AUGUST 9, 1937

FIRE CONTROL NOTES

A PUBLICATION DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE – U.S. DEPARTMENT OF AGRICULTURE

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The value of these publications will be determined by what you and other readers contribute. Something in your fire control thinking or work would be interesting and helpful to others. Write it up and give other men some return for what they have given you.

Articles and notes are wanted on developments of any phase of Fire Research or Fire Control Management: theory, relationship, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire fighting methods or reporting, and statistical systems. Whether an article is four lines or ten typewritten pages in length does not matter. The only requirement is that articles be interesting and worth while to a reasonable proportion of readers.

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

FIRE RESEARCH IN THE LOWER SOUTH

V. L. HARPER

Senior Silviculturist, Southern Forest Experiment Station

This article is adapted from a report prepared by the author pursuant to starting new studies in fire control at the Southern Station during 1937. Some of the fire problems of the southern pineries are presented; and in addition the article exemplifies the type of *problem analysis* and *program* which the author prescribes as a broad guide in planning and carrying out project research.

THE PROBLEM ANALYSIS

Fires burned over annually an average of approximately 43.5 million acres[1] in the 11 southern states, or an average of 22 per cent of the total forest area, during the 5-year period 1928-1932. The forests are far from being wiped out, however. Acreage burned and damage done evidently are not closely related, for the reports of the Forest Survey show a tremendous volume of wood still growing. Nevertheless, no one will deny that more growth could have been obtained under management, of which control of fire is a vital part.

During the same 5-year period there was an annual loss in acreage burned of 4 per cent for the 48 million acres of southern forests under protection. Inasmuch as before 1928 there was not much conscious effort to prevent forest fires, 4 per cent may be considered fairly good at the start in a region where man causes practically all of the fires; yet it cannot be overlooked that in this region of rank ground cover it is easier, the human hazard remaining constant, to protect land the first few years than it is after the hazard has accumulated.

FIRE POLICY IN THE SOUTH

In a region where frequent burning has been the custom ever since the first settlements were made and where the second-growth forests with

[1] Copeland Report.

their wood-working industries still outrank in economic importance all industries except agriculture, it is not strange that there should be questions about the actual effects produced by fire.

It has been a surprise and shock to many to learn that the whole South does not fall nicely into a simple national pattern in which the policy of complete fire exclusion uniformly applies. During the past few years there have been loud and indignant protests from some quarters of the longleaf pine belt against fervent, emotional fire-prevention propaganda. In fact, so serious became the question of fire policy that the Forest Service felt called upon in 1932 to issue a statement[2] recognizing the possibility of using controlled burning in the longleaf pine type.

Although it is admitted, of course, that the South is not uniform and that one policy will not fit all of it, there seem to be two different forms that a fire policy might take:

1. *Should fire exclusion be the public policy with fire used only sparingly, if at all?*

2. *Should controlled burning be recognized in the public policy?*

There appears to be some foundation for the belief that if the latter alternative were accepted as a management measure of respectable standing, more widespread improvement in forest practice might result. In other words, if fire is truly a part of forest management, just as thinning is, should not the emphasis be placed on the condition which requires a treatment of either fire exclusion or some form of controlled fire use? Forest management would then be the main issue and not fire exclusion. As many are quick to point out, the trouble with such a policy is that reform would be slow. Good psychology would dictate making an issue of something simple to preach.

Objections to the first policy are that fuel hazards may build up to the point where protection is impracticable, particularly with the private owner; or, even worse, that complete protection will result in serious ecological disturbances—*e. g.*, that the southern pine type may change to worthless hardwoods, that the game environment may change, etc. Nevertheless, the Forest Service and all southern State forest organizations, I believe, subscribe at present to this or a similar policy. In fact, without more accurate knowledge of the effects of fire, it would be hard to subscribe to any other policy.

[2]"Federal policy relating to controlled burning in cooperative fire protection in the longleaf pine region," by R. Y. Stuart, June 16, 1932.

The Acute Problems

Many difficulties of fire protection in the South spring from lack of sufficient knowledge of the effects of fire. Because fires do less damage in southern pines than elsewhere and appear to have a silvicultural role, the value of a fire policy modified with respect to controlled burning seems indisputable, but there does not exist sufficient scientific data on which to base controlled burning. Damage appraisals, difficult in any region, are even more difficult in the southern forests because the benefits are hard to separate from the detriments. Fire-protection standards or "least P + S + D" objectives, cannot be attempted until more knowledge is gained of the effects of fire.

Regardless of fire policies, protection standards, and controlled burning, there must be fire protection on all soils and types during some stage in the life of the stand, and some soils and stands need fire exclusion all of the time. This unquestionably calls for fire-control technique, and because of the prevalent flashy fuels and consequent rapid rate of spread, the problem of attaining adequate control is not simple.

It would seem, therefore, that three broad objectives should determine the program of the Station's fire project. These are:

1. Better fire-protection methods (fire control, including prevention, presuppression, and suppression).
2. A method of evaluating the effects of fire.
3. Controlled-burning technique.

