La Porte guard station	1,125	176	80.0	640	116	606	180	786	3	Do.
16. Almanor Dam	2,535	163	80.6	2,021	66	816	191	1,007	5	1 standard.
17. Meadow View guard station.	398	162	81.3	182	162	252	312	564	1	None.
18. Squaw Valley	976	110	81.8	548	55	419	76	495	3	1 standard.
19. Spring Garden	3,873	60	82.0	3,293	60	648	81	729	5	Do.
20. Mooretown	283	59	82.3	243	34	64	169	233	5	Do.
21. Jarbo Gap guard station	453	51	82.5	342	51	135	104	329	(1)	(1)
22. Cascade guard station	261	30	82.6	147	30	99	17	116	1	None.
23. Boulder Creek guard station.	1,232	25	82.7	592	20	265	94	359	1	Do.
Total	------	19,985	82.7	------	6,140	19,985	4,181	24,166	---	------------
24. Prattville	1,614	61	83.0	1,304	------	------	------	------	Rejected.	
25. Taylorsville	3,496	46	82.1	2,617	------	------	------	------	Do.	
26. Black Mt. lookout	529	5	83.2	288	------	------	------	------	Primary lookout	
27. Bear Ranch Hill lookout-fireman.	267	0	------	182	------	------	------	------	Do.	
28. Pulga	522	0	------	[2] Low	------	------	------	------	Rejected.	
29. Engelmine	1,783	0	------	[1] Mod.	------	------	------	------	Do.	
30. Red Rock lookout-fireman	[2] Low	0	------	[2] Low	------	------	------	------	Detection value.	
31. Red Hill lookout-fireman	[2] Low	0	------	[2] Low	------	------	------	------	Do.	
32. Three Lakes lookout-fireman.	[2] Low	0	------	[2] Low	------	------	------	------	Rejected.	

[1] Lassen station.

[2] As these values were obviously so low, and the stations in question had no contributed value, it was not considered necessary to compute them.

TABLE 5.—*Plumas National Forest—Area by travel time zones covered within allowable time limits by 23 approved stations*

Zone No.	Total zone acreage, M acres	First 5 stations		First 10 stations		First 15 stations		23 stations	
		M acres	Percent in zone	M acres	Percent in zone	M acres	Percent in zone	M acres	Percent in zone
I	526.9	165.4	31	224.3	43	245.4	47	266.3	51
II	875.3	351.0	40	543.7	62	633.4	72	729.4	83
III	207.1	125.4	61	158.6	77	204.9	99	206.7	100
Total	1,609.3	641.8	40	926.6	58	1,083.7	67	1,202.4	75

TABLE 6.—*Fires by travel time zones covered within allowable time limits by 23 approved stations*

Zone No.	Total fire occurrence	Total fires covered	Percent covered by zones
I	944.0	774.0	82
II	720.5	594.5	83
III	144.0	144.0	100
Total	1,808.5	1,512.5	84

TABLE 7.—*Plumas National Forest—Gross station coverage of lightning and total perimeter units by ranger districts*

Ranger districts (station names)	Merrimac		Quincy		Greenville		Milford		Beckwith		La Porte		Total	
	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total
1. Quincy ranger station	34	140	446	3,314	136	583			110	558	42	55	768	4,650
2. Portola														
3. Greenville ranger station			56	213			90	130	579	3,936	7	21	732	4,300
4. Challenge ranger station			64	1,426	690	2,963			15	62			769	4,451
5. Gansner Bar guard station											168	2,475	168	2,475
6. Brush Creek ranger station	11	402	56	1,543	253	1,076							320	3,021
7. Laufman ranger station	62	961											62	961
8. Strawberry							604	978	65	65			669	1,043
9. Lights creek guard station											330	2,020	330	2,029
10. Genesee			15	75	596	1,287	81	101					692	1,463
11. Bucks Lake guard station			45	115	473	1,807	60	80	195	433			773	2,435
12. Crocker guard station	119	502	76	241									195	743
13. Mohawk ranger station			6	66	20	27	302	402	471	1,873	7	14	806	2,382
14. Fagan Saddle			90	520			20	40	478	3,372	19	47	607	3,979
15. La Porte guard station	82	507											82	507
16. Almanor Dam									16	16	309	1,109	325	1,125
17. Meadow View guard station			35	115	485	2,420							520	2,535
18. Squaw Valley							311	398					311	398
19. Spring Garden					10	10	442	643	163	323			615	976
20. Mooretown	10	63	337	1,878	75	234			208	1,671	20	27	650	3,873
21. Jarbo Gap guard station											88	283	88	283
22. Cascade guard station	17	405		37	11	11							28	453
23. Boulder Creek guard station											100	261	100	261
24. Prattville					328	632	376	527	26	73			730	1,232
25. Taylorsville			15	92	338	1,522							353	1,614
26. Black Mountain lookout			50	351	789	2,854	18	38	112	253			969	3,496
27. Bear Ranch Hill lookout-fireman							373	484	45	45			418	529
28. Pulga	63	267											63	267
29. Engelmine	17	476		17	19	29							36	522
30. Red Rock lookout-fireman			15	75	661	1,627	49	69	5	12			730	1,783
31. Red Hill lookout-fireman														
32. Three Lakes lookout-fireman														

TABLE 8.—*Plumas National Forest—Contributed station coverage of lightning and total perimeter units by ranger districts*

Ranger districts (station names)	Merrimac		Quincy		Greenville		Milford		Beckwith		La Porte		Total	
	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total	Lightning	Total
1. Quincy ranger station	34	140	446	3,314	136	583	----	----	110	558	42	55	768	4,650
2. Portola	----	----	----	----	----	----	90	130	469	3,378	7	21	566	3,529
3. Greenville ranger station	----	----	5	547	554	2,380	----	----	15	45	----	----	574	2,972
4. Challenge ranger station	----	----	----	----	----	----	----	----	----	----	168	2,475	168	2,475
5. Gansner Bar guard station	11	402	16	550	37	149	----	----	----	----	----	----	64	101
6. Brush Cr. ranger station	55	934	----	----	----	----	----	----	----	----	----	----	55	934
7. Laufman ranger station	----	----	----	----	----	----	519	853	----	----	----	----	519	853
8. Strawberry	----	----	----	----	----	----	----	----	----	----	172	643	172	643
9. Lights Creek guard station	----	----	----	----	376	550	59	79	----	----	----	----	435	629
10. Genesee	----	----	----	----	82	167	45	55	113	207	----	----	240	429
11. Bucks Lake guard station	65	267	15	15	----	----	----	----	----	----	----	----	80	282
12. Crocker guard station	----	----	----	----	----	----	75	125	89	116	----	----	164	241
13. Mohawk ranger station	----	----	----	----	----	----	----	----	94	204	5	12	99	216
14. Fagan Saddle	8	195	----	----	----	----	----	----	----	----	----	----	8	195
15. La Porte guard station	----	----	----	----	----	----	----	----	----	----	65	176	65	176
16. Almanor Dam	----	----	----	----	61	163	----	----	----	----	----	----	61	163
17. Meadow View guard station	----	----	----	----	----	----	132	162	----	----	----	----	132	162
18. Squaw Valley	----	----	----	----	----	----	90	110	----	----	----	----	90	110
19. Spring Garden	----	----	13	13	----	----	----	----	13	47	----	----	26	60
20. Mooretown	----	----	----	----	----	----	----	----	----	----	15	59	15	59
21. Jarbo Gap guard station	----	51	----	----	----	----	----	----	----	----	----	----	----	51
22. Cascade guard station	----	----	----	----	----	----	----	----	----	----	10	30	10	30
23. Boulder Cr. guard station	----	----	----	----	5	5	20	20	----	----	----	----	25	25
Total	173	1,989	495	4,439	1,251	3,997	1,030	1,534	903	4,555	484	3,471	4,336	19,985
24. Prattville	----	----	----	----	----	61	----	----	----	----	----	----	----	61
25. Taylorsville	----	----	----	----	36	46	----	----	----	----	----	----	36	46
26. Black Mountain lookout	----	----	----	----	----	----	5	5	----	----	----	----	5	5
27. Bear Ranch H lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0
28. Pulga	----	----	----	----	----	----	----	----	----	----	----	----	----	0
29. Engelmine	----	----	----	----	----	----	----	----	----	----	----	----	----	0
30. Red Rock lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0
31. Red Hill lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0
32. Three Lakes lookout-fireman	----	----	----	----	----	----	----	----	----	----	----	----	----	0

TABLE 9.—*Plumas National Forest—Contributed values of the 23 approved stations, by districts*

Rank	Ranger District station names	Contributed value, perimeter units													
		Merimac		Quincy		Greenville		Milford		Beckwith		La Porte		Total	
		Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on district	Perimeter units	Cumulative percent of perimeter units on Forest
1	Quincy ranger station	140	5.3	3,314	66.9	583	12.5	----	----	558	10.7	55	1.3	4,650	19.2
2	Portola	----	----	----	----	----	----	130	5.5	3,378	75.5	21	1.8	3,529	33.8
3	Greenville ranger station	----	----	547	77.9	2,380	63.6	----	----	45	76.4	----	----	2,972	46.1
4	Challenge ranger station	----	----	----	----	----	----	----	----	----	----	2,475	59.3	2,175	56.4
5	Gansner Bar guard station	402	20.4	550	89.0	140	66.8	----	----	----	----	----	----	1,101	60.9
6	Brush Creek ranger station	934	55.6	----	----	----	----	----	----	----	----	----	----	934	64.8
7	Laufman ranger station	----	----	----	----	----	----	853	41.2	----	----	----	----	853	68.3
8	Strawberry	----	----	----	----	----	----	----	----	----	----	643	74.2	643	71.0
9	Lights Creek guard station	----	----	----	----	550	78.6	79	44.5	----	----	----	----	629	73.4
10	Genesee	----	----	----	----	167	82.2	55	46.9	207	80.4	----	----	429	75.1
11	Bucks Lake	267	65.7	15	89.3	----	----	----	----	----	----	----	----	282	76.5
12	Crocker guard station	----	----	----	----	----	----	125	52.1	116	82.6	----	----	241	77.5
13	Mohawk ranger station	----	----	----	----	----	----	----	----	204	86.5	12	74.5	216	78.4
14	Fagan Saddle	195	73.0	----	----	----	----	----	----	----	----	----	----	195	79.2
15	La Porte guard station	----	----	----	----	----	----	----	----	----	----	176	78.6	176	80.0
16	Almanor Dam	----	----	----	----	163	85.7	----	----	----	----	----	----	163	80.6
17	Meadow View	----	----	----	----	----	----	162	58.9	----	----	----	----	162	81.3
18	Squaw Valley	----	----	----	----	----	----	110	63.5	----	----	----	----	110	81.8
19	Spring Garden	----	----	13	89.6	----	----	----	----	47	87.4	----	----	60	82.0
20	Mooretown	----	----	----	----	----	----	----	----	----	----	59	80.0	59	82.3
21	Jarbo Gap guard station	51	75.0	----	----	----	----	----	----	----	----	----	----	51	82.5
22	Cascade guard station	----	----	----	----	----	----	----	----	----	----	30	80.7	30	82.6
23	Boulder Cr. guard station	----	----	----	----	5	85.8	20	64.3	----	----	----	----	25	82.7
	Perimeter units covered	1,989	75.0	4,439	89.6	3,997	85.8	1,534	64.3	4,555	87.4	3,471	80.7	19,985	82.7
	Total perimeter units	2,653	----	4,957	----	4,657	----	2,384	----	5,212	----	4,303	----	24,166	----

PROGRESSIVE STEP-UP ORGANIZATION

From the *Fireman's Guide*, just issued to members of the northern region of the U. S. Forest Service

Here is a method of organizing and managing men on line which borrows from the one-lick method, the 10- to 15-foot White Mountain variation of the one-lick method, and the individual assignment method which swept the Northern region at one time.