Emphasis for Next Few Years

Because of the need for information on the effects of fire in order to answer questions raised in regard to controlled burning or in order better to define fire-protection needs, the emphasis in the fire work in the past has been on the study of fire effects rather than on development of protection technique. Although work in the field of fire effects is far from complete, it would seem desirable to give fire-protection research a slight preference for the next few years because of the drive being made at the present time by the Division of Fire Control for better fire-control planning on national forests. This does not mean that the efforts to learn more about fire effects will be lessened, since by a realignment of projects more men are being assigned to the fire project than formerly. Investigations on controlled burning would, of course, be continued as a part of the general study of fire effects.

Specific Work Planned for 1937

Research leading to the practice of handling fire, whether it be controlled burning, suppression, or fire exclusion, may be conveniently grouped according to: 1. Basic studies; 2. Studies on technique of handling; 3. Studies for formulation of policies and plans. The Station is primarily concerned with supplying the first of these, although it should contribute as well toward the other two. In fact, the needs for studies to obtain information on handling technique and policies should serve as a guide to the basic investigations made.

In order to facilitate the formulation of the project program for 1937, a few problems will be pointed out in the various recognized fields of fire control and effects.

Fire Control

I. *Prevention.* Fire prevention is extremely important in the southern pine region. Ninety per cent or more of the unwanted fires are man-caused. The motives for burning vary from pure cussedness or spite to the satisfaction of selfish desires, with a ruthless disregard of the rights of others. This is an enticing field for study, but it does not seem wise at this time for the Station to attempt much work in it, although the Station can furnish technical information on the effects of fire and help define and describe risks and hazards. On the national forests much effort must be exerted in this field; on the new forests this work should be extremely profitable.

II. *Behavior.* Studies in (1) fire protection technique, (2) evaluation of the effects of fire, and (3) controlled-burning practice require certain fundamental data in common. A knowledge of fire behavior, made up essentially of combustion, rate of spread, and resistance to control, is, of course, essential to fire protection and also to certain phases of controlled burning. There seems to be no question in regard to the importance of initiation of work on *behavior*.

1. *Combustion.* A study should be initiated on the Harrison Experimental Forest to correlate moisture content of fuels with weather conditions. Immediate questions to be answered are the effects of rain and relative humidity on the inflammability of fuels. This work will also tie in closely with that on the development of a fire-danger rating scheme mentioned below.

2. *Rate of spread.* The study already started of experimental fires on the Harrison Forest is as much as the Station can carry out this year. The

study is confined to one fuel type, a 2- to 4-year herbaceous rough, and should serve to develop the possibility of experimental burns for this purpose.

3. *Resistance to control.* A study of this does not seem important for the fuel hazards which are encountered in the Coastal Plain forests where the resistance is generally low compared with that under Western conditions. No work other than that already under way in cooperation with Supervisor Conarro and the Regional office (8) should be contemplated this year.

III. *Presuppression*—

1. *Fire occurrence.* At some of the oldest forests—The Ouachita, The Black Warrior, The Florida National Forests, and those under the supervision of the Texas Forest Service—there may be records that are helpful in working out the fire-occurrence expectancy. Little work on this is indicated for the present, aside from what might develop in cooperation with Region 8. It is, of course, recognized that the recent record on some of the new forests gives little or no indication of what to expect in the future.

2. *Fuel-type classification.* This subject needs investigation. At the present time fuel-type mapping in the Coastal Plain forests will not be a large factor in fire-control planning. A correlation can be worked out between fuel type and timber type so that the mapping should be largely an office task. Since maps cannot be revised for ephemeral types such as 1-, 2-, and 3-year roughs or perhaps even for slashings which decay and disappear in 2-3 years, the potential fuel types narrow down to only a few. As a start, the following is suggested as a tentative list:

a. *Herbaceous vegetation.* The open-forest fuel types typical of the Coastal Plan forest west of the Mississippi River, with no shrubby vegetation such as gallberry or palmetto.

b. *Herbaceous and woody vegetation.* The open-forest fuel types typical of the flatwoods, and perhaps of parts of the Upper Coastal Plan east of the Mississippi River.

c. *Forest floor.* The closed stands, where the herbaceous material is mostly shaded out.

d. *Cypress swamps and deep ponds.* Particularly the flatwoods, where shallow ponds constitute a high fuel hazard during the worst season (*i. e.*, dry periods).

Whether the shortleaf-loblolly-hardwoods need to be separated from the longleaf-slash type for purposes of fuel classification, or whether the existing types will fit into the above scheme, remains to be seen after a thorough consideration in the field and after consultation with men from Region 8.

3. *Fire-danger rating scheme.* This subject warrants considerable attention both from the standpoint of fire-control planning on national forests as well as from the standpoint of State and private forestry. The problem is mainly one of integrating the factors (1) fuel inflammability, (2) wind, (3) season of year, and (4) visibility into fire-danger classes. The number of classes will, of course, depend upon the administrative measures contemplated by the fire organization.

It is noteworthy here that the manager of one large private forest in the Southeast has expressed unwillingness to consider any danger-rating device for his fire organization, because he tries to keep it at maximum efficiency and strength at all times; furthermore, he is inclined to believe that his woods-burning friends might make good use of the information, although they already rank as amateur fire-danger experts.

4. *Time control.* and

5. *Maximum coverage.* These are highly important subjects but depend upon many factors discussed under other headings.

6. *Visibility standards.* Byram at the Appalachian Station is working on a haze-meter for visibility readings for flat country. When this has been developed, the Southern Station should undertake visibility studies. Work on the Harrison rate-of-spread studies has indicated that at times fires can burn for a considerable period before being observed at nearby towers.

7. *Visible-area mapping.* This is not important for Coastal Plain forests. The work of the Appalachian Station should apply to the Ouachita and other mountainous forests in the territory served by the Southern Station.

IV. *Suppression*—Except for the cooperative work being done with the Forest Products Laboratory, not much time of the Station should be given to this class of studies at present. The fire-project men, however, should become thoroughly acquainted with the suppression problems of the Region.

Effects of Fire

One of the largest tasks confronting the Station is to determine the effects of fire so that the average man can make a clear and concise appraisal of the damage done by any fire. Serious attention must be directed toward the making of simple indexes, and of a simple, yet approximately correct appraisal system. Defoliation which appears to be a good index of damage to surviving trees, for instance, is easily measured. What defoliation means in terms of growth retardation remains to be determined, although what it means in terms of naval-stores yields is already known.

Apparently there is little need to comment in detail on the problems of fire effects. The main thing to stress is that work must be made objective. The desirable final form in which the "effects" data need be presented, should be worked out, and then an earnest endeavor should be made to provide a ready means of collecting the data in that form. A complete evaluation of the silvicultural effects is likely to require a long time, but it is believed that a better basis for making damage appraisals than that commonly used today can be worked out within the near future.

The Fire Project Program

The following long-time fire-program "check list" is presented as a guide in order that the studies may be timely and the development of the program, comprehensive. The foregoing problem analysis, if revised annually to fit new and changing conditions, will provide the basis for placing the current emphasis. The previous year's emphasis needs scrutiny each year in the light of the results obtained and of needs. The subject matter of the present research program, therefore, may need modification or expansion from time to time and is, in no sense, to be considered as final.

A. *Objectives*—

- I. Fire-control technique
- II. Method of appraising damage
- III. Controlled-burning technique

B. *Study subjects* (X denotes current emphasis during present calendar year)—

	1937		
I. Prevention			
1. Risks			
2. Hazards			
3. Educational methods			
4. Law enforcement			
II. Behavior			
1. Combustion	x		
2. Rate of spread	x		
3. Resistance to control			
III. Presuppression			
1. Fire-occurrence scheme	x		
2. Fuel-type classification	x		
3. Fire-danger rating scheme	x		
4. Time control			
5. Maximum degree of coverage			
6. Range-of-visibility standards	x		
7. Visible-area mapping			
8. Transportation			
9. Communication			
10. Fire line or breaks			
11. Hazard reduction by burning	x		
IV. Suppression			
1. Equipment and supplies			
2. Strategy, tactics, techniques (chemicals, tools, etc.)	x[2]		
3. Fatigue factors			
4. Organization			
V. Effects on—			
1. Mortality	x		
2. Growth (retardation)	x		
3. Soil fertility	x[2]		
4. Watershed values (erosion and water cycle)	x[1]		

5. Naval-stores production	x		
6. Game management			
7. Livestock management			
8. Brown-spot disease (control)	x[4]		
9. Reproduction			
a. Preparation of seedbed	x		
b. Stimulation of longleaf pine seedlings height growth.	x		
10. Stand improvement			
a. Control of species composition	x		
b. Conversion of cover type	x		
c. Pruning and thinning	x		

[1]Chemical suppression is studied in cooperation with the Forest Products Laboratory.
[2]Under "Fundamental Studies."
[3]Some work under "Forest Influences."
[4]Major share of work is being done by forest pathologists.

THE FIRE CONTROL TRAINING HANDBOOK—SOUTHERN VIEW

R. J. Riebold

Training Officer, Region 8

In the January issue of Fire Control Notes J. F. Campbell, of Region 6 gave a progress report on the Fire Control Training Handbook, which was begun by a conference of fire and training men from Regions 1, 4, 5, 6, 7, and 8 in Portland last December. The conference prepared a manuscript which was turned over to Ray Linberg, Personnel Training Assistant in Region 6, for editing. Since Campbell's report an edited copy of the Handbook has been returned to the members of the conference for review and criticism, and a final draft of the Handbook submitted to the Chief. Mimeographed copies of the Handbook have been distributed to all Regions for use in training fire control personnel this year.

It has been definitely planned that during the winter of 1937-38 the present mimeographed edition of the Fire Control Training Handbook will be reviewed by a group representing all Regions. Members of the group are expected to bring to the conference their experience in using the Handbook during the current year and from their experience to be able to include in the Handbook an abundance of material illustrating the application of principles and practices in the training of fire control men. It was the consensus of the Portland conference that illustrative material must be noted in detail at the time the incident occurs if it is to be of real value. It is suggested, therefore, that Regional fire and training men keep notes of experiences they have in training work throughout the year so that they may bring these experiences to the conference next winter. It is fully expected that the Handbook as revised and expanded as a result of this conference will be printed in final form and will be available to all fire control agencies within and without the Forest Service in the spring of 1938.