Thoughtful readers will perhaps wonder about the application of the method when the line needs to be driven ahead faster than 8 men could possibly push it. They may be dubious about the complexity of the system by which men are moved ahead. And they may be doubtful about the rigidity of the required organization of the 8-man crew. But one impartial observer reports that under certain circumstances he believes the method has the edge over the one-lick method.

We have then a fresh situation which invites attention from men of ingenuity—students of organization, fire specialists, forest supervisors, district rangers, and fire guards. Supervisor Huff of the Colville, who is said to have developed this particular method, may already have invented desirable improvements. But he has no monopoly on the method or the ingenuity required to build from it and the other ideas now in circulation on organization and management of men for fast construction of control line.

This system differs from the ordinary functional crew unit scheme in that the entire crew progresses forward with each member occupying the same position through the work period. The entire crew moves forward, each member maintaining a constant position in relation to the other workers.

The principle is that each member of a unit has a definite assignment of work to accomplish, and will work on this section until it is completed, or until some other member of the unit finishes, then the whole crew moves forward to new ground. The number of step-ups to be moved forward is the same as the number finished.

Ordinarily the following routine is followed:

The crew consists of 3 seven-man squads with a straw boss in charge of each. These three squads are exclusive of one or more saw crews which are stationed at the rear of the unit. The first squad, which follows the line locator, is composed of axmen whose sole duty is to clear the way for digging tools. Following the axmen is the grub-hoe squad, whose duty it is to loosen the ground for the third squad of shovel men who shovel out down to mineral soil, leaving behind them a finished trench. Large logs and snags left by the ax crew are cut by the sawers. Each saw crew is composed of three men, one of whom has a shovel to dig out under logs and to complete trench after sawing.

To add flexibility to this foreman's unit, the last two or three men in the ax squad are equipped with pulaskis instead of axes. Then if the clearing work becomes heavy, the pulaski men of the hoe squad can assist the axes or, if the digging is slow and difficult, the pulaski men of the ax squad assist the hazel hoes.

The men progress with their line construction as follows:

Each squad, *before they start work building line*, space themselves a given distance apart (about 15 feet) along the ground where the line has been located. Individuals are assigned to a definite position within the squad, numbered 1, 2, 3, 4, 5, 6, and 7, and they remain in that relative position at all times. For illustration, assume we are dealing with the ax crew composed of 7 choppers and 1 straw boss in charge. The number 1 or leading man walks out the located line 90 feet and stops. The number 2 man walks out 75 feet, which places him 15 feet behind the leader, and so on with the entire 7 men. This leaves the seventh man standing at a point where line construction is to begin. A simple way to obtain the proper spacing is to instruct the squad boss to stand at the point of beginning and have the men file past him in order, 15 feet apart. When the last man is reached, he cries "Halt!" and the crew is then ready to start work.

It is the duty of each squad straw boss to supervise the work of his crew, and as this requires all of his time he uses no tool except in rare instances.

After the squad is lined out, they all begin work simultaneously at the command of the straw boss. Each man *completes* the work required of whatever tool he is using as he goes. For example, if he is an axman, he does all the clearing that has to be done as he advances, or if he is a hoeman he completes the loosening of the soil as he goes.

Because of variations in working conditions, even from one end of a squad to the other, it is always the case that one or more men reach the point where the man ahead of him started before the others, and thus he has nothing further to do unless he goes past the men ahead. In order to avoid this undesirable procedure, the straw boss, whose duty it is to observe when a man completes his portion of line, makes a loud verbal command such as "Four" (pause), "up one," or "Smith" (pause), "up one." This command implies to the squad that Smith, who is number 4 man in the squad, has completed his section of line and that all workers in front of and including Smith must move up to the point where the man ahead was working, while number 1 steps forward 15 feet.

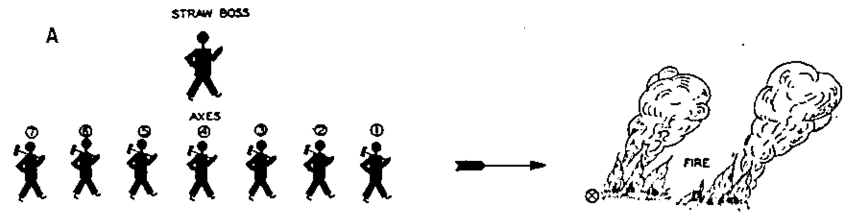
If two men finish at the same time—for example, numbers 4 and 5—the straw boss indicates the name and number of the one *closest to the rear of the squad* (in this case number 5) and orders up *two*, thus: "Five" (pause), "up two." This order implies to the squad that all the workers in front of and including number 5, move up two spaces, while number 1 goes out 30 feet and number 2 out 15 feet beyond the point where number 1 was working prior to the order. The reason only those from the finishing worker forward move up at an order is that, if the entire squad advanced there would be no one with that type of tool to complete the space left by the last man after he changed position.

Under this system it is obvious that the straw boss is the key to a smooth working squad, and it is extremely necessary that he be alert at all times. Also it is essential that the leading or first man in each squad know how to pace or be able to judge distances as it is he who controls the spacing of men. The foregoing description of squad control applies to all squads regardless of tools, except the

saw crews, which, because of their type of work, together with the fact they are last in the foreman's unit, merely progress as the logs, etc., are removed by them. One set of sawers often requires no straw boss, but when two or more are used the need for a boss to line out the work is evident.

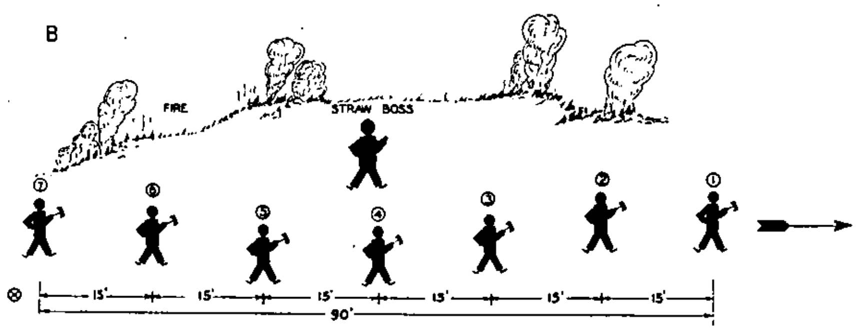
The foreman, in addition to directing the attack and assuming responsibility for his portions of the fire, controls the functioning of his unit through each squad straw boss.

The following diagrams and descriptions portray the functioning of the organization on the ground at a fire, from the moment the men are ready to be lined out.



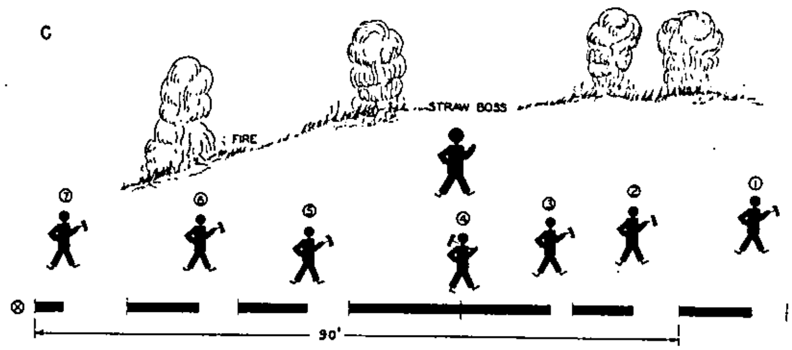
In illustration A the point where line construction is to begin is represented by the letter "X." The figures in circles represent the men grouped in close file in their relative positions within any squad at "X." Number 1 is the lead-off man and number 7 is the last tool-equipped man in an 8-man squad. The straw boss is the eighth man of the squad. The arrow indicates the direction in which line is to be built.

The straw boss allows the men with their tools to file past "X," holding each individual in turn at that point until the man ahead has moved out 15 feet. Number 1 steps out first, followed by 2, then 3 until number 6 is reached. When 6 has advanced 15 feet, the straw boss shouts "Halt!" This leaves number 7 at "X;" number 6, 15 feet out; number 5, 30 feet out; and so on to number 1 who is 90 feet from "X." See illustration B.

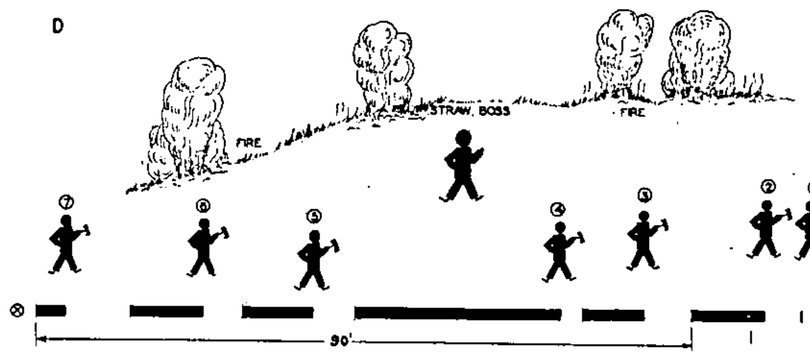


Following the above procedure, the straw boss gives the command to start work. Each man works always toward the man ahead, i. e., 7 toward 6, 6 toward 5, etc. Also, as he advances in this manner, he completes as he goes *all* the work required of whatever tool he is using.

After a short interval of time, some one man within the squad reaches a point where the man preceding him started work. The relative positions of the men, showing work accomplished up to that moment, is given in illustration C.



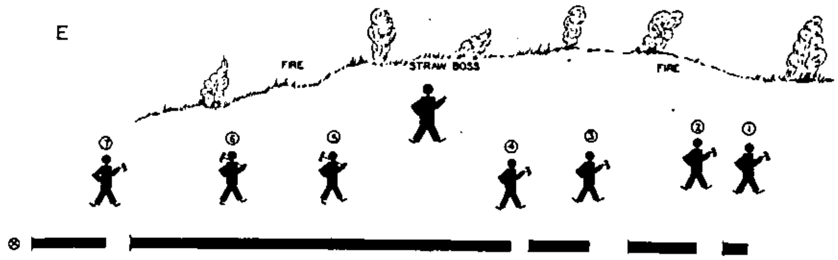
The perpendicular line represents where each man started working. The solid line represents work accomplished up to the moment number 4 reached the point where number 3 started. As 4 reaches 3's starting point, the straw boss shouts "Four" (pause), "up on," indicating that everyone from 4 through 1 move up to the spot where the man ahead is working. Number 1 moves forward 15 feet. Numbers 5, 6, and 7 do not move but continue working where they are. The result is diagrammed in illustration D.



As the men continue working let us assume that numbers 5 and 6 reach simultaneously the point where the men ahead of them started. The positions at that moment are indicated in illustration E.

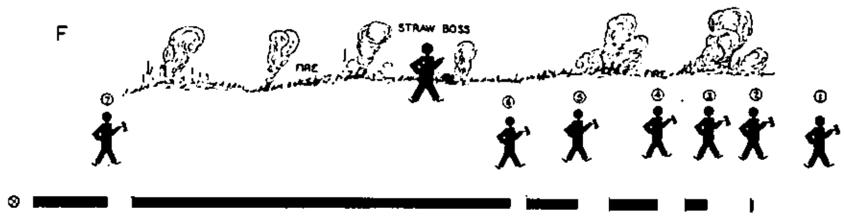
The straw boss then orders "Six, up two." Number 1 moves out 30 feet. Number 2 moves out 15 feet beyond the point where 1 was working prior to the order, which places him 15 feet behind the new position of number 1. Number 3 moves into the space behind 2, which is the spot where 1 was working, and so on down to 6. Number 7 does not move up. The new positions are indicated in illustration F.

E



At any time the order is "up two" or more than two, it is best that number 1 be allowed to place himself in his new position first. Then 2 places himself behind 1; 3 behind 2, and so on in order. In this way it is necessary for only the leading man to estimate the distance

F



to his new position as everyone following in turn, places himself in the space immediately behind the man ahead.

It should be understood that whenever number 7 reaches the point where 6 started, the order "Seven, up one" applies to the entire squad and everyone advances one space.