An attempt was made at the conference in Portland to make the Handbook usable to all forest fire control agencies, in the face of the realization that conditions differ widely in various parts of the country. It may be of interest for those who have not served in the Southern Region to note a few items of the 1936 fire season in Region 8 which make the fire control training job there somewhat different from that in western regions. Before any training program can be planned it is the job of the training officer to analyze the training needs which the situation presents. Most fire training, for example, is planned to take place just before and during the fire season, but in the Southern Region in 1936 there was not a single ten-day period throughout the year in which fires did not occur.

During the year the national forest organizations fought 4,152 fires.

which burned a total area of 156,000 acres. If any part of this year-long campaign can be called a "fire season," the period from February 20 to May 10 is probably it. During this period 49 per cent of the total number of fires burned 76 per cent of the gross national forest area lost. The worst ten-day period during the year was that of March 10-20, in which 445 fires burned 26,306 acres of Forest Service protected lands.

The fire suppression organization is not proud of this record, but is not ashamed of the fact that the average fire was only 37 acres, that even during the worst part of the spring season the average fire was 60 acres. Of the 4,152 fires, 12 per cent were class A's, 55 per cent were class B's, 33 per cent were class C's. Eighty-three per cent of all reportable fires were discovered within one hour; in fact, 65 per cent of them were discovered within 15 minutes. Getaway time was within 5 minutes on 83 per cent of all reportable fires and within 15 minutes on 97 per cent of the fires. Of all fires, 76 per cent were corralled within one hour and 98 per cent within six hours.

Although regional average figures are often deceptive and dangerous generalizations, these figures indicate generally an organization that is on its toes in suppression work. The task of training appears to be one of keeping this organization up to scratch in spite of the turnover of personnel, of keeping it abreast of new technological developments, and of stimulating its inventive ability to devise new and better techniques to meet its own particular fire suppression problems.

The record in fire prevention is much poorer. Only 8 per cent of all the reportable fires were caused by lightning. Of the 3,809 man-caused fires 43 per cent were of incendiary origin. The man-caused fires that were actionable totaled 3,775, but action was initiated on only 11 per cent. Law enforcement action was initiated on only 3 per cent of the incendiary fires. Although there are other factors, and important ones, also involved in the fire prevention job, surely this picture reveals that training has a real need and a real opportunity. Before judging this record too severely, Yankee foresters would do well to try catching the elusive woodsburner in the flat, easily accessible, populous forests of the South.

In the Southern Region there are practically no one-man fires. The rapid spread of grass fires means that every fire must be handled by a fire crew. Practically all fire fighting is done by CCC enrollees, which means that every CCC foreman and superintendent in the Region must be well trained in crew management in fire suppression. All district forest rangers, assistant rangers, ECW supervisory personnel and selected enrollees must be trained in fire prevention work and particularly in the investigative part of fire law enforcement work.

Of course, fire training camps are now held on every forest every year for staffmen, rangers, assistants, and camp personnel, and on most forests systematic training in fire suppression is given to all enrollees in CCC camps. On some forests fire training is given enrollees every month.

The situation faced by fire control training in the Southern Region suggests that the first and most urgent job of training is to put into the heads and hands of all personnel a knowledge of and ability to use better training methods. The new Fire Control Training Handbook will be very valuable for this purpose. It will be used with the full understanding that training methods cannot be learned by reading a handbook.

Training methods will be taught by assembling in training schools of two weeks' duration similar groups of men, such as assistant forest supervisors, fire assistants, superintendents of construction, administrative assistants, and district forest rangers—one from each forest—at the rate of a group a month throughout the year, to learn by doing under coaching. The handbook then will be to these men a textbook and a reference book, each page of which will be full of meaning to them because of their own individual experience in learning training methods in the training school. The men will in turn apply these better training methods to the training of project superintendents, foremen, dispatchers, lookouts, contact men, investigators, and fire fighters.

There must be added to the large amount of technical knowledge and skill in fire control possessed in varying degree by all fire control personnel the means of transmitting that skill, knowledge and ability to other people in the most efficient manner. It is believed that the means to do this are contained in the training methods concentrated in the Fire Control Training Handbook. The more actual experience of fire control men in training work that gets packed into that Handbook, the more valuable it will be.

FOREST FIRES AND FIRE WEATHER IN NORTH FLORIDA

ARCHIE W. BUDD

After more than 5 years of weather recording to determine what relation exists between weather and fire, this author has reached the conclusion that human behavior rather than weather behavior is the malign influence.

There does not exist a close relationship between fire weather and forest fires in the longleaf and slash pine forests of North Florida. It has long been the custom in this region to burn over the forest frequently for one reason or other and the will to burn still persists to such a degree that even on forests in which complete fire protection is sought the human element looms up as a major factor in the occurrence and behavior of fire.

This is the general conclusion which the writer has reached following analysis of several years' records of fires and weather. Records have been kept since January 1, 1932, at Middleburg, Florida, the headquarters for the 14,000-acre property of Budd Forests, Inc. The purpose of the weather readings and fire records was to seek any correlation of weather with fire occurrence and behavior which might help develop more effective fire control.

The analysis of the records showed that 50 per cent of the fires that burned 50 or more acres per fire occurred when the temperature was above average for the season and relative humidity below average—obviously a bad fire weather combination with respect to these two elements of weather. On the other hand, a good many fires occurred when these two elements of fire weather were not the most favorable for serious fires, as 100 per cent of all fires occurring in the class of 20 or more fires per day occurred when the temperature as well as humidity, etc., were below average. The percentage of fires in the various classes are given in table 1.

Table 1. The number of fires from the fire seasons of 1932 to 1937 inclusive as they occurred with reference to classes of temperatures and humidity, number of fires per day and area of burn per fire.

Temperature and Relative Humidity	Fires from 1932 to 1937				
	Fires per day			Area of burn per fire	
	10-14 in number	15-19 in number	20 or more in number	20 to 50 acres	50 or more acres
Temperature above average: and relative humidity below average	50	40	0	22	50
Temperature below average: relative humidity below average	12	20	100	22	20
Temperature above average: relative humidity above average	38	40	0	34	20
Temperature below average: relative humidity above average	0	0	0	22	10

The figures of table 1 strongly suggest some factor other than weather which is operating particularly to start fires. This factor is, of course, the habitual frequent burning practice so strongly rooted in the South. Turpentine operators, cattle men and other willing helpers for one cause or another are wont to burn the woods in December, January, February and March. Table 2 shows the average acreage burned and numbers of fires for November to April inclusive.

Table 2. Average temperature, relative humidity, acreage burned and number of fires by months for the years 1932-37, inclusive.

Month	Average Temperature Degrees F.	Average Relative Humidity Per Cent	Area burned per fire Acres	Fires Number
November	69.27	60.43	21.51	66
December	64.56	65.67	22.26	146
January	66.55	64.57	27.24	197
February	64.57	62.59	23.41	201
March	70.98	55.01	14.89	249
April	77.26	54.78	13.17	45
Averages	68.93	60.73	22.1745	

More fires occurred in March than in any other one month and they averaged next to the smallest in acreage burned. The explanation of this is probably that the green grass and other vegetation served as a retardant to the rate of fire spread which more than offset a lower average relative humidity than for any of the other winter and spring months save April. Wind is a big factor in fire behavior but no data are available for the Budd Forest.

The general conclusion from the study as well as experience on the Budd Forest is that the strongest correlation of fires is with people and that fire prevention is a big part in fire control. There are lots of days that fire will burn, and so long as the local people continue to burn the woods for their own purposes without regard to the wishes of the owners the total acreage burned is bound to be large.

RADIO AND FOREST FIRE CONTROL IN FLORIDA

H. J. MALSBERGER

Assistant State Forester, Florida

The broadcasting system here described is, in many respects, a very effective use of radio in fire control, but one on which opinions vary widely. The U. S. Forest Service is not convinced of the wisdom of a system which permits no "answer back." In most situations it is essential for the dispatcher to *know* that the crew has received the message and has acted upon it.

The Florida Forest and Park Service took the lead in Florida in experimenting with short wave radio communication in forest fire control. A station was established in November, 1936, at the Dinsmore Ranger Station in Duval County 14 miles north of Jacksonville.

Duval County, where the County Commissioners rather than individual land owners cooperate with the Florida Board of Forestry, was the first County in the State to embark upon a program of County fire control. Now 268.954 acres are under protection. This station was located also for the purpose of serving the cooperators in the adjoining County of Nassau, whose lands total about 100,000 acres. It is reasonable to expect that all of the forest lands in both Duval and Nassau Counties, totaling nearly 759,000 acres, will be listed for protection in the near future. This general area was, therefore, most appropriately selected for the initial attempt.

COLLINS TYPE FXB TRANSMITTER

This station is operating through a permit issued by the Federal Communications Commission under a "special emergency license" classification. The station has been assigned an operating frequency of 2,726 kilocycles with the call letters WANB and has an output of 100 watts.

The transmitter is a Collins type FXB. It is an amateur set but was converted for commercial use by the addition of protective devices. These automatic, protective devices consist of an overload trip and time-delay relay which prevents damage to the equipment by accidental overloading.

Information is transmitted by using voice modulation only, rather than code, because the personnel are not trained in receiving messages in code. The use of code would allow the installation and operation of smaller equipment and less power would be required to reach the same distance.

The feature of the station is the frequency control, made possible by a special crystal ground to exact frequency, which is installed in an oven

Acknowledgment is made to Mr. John P. Bryan, radio operator and chief dispatcher at the Dinsmore Ranger Station, for his collaboration in assembling the information contained herein.

which automatically maintains a constant temperature of 53 degrees C. The assigned frequency of the station is checked twice a month. The operator has been exceptionally successful in staying within a very slight variable of the allowable frequency tolerance specified by the Federal Communications Commission.

The approximate cost of the transmitter which is now being used by the Florida Forest and Park Service is $800.