The foregoing descriptions and diagrams of positions are applicable to all squads regardless of tools used except the saw unit.

Application of good judgment by the straw boss in issuing orders, and accurate estimation of distances and knowledge of pacing on the part of the number 1 man in each squad, cannot be overemphasized if maximum efficiency is to be gained from this method. Numerous demonstrations by trained CCC crews and calculations of trench constructed per man-hour under all conditions, have proved definitely the "progressive step method" is noticeably superior to many older methods. Not only is speedier work accomplished, but also a finished trench is assured when the last man passes any point, and in addition the output of each individual is evident at all times. There is no opportunity for "soldiering" on the job.

From the standpoint of safety, the method has further advantages. Workers are not passing one another while carrying sharp tools. They are never so close together there is danger of one striking the other, and, third, in compliance with our safety regulations, each man has opportunity to assume the proper stance while using his tools.

THE AUSTIN ROTARY ORGANIZATION (FOR GRASS FIRES)

This method was described under the title of the "Spinning Fireman Method for Grass Fires" in the July 1940 issue of Fire Control Notes. The following description of the same method is from the Northern region's instructions to men of that organization, and is reproduced here because it is much clearer than the previous description.

Because the scheme will not work where mineral soil is not readily available, the reader's mind may turn to the possibility of supplying loose dirt or sand to the shovel men from a truck driven alongside the rotating members of the crew. Various ways come to mind of applying dirt from a truck to the fire edge by means of a machine such as those used for sanding icy roads. But would a mechanism and crew for putting dirt on a fire in this way be as efficient as a tank truck using water for the same purpose? That is the point where the next stage of experimentation and creative thinking should take over.

Just after the above was written, a letter came from a company producing finely ground diatomacious earth which the company claims is "death on fire." Any mineral earth dust is of course "death on fire" to some degree. Whether diatomacious earth dust would have any net value over ordinary dirt or dust is doubtful, but may be worth looking into. The Northern region has been requested to do so.

This scheme for handling men on the line was developed to speed up suppression of fast-spreading fires in light grass fuels. It is a progressive method and eliminates any lost motion if properly managed. It has proved very effective for small crews on cheat grass fires.

Normally, not more than five men are used. Four is an adequate number where digging is not too difficult. The scheme will not work where mineral soil is not available, since the whole procedure reduces down to "knocking the fire out with dirt."

When the edge of the fire is reached and an anchor spot is found, the procedure is as follows:

Assuming one four-man crew, each equipped with a shovel and canteen of drinking water.

The first man fills his shovel, steps close to fire edge and whips the load of dirt as hard and as far as possible up the fire edge, one-half the dirt striking inside fire and one-half outside. He throws his dirt while moving forward; does not stop but moves ahead parallel to fire about three times the distance his shovel of dirt covered. (Each shovelful, if properly whipped, will knock out fire to 10 feet, depending on density of grass.) He moves one or two steps away from fire and begins loading his shovel again.

Man number 2 steps to fire edge at point where number 1's dirt swath ended, whips his shovelful and moves quickly ahead to a position beyond man number 1.

Number 3, following number 2, releases his shovelful of dirt and follows the action of number 1 and number 2. They have knocked the fire down to a point opposite number 1, and he immediately begins the procedure all over again. This is repeated time after time, each man maintaining his constant position in the crew.

Number four follows behind at all times, shoveling in smoldering chunks of wood, dung, roots, etc., and extinguishes those persistent tufts of matted grass which were not completely knocked out.

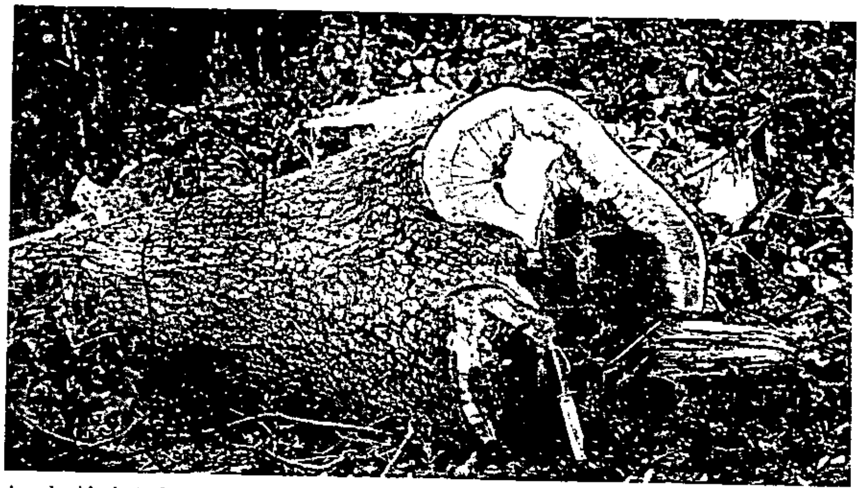
This movement gives the appearance of a three-man wheel rolling up the edge of the fire. Where dirt is plentiful, a four-man crew moves forward about as fast as the men would ordinarily walk.

SUMMARY OF FIRE PREVENTION PROBLEMS AND STATUS OF KNOWLEDGE

From an unpublished analysis of fire problems in the territory of the *Appalachian Forest Experiment Station* by George M. Jemison

Phase	Status of knowledge	Agencies working on problem	Action needed	Priority rating
Who starts fires	Good	U. S. Forest Service Administration, State foresters.	Continue as at present	
Where are problem areas	do	do	do	
When do fires occur	do	do	do	
Why are fires started—underlying causes of occurrence.	Meager	U. S. Forest Service Administration.	Expanded research by Appalachian Forest Experiment Station.	1
Determination of intangible fire effects.	do	U. S. Forest Service Administration, U. S. Biological Survey, privately endowed research in game management—Stoddard.	Expanded research by Appalachian Forest Experiment Station, U. S. Biological Survey, universities.	2
Determination of tangible fire effects on mortality, cull and growth.	Fair	Appalachian Forest Experiment Station.	Continued research by Appalachian Forest Experiment Station.	3
Development of damage appraisal methods for tangible values.	do	do	do	4
Development of damage appraisal methods for intangibles.	Meager	U. S. Forest Service Administration, State foresters.	Expanded research by Appalachian Forest Experiment Station, National Park Service, game specialists.	5
Development of effective methods of applying prevention methods and evaluation of accomplishments.	do	U. S. Forest Service Administration.	Expanded research by Appalachian Forest Experiment Station.	6

Cut-over, burned-over spruce type in North Carolina. The evaluation of such an effect of fire on site is a major problem that the Appalachian Forest Experiment Station has not yet undertaken. From an unpublished analysis of fire problems in the territory of the Appalachian Forest Experiment Station by George M. Jemison.



A valuable butt log culled because of decay that entered through a fire wound. Inasmuch as the decaying process takes place over many years and because the tree heals over the fire scar as shown above, determination of probable future cull due to fire is difficult. The Appalachian Forest Experiment Station is working on this problem. From an unfinished analysis of fire problems in the territory of the Appalachian Forest Experiment Station by George M. Jemison.

Economics of Fire Control.—The economics of fire control is really not a separate problem, but one which is tied in with every phase of the fire-control job and is so important that it deserves more than passing attention. Economic considerations enter into fire-control plans of all kinds; the determination of detection network, manpower requirements, and road and trail needs. If fire control is planned for on a sound business basis, then an economic objective must be set up. It resolves itself into a cost-accounting study (in the broadest sense), a job of finding the most profitable expenditure. As such it involves every phase of fire protection, particularly presuppression. This will constitute a major job for research in the future.—From an unpublished analysis of fire problems in the territory of the *Appalachian Forest Experiment Station* by George M. Jemison.

A Presuppression Theory.—Some of the best chances for saving fire-control dollars lie in making better and more efficient use of available presuppression facilities. If a fire protectionist were clairsentient and a sage as well, he would always be able to have exactly the right number of men at every spot a fire was going to occur. Presuppression and suppression costs would thus be reduced to an absolute minimum. Lacking such powers, the official responsible for fire control can do one of three things: (1) have a man "behind every tree," (2) have no men until a fire starts, or (3) attempt to strike a happy medium between the first two possibilities. The first would obviously be too expensive. The second would undoubtedly result in huge burned acreage because of lack of preparedness. Efficiency of fire control can be measured by the degree of success with which an administrator chooses the point of diminishing returns represented in the third possibility—the point where further expenditures fail to eliminate an equal amount of damage. The degree of presuppression effort should be aimed at this point of diminishing returns.—From an unpublished analysis of fire problems in the territory of the *Appalachian Forest Experiment Station* by George M. Jemison.

WINGS AND PARACHUTES OVER THE NATIONAL FORESTS

Roy Headley, *Fire Control, Washington, D. C.*

After the first World War, airplanes naturally drew the interest of forest officers. The California region did more than speculate about the possibilities. The only way which occurred to anyone to use these fascinating new machines was in systematic patrol for detection of fires. This was started in 1919 through the fine cooperation of the Army Air Corps. This cooperation incidentally led to enduring friendship between Forest Service men and Colonel Arnold, now General Arnold, and other members of the Army Air Corps who flew the "flying coffins" of that time and struggled with their temperamental engines. Some of the pilots of that day won fame later on for round-the-world flights and other contributions to human conquest of the air.

For several years, despite the accumulating evidence that airplanes could not compete with lookout men for first reports on fires, this attempt at aerial detection was continued. Then came a period in which the use of aircraft was confined to special detection flights after lightning storms and the scouting of going fires. Such special detection flights never discovered as many fires before they became visible to lookouts as was hoped, but the method has some real value and is a permanent thing. Aerial detection always was and always will be worth while when systematic stationary lookout service is not in effect. The very latest development along this line is on the Clark National Forest where smoke from widespread incendiary fires sometimes cripples the lookout system. When that happens the only alternative is detection by foot and motor patrolmen. But local businessmen own and love to fly the light and economical "cub" planes. One of them can be hired and kept pretty continuously in the air over a ranger district at a cost little, if any, higher than the cost of a corps of foot and motor patrolmen. When the smoke blanket is not too thick, fires can be seen from the air when the horizontal range from the ground would be very poor indeed. The low initial and operating costs of such planes make possible the continuity of detection, lack of which is the great defect of conventional aerial detection.

Scouting of large fires has also been continued and has lately been given a more practical turn by new techniques. Aerial pictures are developed while the plane circles for a short time and are dropped from the plane to the fire boss on the ground.

During the last 10 years, aircraft found its major field of usefulness in the transportation of materials, equipment, and supplies to be dropped where needed in remote locations or landed at one of the 80 fields which have been constructed on the national forests. In 1930 the author happened to be present at what was probably the start of the dropping of supplies. Howard Flint in Spokane

received an urgent request from a fire at the head of the St. Joe River for aerial delivery of badly needed gasoline and oil for pumpers. With such ingenuity as he could command on short notice Howard packaged the gasoline and oil, and they were delivered with surprisingly little loss. Later the Northern region developed the tight-package method of dropping most types of supplies. This was superseded first by the loose-package method and then by the burlap parachute originally developed by Lage Wernstedt in the North Pacific region. The Northern region prefers condemned Army silk parachutes, when they can get them in sufficient quantity. This form of transportation to the more remote locations has proved so successful that for several years more than 100 tons of supplies have been delivered annually by that means to going fires.

Parachuting of men to fires was, therefore, a logical growth. T. V. Pearson of the Intermountain Region originally advocated the method in 1935 and succeeded in getting some experimental work done, but could make no permanent converts to his theory. In 1939, Harold King, the Forest Service engineer-pilot, and the hard-headed fire-control men of the North Pacific region took up the idea and swept all obstacles and opposition aside. By good luck and good management a manufacturer of a new steerable type of parachute was interested. In November 1939, 58 jumps were made on the Chelan National Forest to test the technical practicability of the method. By this time, the Russians were jumping men to fires, but apparently not in the sort of unfavorable terrain characteristic of our mountain forests with their abundance of snags and windfalls. So far as known, the Chelan project was the first to test premeditated parachute jumps in timbered mountain country. It was surprisingly successful. Landings were deliberately made in thick timber to get experience with what would happen if a jumper failed to hit an opening at which he had aimed. There is no profit in landing in a tree because that slows up the jumper on his way to the fire, and much labor is likely to be involved in getting the parachute down out of the tree. But successful parachuting must not depend on being able to miss the trees every time. It was found that landing in trees represented little hazard to either men or parachutes. The jumpers came to call them "feather-bed landings."

Before the end of the November experiment, much redesigning had been done on the harness, the protective suit, and the rope and other devices by which the parachute man lets himself down if he lands in a tree. Even the manufacturers' prize parachute had been changed slightly to make it open differently and give the man a less severe yank when the 30-foot chute opened with a loud report.

Another surprise was the success men had in landing close to or even on a mark. The long continued and expensive project for finding ways by which chemical solutions could be dropped on small fires had just been closed up as a good idea which would not work, because the required marksmanship from level flight in conventional planes simply could not be attained. But it developed that with the aid of the steering "flaps" on this parachute a man could come within a few yards of landing where he wanted to.

During the winter the experimental project was recorded in a careful report, as explained by Mr. Godwin in the April 1940 issue of Fire Control Notes.

By the end of June 1940, 16 more parachutes and accompanying outfits had been purchased and 16 volunteers trained for the next stage of the experiment. Eight men were to work from the Chelan National Forest in Washington, and eight from Missoula, Mont. Parachuting men to fires may be technically practicable still not profitable in the management of fire control. Most of the annual 4,000 fires in the Northern and North Pacific regions are easily extinguished by the nearest lookout firemen who go directly to them from the lookout stations which they must occupy anyway for fire detection purposes. Other fires spread almost immediately to such size that nothing less than hundreds of men would have a chance to stop them. Probably not over 200 fires out of the annual 4,000 offer any chance to obtain any net efficiency by the use of parachute firemen over other forms of transportation. Worst of all, these 200 fires do not automatically identify themselves as needing parachutists. The dispatcher in each case must judge—and guess. He may decide that fires Nos. 101, 102, and 103 need parachute firemen, only to discover when it is too late that these were easy fires, and that he should have sent his high speed parachute men to fires Nos. 104, 105, and 106. Or he may have 100 lightning fires occurring within a few hours, to each of which he would like to send all of his available parachute men. He may dispatch 20 parachute men to reinforce some hard-pressed crew in a losing battle, only to find later that just as the parachaute men arrived the wind went down and the men were not needed, or, on the other hand, that the fire went on into a big run despite the parachute reinforcements.

The management problem is, then, whether with fires occurring in unpredictable time and location patterns enough actual total reduction can be made in fire damage and costs of firefighting to cover the cost of this special form of transporting men to fires. The answer can only be found by actual tests—the first of which has been made during the past summer. If this initial test is favorable to parachuting of firemen and if the necessary funds can be had, the venture will be tried on a larger scale in 1941.

During the 22 seasons since aircraft was first used on the national forests, there has been a pretty large amount of aerial work done for detection, scouting, transportation of men and supplies, and photographic mapping. Survey of 133,742 square miles has been made by aerial photography, and these pictures have been converted into maps for 84,819 square miles. One rapidly growing use of airplanes is for quick mobilization of picked fireguards or, more often, Forest officer overhead on exceptionally difficult fires. Up to 150 men are now assembled at landing fields all over a region and flown to the landing field nearest a big fire with amazing speed. The imperative demands for trained overhead on a large fire can seldom be met adequately in any other way.

Although any flying over rugged mountain terrain is relatively dangerous, and both scouting and aerial delivery of supplies are particularly so, not one employee of the Forest Service has been killed in 22 seasons of flying—up to the time this issue clears from the Division of Fire Control on July 20. Considering the low elevation at which much of this flying must be done to be worth while, and the miles flown through dense smoke and among the deadly down drafts

which occur around fires and in rough topography, this must be something of a record. It tells things about the skill and experience of mountain pilots and also about what forest officers have done in refusing to charter ships unless skilled mountain fliers are to pilot them.

Although no Forest Service employees have been killed, there have been fatalities, crashes, close calls, and injuries. In 1921, an Army Air Corps pilot was killed in taking off from the field at Alturas, Calif. Pilot Duck of California was killed in 1939 in Utah while flying west with a new cargo ship he had just purchased for use under a Forest Service contract. But he was not actually on a Forest Service job at the time. The only other fatality seems to be that of July 1940 when pilot Robert Maricich was killed while flying supplies to a Bitterroot National Forest fire in a plane owned by the Johnson Flying Service of Missoula, Mont. Del Claybaugh, a dropper employed by the Forest Service, was injured, but not fatally. At the date this is written, the crash is attributed to a down draft. A near-by lookout man was first to arrive at the scene of the crash, but the second was one of the new parachute firemen dropped for the rescue job and to report back by means of his new 6-pound radiophone.

The crashes and close calls known to the writer are these:

On the Bitterroot in 1939, when pilot Dick Johnson and Assistant Supervisor Sutliff crashed in a down draft in Goatrock country while looking for a camp site at which to deliver supplies. Although the plane was completely wrecked, both men escaped miraculously with only minor injuries. This was one of the three planes which the Johnson Flying Service has lost on Forest Service work within 2 years.

On the Flathead in 1938 when pilot Dick Johnson crashed when landing with a 2-ton load of improvement construction materials at Big Prairie landing field. This is understood to be another case of down draft.

On the Trinity in 1938 when a plane crashed in thick timber while dropping supplies to a fire, but without injuring either pilot or dropper.

On the Idaho some 10 years ago when a plane crashed after delivering men to a Forest Service landing field.

On the St. Joe some 10 years ago while Howard Flint and Pilot Nick Mamer were on an observation trip in a new plane. The engine quit cold. Although both men were equipped with parachutes, they took a look at the snags and rough ground under them and decided to ride the ship down. Both men were knocked out by the crash, but both came to and were able to walk out without aid.

In California in the early twenties when C. E. Rachford was in two crashes of the "flying coffins." In one instance a service man had failed to fill the radiator, and in the other the engine quit as engines of that time were prone to do. No one was hurt.

There have doubtless been other crashes, and it would be well if readers will report them for this permanent record, together with any corrections in the foregoing. Otherwise the information will soon begin to be inaccessible.

Even with all the accidents completely listed for the 22 years, the safety record will doubtless be a remarkable one considering the inescapable hazards. If we can only keep it up!

FIRE SUPPRESSION

By ROBERT MUNRO, *Forester, Southwestern Region, U. S. Forest Service.*

If you look through the index for Fire Control Notes and the tables of contents for issues since October 1939, you will find backfiring mentioned only twice—two articles on backfiring equipment by Fred Funke. It cannot be that backfiring is not an important tool. Some fires and some lives have been lost because of unskilled use of this tool. Many fires have been lost because of failures to use it at all. It cannot be that new ideas and skills are not needed. The subject is full of unsolved problems, the need for more skill, and good chances to develop new and better methods. When an observer succeeds in finding backfiring being done he too often has to groan inwardly over the awkwardness displayed. Backfiring is no longer taboo in regional handbooks. Some of them say "Use it—with skill and discretion, of course, but use it—or else." But until now, fresh ideas on backfiring have not appeared in Fire Control Notes. Perhaps the initiative of this author will break the spell that has hung over the subject. There is room to disagree with some of his statements, but the fact remains that out of his experience and for his particular conditions he has distilled some original ideas. Have any others learned something about backfiring in recent years?

In handling fire line work in the ponderosa pine type, which is the hazard zone in Region 3, a change is suggested from the old methed, i. e., line location, line constructions, backfiring, mop-up, and patrol. This proposed change would give the following order: line location, line construction, line mop-up, backfiring, and patrol. Fire spreads rapidly in the ponderosa pine type, but usually the fuels are light and may be handled fast. Consequently, the reason for this suggested change is that standing and down dead timber can be handled faster and with a greater degree of safety by locating the line so that line mopping up may be done before the backfiring is started. A substantial saving is also made in shortening the patrol time on the line, which in turn allows interior mop-up to start earlier. The mopped-up strip along the fire line will cool down quickly after it is burned over by the backfire if the dead timber is not there to hold fire. Danger of spot fires is also materially reduced. The lack of proper mop-up work has been a weak point in fire suppression work and has proved to be one of the causes of extra period fires.

This method hinges on the time factor and on proper line location, that is, if time and men are available to handle the job before the main fire strikes the line, the dead material can be handled much easier and faster when it is cool than when the crew is hampered by fire and smoke. The fire's behavior thus influences the line location, as the mop-up work is one of the main factors that must be considered in fire suppression work.

Except in emergencies, when it is necessary to do the work immediately, the backfiring should be done at night. There is usually less wind, and spot fires are more easily located. In handling the

backfire job careful attention should be given to training the crew that will be used in this work, also to the training of the patrol crew and the crew used to control spot fires. Backfiring can be safely and effectively used if it is properly done.

The handling of this job during the day when wind velocity is usually highest is considered in these problems, as most failures occur under such conditions. Emergency conditions quickly develop when prompt action must be taken or the main line will be lost.

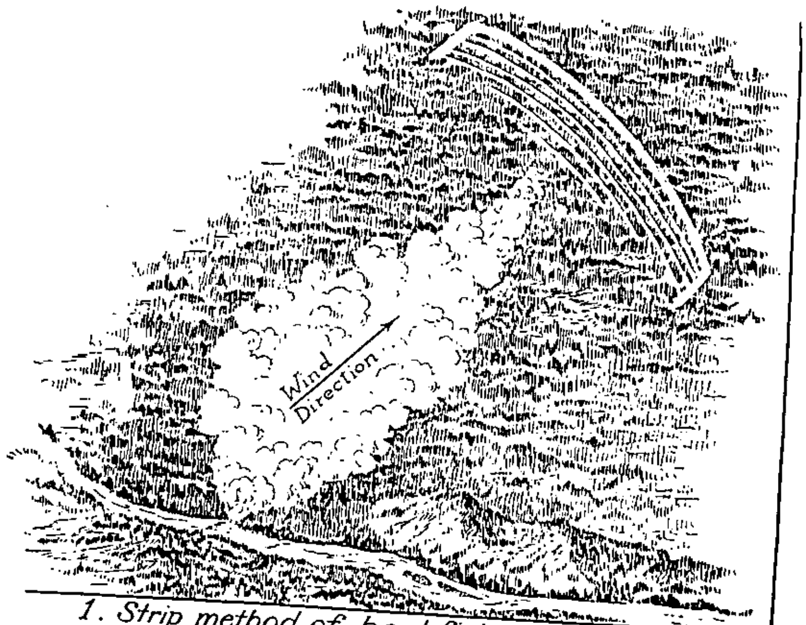
The problems presented therefore deal with emergency conditions that are common during peak periods.

It is important that the backfiring crew should be supervised by an experienced forest officer, who should also be directly responsible for the patrol and spot fire crews until the line has cooled down to the extent that it is safe to turn this work over to a patrol force.

The backfiring should always start at the highest point on the line and be worked downhill, by sections, giving due consideration to wind direction. The length of the sections should be governed by the amount of line that the crew can safely handle and patrol before the next section is backfired. Too much emphasis cannot be placed on the necessity for a vigilant patrol for spot fires until the line has cooled down to the extent that there is no further danger.