Control Points

The station has two control points, one located in the county ranger's office and a remote control point in the lookout tower. This arrangement makes it possible, under ordinary fire conditions, for the radio operator to be the lookout and dispatcher at the same time. During the peak of the season, however, two men are required. The advantage of having a remote control point in the observation tower is that the radio operator can keep in closer touch with the condition of going fires, and is thus enabled to keep better control of the crews.

The remote control point must be equipped with a modulation monitor in order to determine that the station is operating correctly when the operator is removed from the transmitter. It must also be equipped with a receiver and a switch to turn the transmitter off and on. The cost of this additional equipment amounts to $150 but is well worth the investment because it provides a more flexible system of broadcasting.

Station Receiver

The receiver in the station is designated as the "station receiver" to differentiate it from the receivers in the trucks. It is a RME 69 model. It is a communication, band-switching, superheterodyne type of receiver, covering a frequency range of 550 to 32,000 kilocycles. The band-switching and large-range features are the important factors of this receiver as contrasted to other types which have a limited field. The wide-frequency range is not absolutely essential but is desirable in the event the Federal Communications Commission may change the frequency or assign another frequency to the Florida Forest and Park Service to take care of portable mobile equipment used in two-way communication. The present equipment is flexible enough to take care of such a possible situation.

The cost of this equipment is $150.

Antenna and Ground

The antenna and ground can properly be considered to be the most important single item of the station. The dependability of reception over the area is governed by this equipment. The objective in the construction of a forest fire control radio station is to concentrate power, which is equally radiated in all directions around the transmitter, along the surface of the earth. If the antenna is located near the center of the protected area it must be absolutely non-directional in order to assure proper reception in areas of the control unit.

The concentration of power along the surface of the earth is also essential to secure consistent reception of messages 5 miles distant from the transmitter as well as 35 miles or more. Station WANB was constructed for the purpose of obtaining a 40-mile radius. Consistent coverage has been checked and found that reception is satisfactory within a radius of 30 miles. No tests have been made beyond this point but indications are that the reception will be satisfactory within 40 miles.

The strong ground wave is accomplished by the use of a quarter-wave Marconi antenna suspended vertically from a 95-foot pole. A number ten copper wire is used on the pole for the antenna. The Department of Commerce requires poles erected within ten miles of an airport or airway to be painted. It is, therefore, essential that the pole be not creosoted but be treated with some other preservative.

At a point in the ground, exactly beneath the center of the transmitter, a 12 x 16-foot copper-mesh screen is buried 8 inches deep. A 20-foot section of 1½-inch galvanized iron pipe establishes a permanent ground to which is attached the screen. Sections of number 12 copper wire are soldered to the screen and extend radially from it. The 84 radials are 87½ feet long and the wire is buried 6 inches in the ground and terminates in a 6-foot galvanized ground rod. The wires were easily placed in the ground, without disturbing much sod, by the use of a dibble.

The complete cost of the antenna and ground is about $300.

Incidentally, part of the power reaches the sky wave and is used for contacting monitor stations at distant points for frequency tests. Cards verifying reception have been received from short-wave enthusiasts as far north as the New England and Great Lake states. This same power could be used for communicating with forest fire control stations at distant points to check on approaching weather conditions and for exchange of other valuable information.

Microphones

Crystal microphones are used at both transmission points, thus eliminating batteries which would be necessary if carbon microphones were used. They are Shure type 70 S. These instruments are made especially for voice frequencies. They cost $15 each and two are in use, one in the station and the other in the tower at the remote control point.

Control Panel

The control panel and table were made by the operator and are constructed of tempered Masonite to which was applied a coat of lampblack. The unit is entirely satisfactory and cheap, costing $25 complete. It employs a foolproof switching device arranged so that the two control points could not possibly interfere and have two people talking at the same time. This is a very necessary safeguard due to having a remote control station in the cabin of the tower. It is necessary to keep an accurate electrically-operated clock to regulate the proper times to go on the air.

Receivers in Trucks

Philco types 810 PV and 811 PV (police variable) receivers are used in the trucks of the Florida Forest and Park Service and ECW organizations. This equipment has a tuning dial instead of a fixed frequency which makes it more valuable because it can receive messages broadcast from stations having different frequencies than that assigned to this station. It means further that the equipment need not be altered if this station's frequency is changed. The receiver is widely used in police radio systems and costs $35.

A feature of this equipment is the loop-receiving antenna attached to the top of the cabs on the trucks. The antenna mounting is constructed of oak and a metal frame. Number 12 copper wire is threaded inside the mounting on bakelite insulators. This antenna is cut to approximately a quarter-wave, 92 feet of wire being used in this case. The efficiency of such a loop-type antenna is largely responsible for the very successful and strong reception received in the field. It is impossible to stress too greatly the necessity for sturdy construction of a mobile antenna on account of the hard usage given it by trucks traveling through the woods over woods trails. It would seriously affect the suppression work to be constantly repairing the equipment during the peak of a fire season.

The loop-type antennae cost $22 each, but they can be constructed for $10 each when using your own labor.

Operation of the Station

The radio operator commences testing at 9 a. m. and tests each hour thereafter until 6 p. m., unless weather conditions demand a longer service. If the fire danger is great, tests are broadcast each half hour. A fire call is broadcast at any time a fire occurs. The receivers in the truck are kept on constantly, if there is any fire danger, to receive the calls. Specific locations of all fires are broadcast and the county ranger is kept informed of conditions over the unit at all times.