Problem 1

If the main fire is advancing before a strong wind a careful watch should be maintained for the development of a fast running point



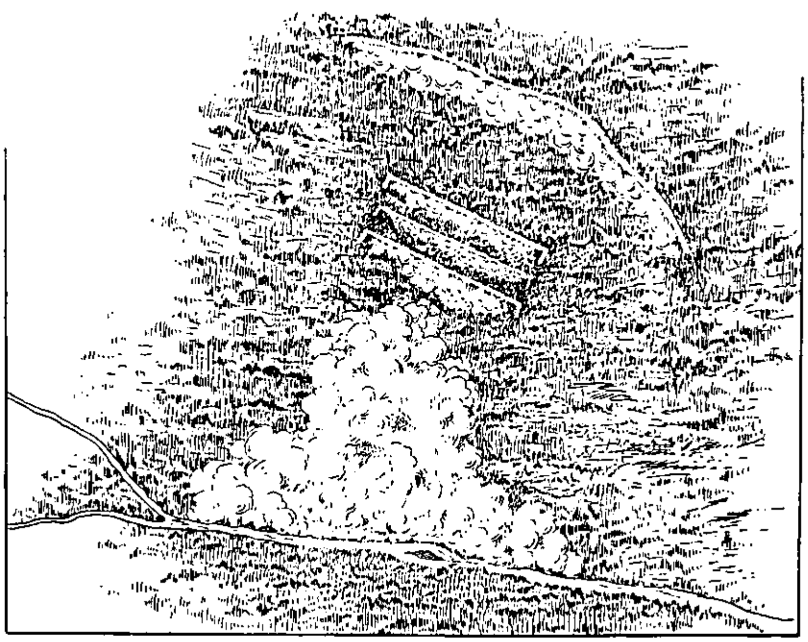
1. Strip method of backfiring against wind.

that may strike the fire line before the backfire has burned back far enough to eliminate the danger of the main fire jumping the fire line.

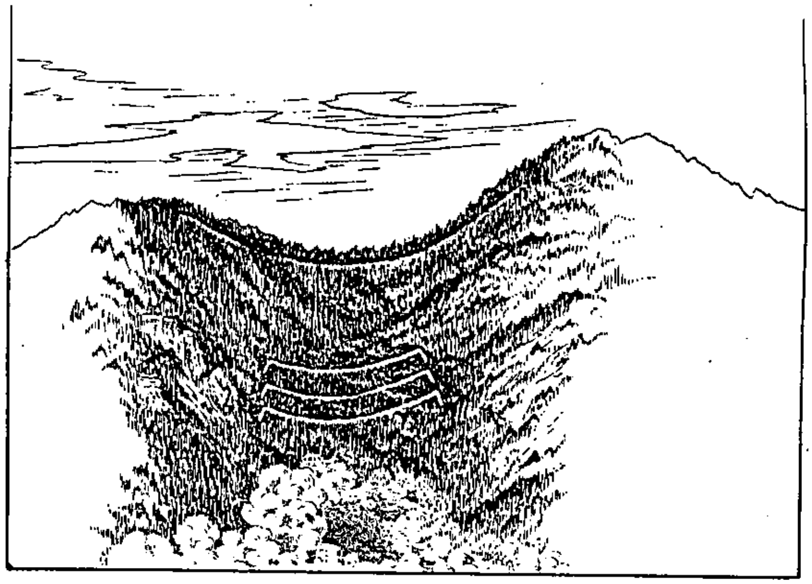
When such a point develops and time is available, the backfire may be worked against the wind by, first, setting the backfire on inside edge of the line; second, have backfiring crew fire narrow strips parallel to the line, working back toward the main fire and gauging the width of the strips to hold the crest of the fire within a safe limit. That is, if there is danger of the fire jumping, if a 3-foot crest develops, the width of the strips backfired should be narrowed down so that no dangerous run with the wind, may occur. In heavy winds these strips must be very narrow. Often 4- or 5-foot strips are advisable in locations that are directly exposed to the wind. (See sketch 1.)

Problem 2

If the fast running point does not allow sufficient time to handle, as above described, the advancing fire may be checked by "buffer" lines and and time gained thereby to complete the backfiring work. This system is shown by sketch 2, where the fire is advancing over fairly level ground. The "buffer" line idea is based, first, on the necessity of disposing of fuel ahead of the fire; and second, on setting up convection currents that will tend to arrest the velocity of the main fire and bring it to the ground. Three buffer lines are usually sufficient to do this in heavy reproduction and pole stands. The line nearest to the main fire should be the first built. These lines may be narrow, just wide enough to hold the backfire until it has gained sufficient

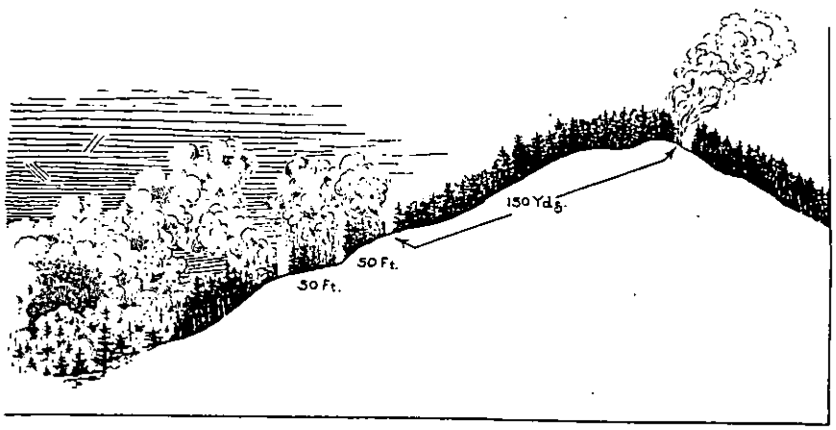


2. Use of buffer lines to check fast running fire.



3. Buffer lines in place to check fire (Fire line on high ridge)

volume to create a strong draft, and they can be quickly constructed. The lines should be long enough to envelop the point of the fire, with a right angle turn at the end of each line. This right angle should be 20 to 30 feet long, and its use is simply to hold the backfire until it has developed volume in order to create a strong draft. These lines should be backfired as soon as constructed. This work should be handled under the direct supervision of a forest officer in order to be sure that the safety of the crew is provided for.



4. Buffer lines and backfire in heavy fuels.

While this work is being done the main backfire should be steadily worked back from the main fire line, using the strip method previously described.

Problem 3

Where the main fire line crosses the head of a canyon or a low "saddle" on a high divide, these danger spots should be carefully studied before the line is backfired, as the wind is often more intense at these points because of topographic influences. Special treatment is usually required, such as narrow strip backfiring, and if the main fire is very close, "buffer" lines should be provided. (See sketch 3.) If the main fire develops a point here the buffer lines should be immediately backfired in order to lessen the chances of losing the main fire line, as it is certain that the fire will strike the line first at the point where the wind is most intense. The value of a lookout scout at such points should be considered in order to keep a close check on the behavior of the fire.

Problem 4

Sketch 4 shows a side view of the typical fire line set-up on a high ridge, with "buffer" lines backfired to slow down the main fire until the backfiring job can be handled.

Will 1940 be the Eighth "Bad" Fire Year?—When this issue reaches readers in October or November, the answer will doubtless be clear. But at the time this is written, July 16, the prospects are that 1940 will take its place with the preceding 7 outstanding bad years in the history of the national forests. That would make 8 such year out of 36.

After an early 1939 spring so dry that it broke records and gave everyone the jitters, June proved to be exceptionally wet in the 4 far western regions. Early spring in 1940 was not so dry, but June was almost rainless and some large areas suffered from drying winds.

At the date this is written, the North Pacific region is just pulling out of a bad crop of fires, and the Northern region is closing up a battle started by 701 fires from lightning storms on the night of July 12. Newspapers of July 16 report 8,500 men on Northern region fires with hundreds more behind the lines. But as much as 0.72 of an inch of rain has just been reported from one western Montana station. More may follow.

Bad fire years exert a dominant influence on average annual losses, but it is well to view such outstanding years in a perspective of their own. The following table tells the story:

	Area lost per million acres protected, national forest and private inside (acres)
Nationally bad fire years:	
1910	25,642
1919	12,996
1924	4,429
1926	9,146
1929	5,236
1931	3,368
1934	3,279

If 1940 proves to be the eighth bad year, the loss per million acres protected must be held at around 3,000 acres if the general downward trend is to be maintained.—Roy Headley, *Division of Fire Control, Washington, D. C.*

FIRE PREVENTION IN PENNSYLVANIA SCHOOLS

By Stanley Mesavage, *Colliery Forester*

Mr. Mesavage prepared this article and read it before all school children in Newport township. A Flagg poster had been placed on display on the bulletin board of each school, and after the reading of this statement it was placed alongside the Flagg poster on the blackboard for future reference.

Special Bulletin No. 1

October 1, 1939.

To All School Children:

In order to maintain a growing forest, productive of timber, wildlife, and other scenic and recreational values, it is important that every means of protection be given it.

Tree-clad hills and mountains mean more game for hunting, more timber for our mines, purer water for drinking purposes, and greater recreational benefits. Our forests are now producing what I have just stated above. It is important that YOU and YOU and YOU assure its protection.

We now have better hunting as a result of better forest protection: more rabbits, squirrels, pheasants, quail, and grouse can be found now in our green forests. The scrub trees are disappearing, and taller and straighter trees are appearing.

Remember—that FIRE is the accursed enemy of the forest. It robs YOU of a future timber crop, it destroys YOUR future hunting; it reduces the water table and lowers the height of YOUR mountain streams; it makes desolate YOUR future recreational centers, and most of all, FIRES threaten YOUR community, YOUR home and property, YOUR life and that of your family.

Remember also—that fires threaten the lives of miners and workmen who may be YOUR relatives as a result of the dangerous fire smoke entering the mines. Miners can be smoked out like rats in a hole. Fire may also ignite a coal vein, causing serious loss to YOUR income. For the above reasons, we must not have any grass or forest fires. Fires can be prevented. Small fires always grow into larger ones. DO NOT TAKE ANY CHANCES.

Report all suspicious smokes, and those starting fires to Stanley Mesavage, YOUR Forester, by calling Nanticoke 2105 or 2106, or by notifying the clerk at the Glen Lyon supply store.

MECHANICAL WEAKNESS OF THE FIRE SWATTER

GILBERT SYKES, *District Ranger, Coronado National Forest*

This ranger district depends largely on the swatter as the main fire tool. We have a good many miles of Mexican border facing us, the majority of which runs through rough, steep, and inaccessible country with a ground cover of thick, tough bunchgrasses and browse. Throughout this area the swatter has proved to be, by far, the most effective tool in fire suppression.

Two main weaknesses, however, have developed with the swatter. The first, a question of mechanical failure, is the more serious, and frequently occurs at a critical time during attempted fire control.

This trouble takes place in the metal supports that hold the belting to the handle. Breakage occurs either at the point where the metal shank which runs up into the handle is held fast in place by a rivet, or, more frequently, at the first rivet hole out from the handle. Sometimes the second rivet hole gives way, but this is not quite so serious as failure at the first hole, for if it occurs at the inner one, it is only a matter of a very short time until the break also takes place on the opposite side of the swatter at the same point.

The second weakness is a matter of the thickness and rigidity of the belting itself, and may be overcome through more stringent specifications by central purchase. Some of the swatters received are only three-sixteenths of an inch thick, others are a full quarter inch. The former are somewhat better than worthless, but not much. On a hot fire line they become more flexible and develop a sort of back-lash which makes it almost impossible to strike the ground cover with the flat swat necessary for effective "swatting."

The swatter is a fire tool that can be carried through rough, steep country with considerable ease, and, what is perhaps quite as important, with safety to the carrier and those near at hand. In much of the steep, rough, and rocky bunchgrass country on this district it is far ahead of any other tool used in suppression work. Once the grass is out, the line is built; no slow trenching and scratching down to mineral soil where none exists in the first place. The swatter also lends itself very well to the one-lick method, and the rate at which a grass fire may be checked with swatters using this method is certainly worth investigating. This is even true where a moderate amount of browse and trees exist. If some of you are inclined to doubt this statement, as I know many will, just give the swatters a trial, under a good severe test.

As I see it, the mechanical failure is not very much of a problem to solve. I believe the answer is simply one of using heavier metal

half round. At present this is half an inch wide, and the rivets used come so near to the edges that there is very little metal left between the holes and the edge of the half round. I believe that ¾ half round with a backing strip of ¾ by ⅛ would solve the problem. The same method of anchoring the metal into the handle could be used as long as the wooden handles are of the larger size, these being a full inch and a quarter. The size of the belting seems to be best when the dimensions are 12 inches by 12 inches by ¼ inch.

Swatters lately received made by the Council Tool Co., of Wananish, N. C., seem to be quite as good as, or superior to, any others so far sent to this region. They have good stiff belting, the handles are full size, and the general workmanship seems to be competent. However, they are made up of half inch half round steel, and breakage is occurring on the fire line as it does with others of inferior make.

A good swatter is a fine tool to have on a grass-type fire, but it is disconcerting to find only a stick left in the hands and a floppy piece of belting hanging on by one corner while a hot fire is doing its best to get away. At any rate I believe the trouble is worth fixing.

Region 4 Plane-to-Ground Radio Communication.—Last summer Region 4 took radiophone I-25 and mounted it on a 1 inch by 24 inches by 40 inches board. Just below the transmitter the power supply was mounted, and just over the transmitter a motorola receiver equipped for push button tuning was installed.

This completed assembly was provided with four angle iron feet spaced so that the holes through the feet would fit the bolts used to hold in place one of the chairs in a "Travel-air" plane. The completed assembly weighs approximately 65 pounds, and can be installed in a ship in 10 minutes. It is so arranged that the pilot can operate it, if he so desires. An antenna reel was provided so that the wire could be fed from the bottom of the ship. The airplane was both shielded and bonded.

The first test conducted with this unit was started from Cascade on the Payette. The Idaho, Salmon, Challis, Payette, and Boise Forests were asked to stand by for calls from I–25.

As soon as the plane was in the air contacts were made with all these forests. Distances involved were from a few miles to about 100 miles. Contacts were 100 percent effective, and loud speaker reception was had in the ship.

While flying over the Idaho and Payette forests, contacts were made and maintained with SP sets on the ground. During the test flight we were informed by the Salmon that the Missoula radio station desired to contact I–25. This contact was immediately made, the distance being about 140 to 150 miles. They were rather surprised at the signal strength from the ship, and so were we.

During the field season of 1939 this unit was used considerably over the fire forests in Region 4 and proved entirely satisfactory. It is planned that this year use be made of the same unit in the same way.—Francis Woods, *Communications, Intermountain Region, U. S. Forest Service.*

Use and Misuse of Pumpers.—One veteran fire boss in a Western region has suffered so many times from misuse of pumpers that when the subject comes up he invariably responds with a heated statement that if he could get all the pumpers in the world together he would like to take them out to sea and sink the ship. In his calmer moments, however, even this man would probably recognize that pumpers have a place in fire suppression. The majority of fire-control experts would certainly not want to do without them. But it is astonishing how many times an observer finds pumpers being misused in more or less ludicrous ways. Even after many years of experience and training, one Board of Review report on a 1939 fire finds it necessary to devote a paragraph to the unwisdom of taking time to lay a hose line which did not result in much accomplishment—less in fact than if the man-hours expended on the pumper and the hose line had been used in more efficient forms of initial attack.

BLITZKRIEG FIRE SUPPRESSION TRAINING—THERE IS SOMETHING NEW UNDER THE SUN

K. D. FLOCK, *Personnel Management, Region 1, U. S. Forest Service*

Twenty fire suppression overhead men from the regional office spent long hours in training at and around the remount depot on June 27 and 28, 1940. Many of the men had been fighting crew fires for over 15 years and were somewhat skeptical when they were promised a session of 100 percent new wrinkles for two solid days, but before the final bell was rung they agreed that the bag could still hold new tricks.

The first morning was spent in conference under leadership of Clayton Crocker. The discussion concerned new techniques of fire line construction, the merits of various systems, and detailed announcements of the high-speed program.

The afternoon was given to Gordon A. Rice, of the Pacific Marine Supply Co., makers of Pacific pumpers. Gordon is one of us, since he started out as a hard-bitten smokechaser after having spent his youth on a ranger district in this region. He put on a splendid demonstration of the proper use of water on fire. A hot fire was started in heavy slash fuel, and when it became a 40 man-hour smokechaser blaze, Gordon jumped into it and put it out cold in 20-odd minutes with one nozzle from a type "Y" Pacific pumper. No one in the group ever saw a nozzle used properly before, and several men "fessed" up that their ideas of water on fire were entirely revised.

The second day was really eventful. A CCC crew had been trained by Crocker and Flock in the "progressive step-up" method of line construction. They put on a demonstration in open country so the group could see the mechanics of the system.

Al Austin put out a cheatgrass fire with his rotary use of manpower; Axel Lindh and H. T. Wicklund put on a show in use of the improved Bosworth trencher. Then the whole crew went down Butler Creek to the spot where an empty-handed group of camp bosses were to serve a hot dinner. With no food or dishes, this group of fellows looked pretty silly until Crocker gave them a sheet of paper out of which by magic they served a hot dinner for 50 men, with all the trimmings, in jig time.

Apgar furnished an SP set, so by reading the simple directions furnished by Crocker, these camp boss trainees soon had the hot dinner ordered from Missoula by plane. It was with mingled skepticism and awe that the group watched neat brown packages being dropped at their feet under the silken chutes. Of course, they all predicted that the food would consist of badly shaken hash and canned prunes. Out of four drops, however, there came braised beef, mashed potatoes, peas,

gravy, fruit, fruit cake, coffee, bread and butter sandwiches, and 13 gallons of ice water. All the food was steaming hot, and no spill or breakage was experienced. There were no containers or utensils to carry out. They were either paper or made of cheap material. The details of this system can be learned elsewhere, but it is sufficient to say that it was an eye-opener, when one considers the many man-killing walks from fire to camp and back when every ounce of energy is needed to fight fire.

After the noon dinner the "progressive step-up" method was demonstrated by three squads of CCC men in actual fuels. The trainees were surprised at seeing line push through the woods faster than it had been seen before and with such precision.

A tough chance was blazed out for the Cletrac 35 brush buster through down logs, stiff grades, and in heavy brush. Many bets were won and lost on the time that would be used to make a line 27 chains long in the jungle, and to the surprise of many the job was sewed up in 25 minutes by the machine. The experts estimated that it was a 4½-hour job for 25 men. "No wonder Hitler's men went so fast through obstacles on his western advance," said one of the trainees.

As side issues, the trail scooter and mule-loading exhibits were put on in the evenings at the remount.

The consensus was: "It was a good school, Clayton, and we were surprised because there were so many new things."

Fresh Emphasis on the Importance of Volunteer Cooperative Suppression Crews.—In Board of Review analyses of 1939 fires the potentialities of volunteer suppression crews in small towns and villages receive special emphasis. In many places grass fires starting within striking distance of such communities spread with such speed that nothing but the quickest possible attack can hope to prevent a run over a large area and into timber or watershed land above the grass. It is often impossible to keep paid suppression squads, even CCC crews, constantly standing by ready to go with the necessary promptness and speed. But we know from past experience that when the proper interest and enthusiasm is generated, a volunteer crew of businessmen and workers in small towns can turn out to such fires with all the traditional speed and vigor of volunteer fire departments. The famous work of the Crag Rats at Hood River, Oreg., before the days of the CCC, is an illustration of the possibilities of such crews. One important idea emphasized in 1939 reports is that the function of such a volunteer crew should often be to go to the fire and work only for the first hour or two, until fire-control officers have had a chance to organize a crew from less readily accessible sources. The desired type of action from volunteer town and village crews might be far easier to get if the men knew that they could be back at their work in a few hours. With their working clothes always kept where they could be grabbed instantly and with the thrill which comes from a fast run and a fight of limited length, such crews of village businessmen and workers might find such a form of service not only within reason but an exciting and pleasing change from their routines.

Output Per Man-Hour.—Board of Review reports are beginning to comment on the curious fact that fire bosses and inspectors are so often insensitive to the rate of output per man-hour on the work for which they are responsible. One report says: "We need to know more about the actual suppression work on the line if improvement in production per man-hour worked is to be obtained. The production of 0.09 of a chain per man-hour tells its own story when compared with standards set by regional judgment through the years and indicated in the dispatcher's guide. The problem will be solved by better methods of organization and fire fighting and a reduction of walking time for work crews."

COMMENT ON "CHECK OF CENTRAL STATES FIRE-DANGER METER"

By H. T. Gisborne, *Northern Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service*

Danger measurement is not an easy subject. But neither is it something which can be left wholly to fire research men. Every man who is responsible for fire control management needs to understand at least the strong and weak points of theories and methods now in use. No one except administrative managers can decide the number one question—exactly what use or uses do we want to make of such measurement systems—but that answer has not yet been fully worked out.

The author, a pioneer in this field, sets a good example by offering comment and criticism on a previous article. Fire Control Notes cannot completely fulfill its role without an abundance of such comment, either directly constructive or merely critical, or both.

Designers of fire-danger meters should have been interested particularly in two statements made by Reynolds and Bruce in their article in the April 1940 issue of Fire Control Notes, page 79.

The authors assert that "As generally used, the lowest danger-class on any meter indicates weather conditions during which fires will not occur. Since 18 fires have occurred here [in 752 days studied] on days of danger-class 1, as this meter is now graduated, the meter should be regraduated so that class 2 will include these days."

In designing the Region 1 meter class 1 was used as the lowest, rather than class 0, for three reasons. First, there are almost no conditions under which forest fires cannot originate. We have had rare cases of fires burning through the crowns or in snags with snow on the ground. Lots of fires originate during the pouring rains of thunderstorms. Hence, there really is no such thing as class 0, if that is to mean *no chance of fires starting*. Use of class 1 admits that there is always a very small chance of fires starting, though they may not spread far.

Second, if there were certain rare conditions of absolute safety from fires there would be no present advantage in segregating and distinguishing them in one class. The administrative organization of any timber protective organization is always adequate to handle freak and rare cases that often require only a report after the officer has learned that the fire occurred.

Third, class 1 was preferred to class 0 in order to escape mathematical difficulties inherent in the use of zero.

Reynolds and Bruce raise a good question which should be answered uniformly for all regions: Should the lowest class of danger in a scale designed primarily for administrative action include *only* those

conditions when forest fires can neither start nor spread? My personal and present vote is "No." When we get a national scale of 0 to 100 percent, I might vote "Yes."

For the other end of the danger scale Reynolds and Bruce raise a similar question by asserting that "also on most danger meters, only about 1 day in 100 is in the highest danger class." I do not see how such a statement can be made on the basis of only a few years of measurement. The highest class of danger shown by a meter must represent the worst probable (perhaps worst possible) conditions at a single station, if that danger scale is to distinguish that day from less bad days. The frequency of occurrence of that condition is difficult to determine until records covering a normal distribution of easy, average, and bad years has been accumulated. A minimum of 10 and usually 20 years is required to determine a dependable meteorological normal.

Reynolds and Bruce contend that as there were no days of class 7 and only 2 of class 6 in the 2 years covered by their records the meter should be regraduated. Is it not possible that these 2 years were easy or average, and that with the advent of a really critical year plenty of class 7 days would be recorded?

This raises another basic question concerning danger-meter design. Should the meter be made to distribute the frequency of occurrence of the various classes on some preconceived basis, or should the meter rate all possible conditions and the data then be used to determine the frequency? In other words, should we assume the frequency or should we find out what it is? I vote for the latter.

If we ever succeed in designing a satisfactory national danger meter it seems probable that the highest class, degree, or percent representing the worst possible (or probable) for any forest spot in the United States will never be registered by meters in places which never have 40-mile winds, 2-percent fuel moistures, and subzero humidities, all at once. I understand that such conditions have been measured in California. If we save 100 percent national fire danger for this condition most of us will be very glad not to record *any* of it.

New York's Got Rhythm.—The one-lick method receives frequent and favorable mention in The Observer of July 1, 1940, issued to its men by the Conservation Department of New York.