Service Parts

It is very important to the successful operation of a radio station to keep an ample supply of service parts for emergency use. This station carries service parts and test equipment valued at approximately $150.

Operating and Replacement Costs

Cost of power for the transmitter, averaged over a five-months' period, amounts to $6 per month. This includes battery charging for Florida Forest and Park Service and RCW radio-equipped trucks and is based on a cost of 3½ cents per kwh for current.

Frequency monitoring service required by the Federal Communications Commission costs $5 per month. The cost of tube replacement and maintenance of the transmitter and station equipment is estimated at $50 per year.

Maintenance of truck receivers is estimated at $5 each per year, totaling $75 for the 15 receivers operating in the Duval-Nassau unit.

The life of the antenna and ground system is estimated at 20 years, making a cost of $15 a year for replacement. Summarizing, the total estimated cost of operation and maintenance, excluding salaries, for the radio system amounts to $272 per year.

Organization

One man is employed as radio operator and chief dispatcher who has a second-class radio operator's license. He is aided by an assistant operator and dispatcher who has a third-class operator's license. The duties of these men have been mentioned and in addition it is their responsibility to maintain all radio equipment and receivers and repair telephones.

Conclusion

In summarizing the radio equipment, it is our opinion that the most important factors guaranteeing the successful operation of the station are good antenna and ground for the transmitter and antenna for the truck receiver. These factors make it possible for a transmitter of 100-watt capacity to do a satisfactory job which otherwise might require a 500-watt transmitter. The latter equipment is much more expensive. The total cost of the complete radio installation amounts to $2,610.

The station is now completing six months of service through a partial fire season. It is too early to draw definite conclusions on the exact value of radio communications used in conjunction with a tower and telephone system in the suppression of forest fires.

Several outstanding values of the radio are listed. It materially increases the speed in dispatching fire crews because they can start before the triangulation of the fire is completed and be informed en route of the actual location. One towerman can locate the fire accurately enough to start the crew in the right general direction. It permits the organization to be very mobile, which is of primary value. Crews can be patrolling the woods during hazy weather of low visibility or patrolling to prevent timber theft. The crews are not required to remain stationed at a tower or telephone. This permits labor crews to work on forestry improvement projects, such as thinning, planting, etc., and still be immediately available for fire suppression work. A man remains in the truck to receive the fire messages in such instances and then collects the laborers.

The use of the radio also materially reduces the mileage and consequently the wear and tear on the trucks. Quite frequently trucks are dispatched to fires en route to the tower or reporting telephone before the complete trip is made. The radio station is located at the central dispatching stations which permits the operator to know where the crews are at all times.

It is not possible to ascribe definite improvement of results at this time entirely to the installation of the radio system. It is apparent, however, that the crews and the entire organization rely to a great extent upon the system. A statement was made that if they had their choice between a tower and telephone system and ten trucks with no radio, and a tower and telephone system and five trucks and the radio they would take the latter.

The radio system alone does not cost quite as much as five trucks, and when salaries, operation, and replacement costs of the trucks are considered, the comparison is greatly in favor of the radio even from a strictly financial standpoint. In addition, the psychological effect of radio on the public is undoubtedly a distinct asset in forest fire control work, especially during the early stages of such a program.

RADIO INTERFERENCE

A. GAEL SIMSON

Radio Engineer, Region 6

With increasing use of radio, especially of the ultra-high frequencies, interruptions of Forest Service radio communication by various noise-producing devices, such as heating pads, neon signs, electric motors and diathermy apparatus, are becoming more and more prevalent. The diathermy apparatus (machines for producing artificial temperature in patients) is becoming one of the worst offenders because the use of such machines is spreading rapidly and because the interference range of the equipment is considerable. These machines have created heavy interference over distances of several hundred miles.

Medical men as a group are very cooperative in reducing interference from medical apparatus, when the interference is brought to their attention. The remedy is usually to shield the equipment room and insert chokes in all wires leading into the room. Occasionally, however, an owner or user of diathermy apparatus refuses to quiet it. Almost invariably this attitude is a result of his ignorance of his responsibilities.

When all other means fail, it may be helpful to refer the diathermy owner to the following excerpt from the Communications Act of 1934:

> Section 301. It is the purpose of this Act, among other things, to maintain the control of the United States over all the channels of interstate and foreign radio transmission; and to provide for the use of such channels, but not the ownership thereof, by persons for limited periods of time, under licenses granted by Federal authority, and no such license shall be construed to create any right, beyond the terms, conditions, and periods of the license. No person shall use or operate any apparatus for the transmission of energy or communications or signals by radio (a) from one place in any Territory or possession of the United States or in the District of Columbia to another place in the same Territory, possession, or District; or (b) from any State, Territory or possession of the United States, or from the District of Columbia to any other State, Territory, or possession of the United States; or (c) from any place in any State, Territory, or possession of the United States, or in the District of Columbia, to any place in any foreign country or to any vessel; or (d) within any State when the effects of such use extend beyond the borders of said State, or when interference is caused by such use or operation with the transmission of such energy, communications, or signals from within said State to any place beyond its borders, or from any place beyond its borders to any place within said State, or with the transmission or reception of such energy, communications, or signals from and/or to places beyond the borders of said State; or (e) upon any vessel or aircraft of the United States; or (f) upon any other mobile stations within the jurisdiction of the United States except under and in accordance with this Act and with a license in that behalf granted under the provisions of this Act.