District Ranger E. W. Blue describes one ingenious management device which has not been reported before. In commenting on a demonstration of the one-lick method he had witnessed, he says: "The problem of proper spacing of men (with digging tools) does not appear to be difficult * * * and one crew kept in almost perfect rhythm when the leaders counted loudly and each man struck on the count of four."

While counting aloud to regulate the ratio between licks and strokes would have its drawbacks, it has interesting possibilities. Expert woodsmen, who know their psychology, resort to counting their steps as in pacing, when they need something to relieve the tedium and fatigue of hard monotonous travel in the woods. Perhaps the spirits and accomplishment of a line construction crew could be given a lift by a well-designed device of the same kind.—ROY HEADLEY, *Fire Control, Washington, D. C.*

LINDH'S PROPOSALS CALL FOR A TEST

Comments on A. G. Lindh's Article Entitled "Separating the Good People From the Careless"

By John P. Shea, *Psychologist, U. S. Forest Service*

Mr. Lindh's proposals in the April 1940 issue strike a responsive chord with me. They follow in general the methods employed by traffic experts to prevent automobile accidents. If we carry them out we may find, as the traffic people have found, that such methods of educating the public cost much in man-hours and money, but are extremely effective.

If it is decided to carry out Mr. Lindh's proposals, let's make up our minds in advance that careful implementing and systematic follow-up will be necessary.

An important question yet to be answered is: How can we separate the sheep from the goats before they go into the forest?

I make the following suggestions:

After education of the public has been given along the lines laid down by Mr. Lindh, a test should be made in three phases.

Phase I.—Do they *know* it right?

Make and give a test for "goatiness." Such a test will aid us to weed out those who fail to pass it, and to certify only those who do. For convenience and time-saving, the test may be in the form of a check list—with questions which the candidate must answer. This check list should closely follow the training course and text that Mr. Lindh specifies.

In check list form the test can be administered to groups as well as to individuals. Each candidate should be given a mimeographed copy of the check list to fill out. He should show that he knows a sufficient number of right answers before he passes this phase of the test.

This is only preliminary to the main part of the test. I am skeptical of mere questions that may be gibly answered. Habits must be checked also, if we are really going to separate the goats from the sheep. Knowing the right answers and doing the right things in the forest may be two entirely different matters. Habits are strong. So, the candidate's *habits* should be tested. If our instruction has made the candidate a safe person to go into the forest during the fire season, this second phase of our test should show it. It should reveal specifically whether new, desirable habits with matches and smokes and campfires have actually been started.

Phase II.—Do they *do* it right?

This "doing-it-right" phase is an important part of the step to separate safe people from unsafe people in the forest. In this phase of the test the examiner has collected the check lists from the candidates. The examiner puts before the candidates certain test materials, match, ash tray, cigarettes, etc., and instructs them to do now what they would do in the forest with the same fire-causing material.

In this phase of the test the examiner should test the candidate by what he actually does with the match, a cigarette, cigar, pipe, ash tray, etc., when these are put before him for his use. For example: Did the candidate break his match? Put cigarette stub in ash tray, etc.? The test situation here should, as nearly as possible, simulate actual outdoor conditions.

The examiner now rates the candidates on what he observed of the candidate's habits with matches, cigarettes, etc. throughout the entire period of instruction and testing.

When habits are still wrong, the examiner withholds certification or permit until candidate actually *does* the right thing.

Those candidates are certified who pass both phase I and phase II of the test.

Phase III.—Will they keep on doing it right?

In this phase of the test the examiner hands to the successful candidates certificates or permits duly signed by him or by a forest officer. The certificate should carry also a brief list of essential things to do in the forest in the way of fire prevention and cooperation with the Service. The candidate should then be asked by the examiner to read the certificate in full, and if he agrees to abide by the program laid out therein to sign the certificate in duplicate. One copy is kept by the candidate, the other is returned to the forest officer.

One provision in the certificate should state that in case a fire breaks out while the permittee is in the forest, he is to cooperate with the forest officer along lines indicated, reporting, suppressing, etc. It should be stated that in case a fire breaks out while certified persons are in the forest, they may be called on to give an account of their time and activities while in the forest.

In this way, the certified persons would clearly understand that the privileges they enjoy in the forest also entails obligations on their part.

The foregoing suggestions to implement Mr. Lindh's proposal are designed to be a sort of education in fire prevention that goes clear through to habit changing. It is designed (*a*) to educate the public in fire safety; (*b*) to separate the good people from the careless, and certify only the good ones; (*c*) to obtain the cooperation of the certified persons with forest officers; and (*d*) it provides the Forest Service may have a hold on the people who are certified during all the time they are using the forest.

Forest officers in the field may see many ways of correcting and improving these suggestions.

MORE COMMENTS ON LINDH'S SCHEME

Lee P. Brown, *Training officer, Rocky Mountain Region, U. S. Forest Service*

As I get it, Lindh proposes to test the public and issue a certificate or permit to come and go in high hazard areas.

The following arguments parallel to some measure the arguments which can be made against any law, but which do not stop the passage of laws.

1. People can pass this test 100 percent, or any test we can devise, and still start fires. Regions 5 and 6 both have had cases where timber operators, local residents, and even trusted employees of the Service have been found to be careless with fire. Under such conditions permits to enter and be within a high hazard area would defeat the very purpose of control.

2. If an area of high hazard exists and there is reason to close the area to public travel or to smoking, campfires, etc., isn't it parallel to the police powers of the State? Closing roads to travel during existence of hazardous conditions; closing areas to travel for the benefit of special use, such as parades; routing travel to and from ball games during heavy traffic are similar examples. Exceptions are not generally made in these cases because to do so would defeat the purpose of control.

3. Some exceptions cannot be made because of the excessive cost of administering the area under these conditions. Several million people visit the forests every year. All of them would have a right to demand the test. For example, say we close a number of thinning areas in the Black Hills. There are several thousand, say roughly 20,000, in and adjacent to the area, and possibly 100,000 visitors who spend some time there. Now then, suppose only 1/10 demand the right of test. We have the cost of testing 12,000 individuals and the cost of maintaining an intensive patrol to check those who have permits and those who have not.

Now, suppose we close areas to campfires and smoking on the Roosevelt and Pike, which are adjacent to heavy population centers, as we did last year because of drought. What sort of an administrative problem are we setting up in saying: "You may but he may not?"

4. It seems to me that testing *habits* is a vital factor, as witness our ash dumping fire at the training camp last fall. Last summer the key fire warden on one of our ranger districts caused a smoker's fire. He smoked infrequently; he suffered a momentary lapse of caution. Result—a fire.

5. The mere fact that I never have set a forest fire, although I have spent years living and working in the woods, is no assurance that I won't, but it is the best exemplification of correct habits you can have. Of what value is past record in a high hazard area?

6. After all, it seems to me that the best criteria are the fundamental reasons for the restrictions. Is the restriction necessary because of

critical conditions on the ground when all possible risk must be removed, or is it necessary because of high and frequent risk caused by human occupancy with hazards normal or low? The questions of risk and hazard are deciding factors. No one is allowed to smoke in a powder magazine. Signs of "Employees only" prohibit strangers or visitors from entering manufacturing plants or construction jobs. Within the plant or on the job are signs "No admittance," "Danger, high voltage," "Stay out," etc. The mere fact that an employee is safety-minded does not gain him entrance to areas of high hazard. The necessity for his presence, in spite of the hazard, puts him there. All other employees are not permitted there, but are kept out by a watchman, foreman, or by the crew itself. It is a case of self-defense—protecting themselves and protecting each other. The outsider always adds materially to the risk of accidents.

Fire Reports, Errors, Headaches, and the Law of Diminishing Returns.—When the new Form 929, Individual Fire Reports for 1940 are all punch-carded and run through the tabulating machine, the Forest Service will have a brand new statistical tool to work with. But the value of this new statistical information will not be limited to current use. Twenty-five years from now, management and research men will be using the new form of fire statistics to discover trends, draw conclusions, and develop new ideas. Will the men of 1965 say of the men of 1940, "They certainly set a high standard of accuracy, and when they adopted a set of instructions, they certainly followed them"? Or, will they say something about the inability of the men of 1940 to do simple arithmetic, and read and follow instructions?

The answer will depend, first of all, on the mental discipline of over a thousand widely scattered men and women who make and code individual fire reports. Every report is a mental test of each person making or coding or checking a report. If he reads the instructions carefully, reasons correctly therefrom, and has trained his hand to record accurately what his mind has directed, he will be upholding the dignity of this kind of hard work as well as winning applause from all users of fire statistics. There is no finer team work than that in which many widely separated individuals are conscious of the whole team and play their own individual parts where the inspiration of close association is lacking, as in a job like this one.

To catch the inevitable few mistakes and get the new 1940 coded fire reports onto the punchcards with an irreducible minimum of error, it was at one time planned to assign an experienced fire man to the job of making a last final check in Washington. This plan had to be given up and the job added to Miss M. A. Bell's other duties.

On July 1 she had completely checked 659 reports and written letters calling attention to errors discovered. But by this time there were over 1,800 unchecked reports awaiting her attention. Something had to be done. The plan adopted was to rush the accumulated reports through with no systematic check except to see that the "code numbers" columns were all filled in with correct numbers of legible digits. Occasionally, both an administrative entry and the code number are left blank, despite all the checking at forest and Regional offices; or the number of digits in the code numbers column does not match the number of columns on the punchcard assigned to the item. Mrs. Moler, the machine operator, cannot be expected to take time to puzzle over such slips. In this fast check, Miss Bell also made sure that the cause entries conform to instructions, and checked "area when controlled" with areas entered in the damage block.

After the accumulated pile of unchecked reports was rushed through, a form of spot check was adopted. As time permitted, 100 reports were taken at random from each region in rotation, given a thorough check and the region written about errors found, if any.

This form of spot check is by no means all that is desirable. Too many errors are still showing up. But it is hoped that reports coming to Washington will be so well done in the future that the law of diminishing returns would not justify any more thorough checking.—ROY HEADLEY, *Fire Control, Washington, D. C.*

IMPROVEMENTS IN BACKPACKING THE PORTABLE PUMPER EQUIPMENT

FRANK H. ANDERSON and G. W. KRUSE, *Camp Superintendent* and *Junior Forester, Superior National Forest*

Road and trail mileage and water using equipment on wheels have so increased that it would be easy to neglect the instances when nothing will really serve except a portable pumper with plenty of hose and fuel all carried to the right spot on men's backs. Pumpers and hose lines seldom pay in initial attack, but that does not mean there is no need for ways of carrying them into the jungles with the highest attainable ease and speed. Quick and easy delivery of a pumper to a mop-up job in heavy fuels may often provide the only way to prevent a fire that "jumped the line" and made the headlines as a big destructive fire. The authors have something to show for their search for better equipment for transporting pumpers and hose.

Those individuals who have had experience in backpacking marine pumps, hose, and gasoline over rough terrain in packsacks or on ill-fitting packframes will no doubt be interested in any improvements offered to make the job easier and less back-breaking for the man under the load.

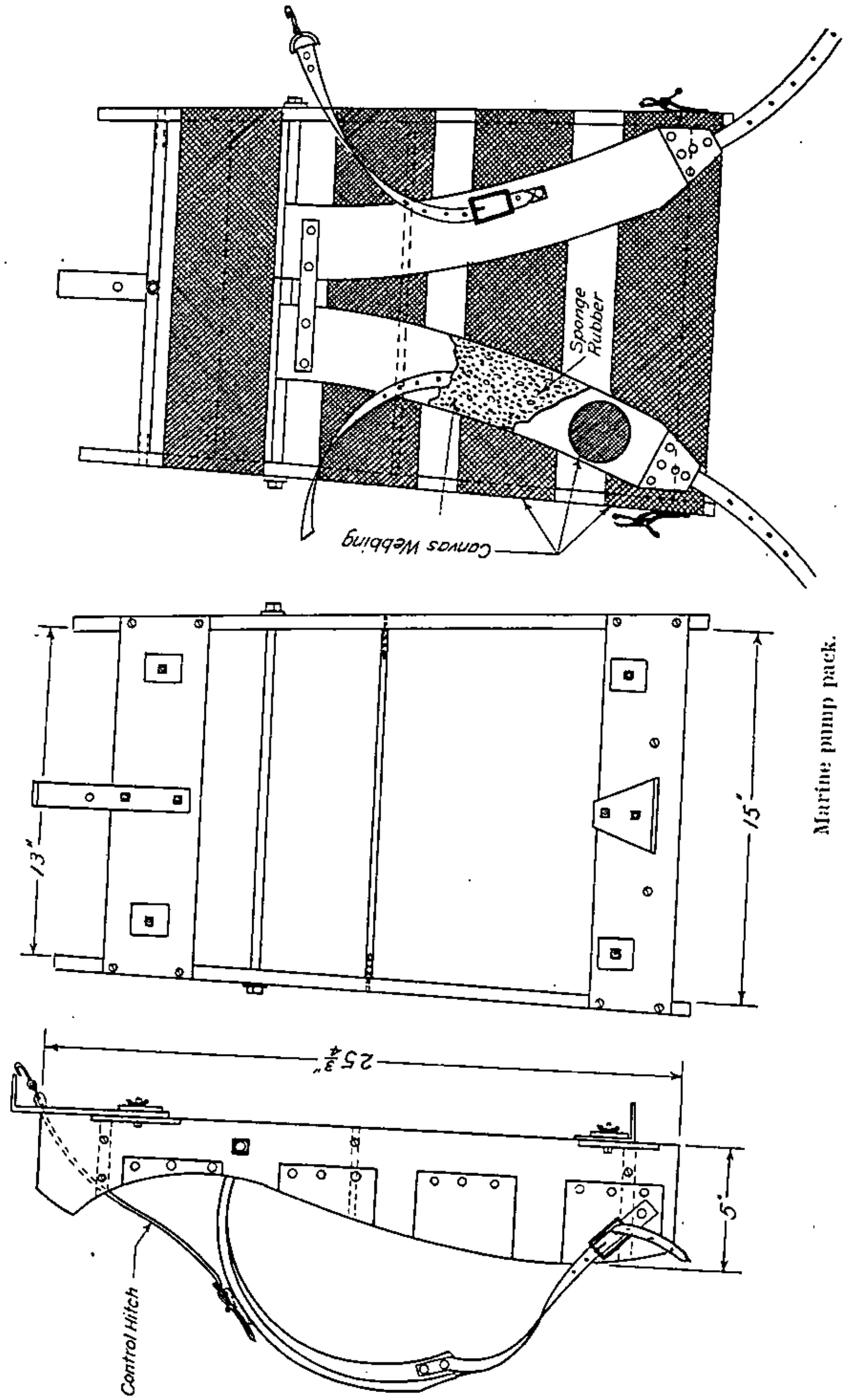
The chief complaints on using the common type packframes or packsacks are:

1. The load is carried too low.
2. The bearing point on the shoulder cuts down normal circulation in the arms.
3. The weight is not distributed over the back.

After a year of study and experiment, the authors offer what they believe to be a solution to the problem.

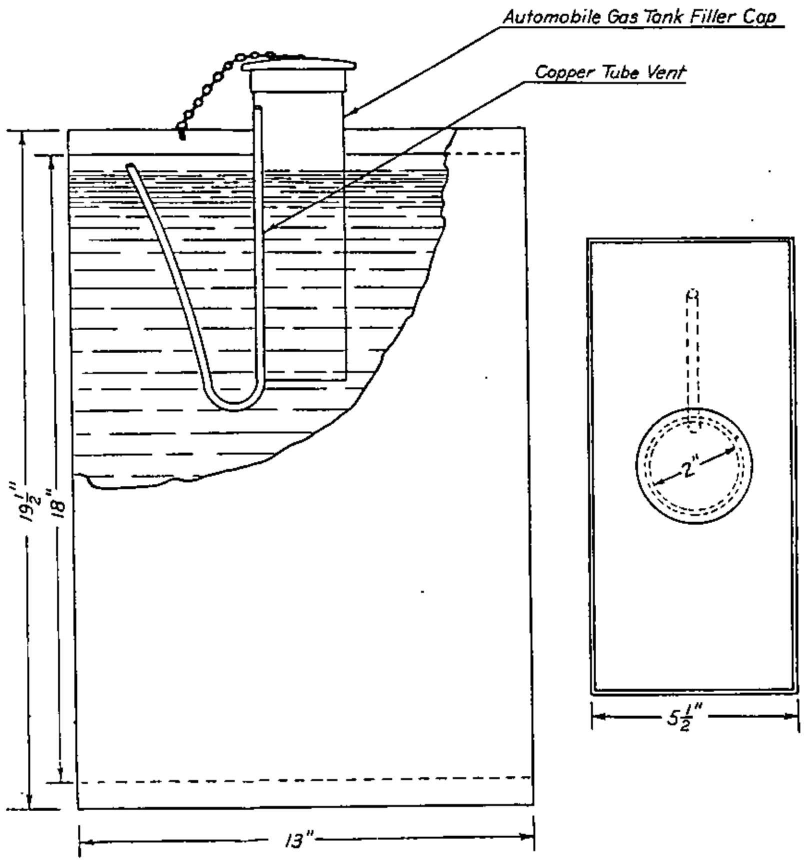
The new form-fitting packframe for marine pumpers is designed to fit the curvature of the back, thus allowing a more comfortable distribution of weight on the packer. The load is slung higher than on other frames. The padded packstraps help to eliminate the cutting off of blood circulation that has so often produced a numbness in the arms of the packer. The adjustable control hitch, which fastens to the packstraps and to the base of the pumper, gives the packer absolute control against swaying and holds the load in the proper vertical position in such a manner as to eliminate most of the back drag. The addition of a head strap, which eases the load a bit more, is optional. Any type of hitch, clamp, or bracket may be used in attaching the pumper to the frame.

A new type of hose pack enables the packer to carry and distribute 400 feet of linen hose with ease. The hose is connected and lapped on the frame and held in position by door springs. Hose can be strung out about as fast as a man can walk. This system is a time saver where minutes count, as it eliminates the time used in uncoiling the hose by hand. Hose can be strung out through heavy cover very quickly with-

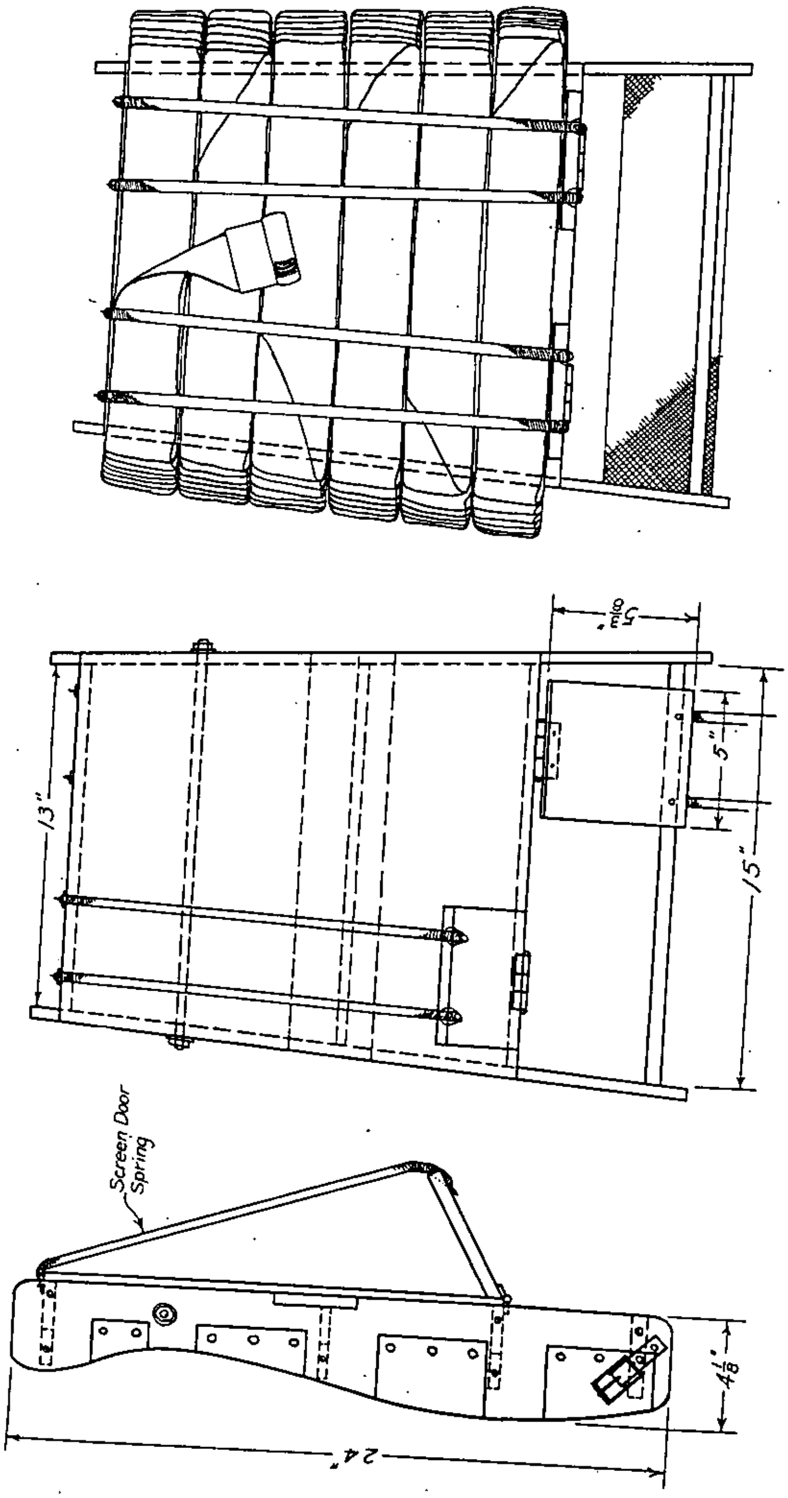


Marine pump pack.

A. Side view showing the position of frame on packer; B. Rear view showing clamps for holding pumper to frame; C. Front view showing adjustable control hitch, pack straps, and webbing.



Portable splash proof gas can, 5-gallon capacity.



Hose pack.

A, Rear view showing position of hose pack on packer; B, Rear view showing lapped hose being laid out—note door springs; C, Illustrating the manner in which the hose is lapped on the frame; D, Rear view showing gas can mounted on frame—note filler cap.

out the use of a brushed line. This form-fitting frame can also be equipped with the adjustable control hitch and head strap if so desired.

The new splash-proof gas can for transporting pumper fuel has a capacity for 5 gallons of mixed gas and is mounted on a form-fitting pack frame.

The automobile gas tank filler neck and cap prevents the leakage of fluid onto the back of the packer. The filler neck acts as a baffle plate and prevents splashing close to the filler cap. The copper tube vent must be installed with this type of can to allow air to escape while filling the container.

The gas tanks have been removed from the pumps on the Superior National Forest, and gas is siphoned directly from the pack can to the carburetor. This in itself has the advantage of eliminating the necessity of stopping the pump so often to refill the tank.

It will never be possible to make packing pump units easy. However, any method which can be devised to cut down the excess effort used in getting the equipment to a fire will mean faster attack by fresher men.

How Many Dimensions Has a Fire?—In reviews of the McVey fire of 1939 on the Black Hills and Harney National Forests, the point was made that the vertical dimension of a running fire is often more important than its area or length of perimeter. Another 1939 review talks about "depth of perimeter as well as length of perimeter." The point is that when a fire burns into "goat rocks." the fuels may be so spotted and so exposed to the wind that the job of making a control line has to be one of putting out, isolating, or mopping up fires spotted over a considerable area rather than making a continuous barrier at the outside edge of a fire. The point is made that this is important to consider in the calculation of probabilities, and that as we develop rules or guides which can be more universally used this information should be made available to the men responsible for dispatching to fires which may burn into this kind of country.

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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.