This section appears to give the Federal Government power to abate radio interference. It has not yet been passed on by the courts and at the present time it is not desirable officially to take action under the above section. Nevertheless, it does have value as a moral force.

DOES SALT AFFECT THE STAMINA OF THE FIRE FIGHTERS?

A. A. Brown

Fire Control, Region 2

At the Spokane Fire Conference held in February, 1936, the question of the possible value of salt as a stimulant to the fire fighter working under conditions of great heat and exertion was brought up for discussion. Little could be offered on the subject by any of the forest officers present, and it was set up as a subject in need of investigation, which was later assigned to Region 5 for report. The following article represents authoritative information which it has been possible to assemble from available authorities and original sources.

The phenomena of heat exhaustion and the new techniques in its treatment, which have lately assumed prominence in medical literature, are of very practical interest to foresters. Heat disorders are revealed caused by a condition of disturbed fluid balance of the body usually induced by loss of salt and water through excessive sweating. Consequently, treatment is concerned primarily with restoring both salt and water to the blood stream and tissues. Injection of salt water into the veins is sometimes resorted to by physicians.

Quite naturally this question arises: "Can heat exhaustion not only be avoided, but can the wellbeing and efficiency of fire fighters or other forest workers exposed to hot temperatures be improved by prevention measures designed to maintain the chloride balance?"

Special reference is made to the paper by Dr. R. O. Schofield on "Heat Prostration—Its Treatment at Boulder Dam," which was read before the California Medical Association at Riverside in 1934. This paper has since been the subject of considerable discussion both within and outside of medical circles.

Dr. Schofield expressed the belief that increased use of both salt and water at Boulder City had been the most important prevention measure in decreasing the number of heat cases. Accordingly, suggestions have been made that such expedients as putting salt in the fire fighter's drinking water, equipping him with salt pills, or giving special attention to inclusion of salty foods in fire camp mess, might well be valuable provisions for maintaining the fire fighter's stamina under conditions of extreme exertion at high temperatures.

The possibilities of preventing heat cases by the use of salt in this way may be best examined by reference to the medical literature on clinical treatment. Three types of heat disorders occur. These are tabulated as follows with comparative descriptions of clinical manifestations and modern treatment:

Condition	Pathological changes	Clinical features	Treatment
Heat cramps	Loss of sodium chloride	Cramps	Salt and water by mouth. Perhaps hypertonic saline solution intravenously.
Heat exhaustion Heat prostration	Circulatory failure from insufficient blood volume	Fainting, prostration, collapse. Skin cool, moist. Blood pressure low. Temperature subnormal or slightly elevated. Pulse small, soft.	Fluids, especially normal saline solution intravenously. General treatment for collapse.
Hyperpyrexia	Failure of sweating	Delirium, convulsions and coma. Skin dry, hot. Temperature 41.7° C. (107° F.) or more. Pulse rapid, full.	Cold water spray and fan.

Comparison of the Essential Features of the Different Disorders Due to Heat

Heat cramps usually occur in men who have become acclimated to physical exertion at high temperatures, as far as exhaustion and hyperpyrexia are concerned. Cramping usually occurs during or after a period of heavy sweating induced by physical labor after copiously drinking water.

The explanation offered is that the body loses both salt and water through sweating during exertion. When water alone is taken in sufficient quantities, the chloride balance of the system is upset. This unbalance changes the osmotic action of fluids to the muscles and the difference of fluid pressure is manifest in muscular cramps. Salt added to the drinking water will decrease the osmotic fluid pressure and prevent or alleviate cramping. There is apparently a correlation of occurrence of cramps to a previous intake of alcohol.

Heat exhaustion and prostration are caused by circulatory failure due to a depletion of the blood supply. The body so guards its chloride balance and temperature that water and salt lost in sweating is taken at the expense of the fluid portion of the blood. Treatment in this case is the intravenous injection of saline solution. Intake of water, or better still salt and water, should aid in preventing prostration cases.

Hyperpyrexia is brought about by the failure of the sweat glands. Research revealed no cause for failure other than phsiological diseases. This failure *may* be brought about by the lack of water in the system. While I have found nothing to substantiate this claim in reference texts, it seems reasonable that if there is an abundance of salt in the system, the sweat glands will no longer function because the chloride balance is such that to lose more water through sweating would result in a too high concentration of chlorides in the blood. If this be so, then the use of salt as a preventative measure in heat disorders would aid in the cases of cramps and in prostration and exhaustion but might cause greater frequency of hyperpyrexia.

Statements of Authorities

Major Henry A. Brodkin, Military Medical Surgeon of the National Guard, in a series of observations with men not acclimated to long marches in hot weather has classified the appearance of the men into three groups:

> The first was the man whose face was flushed, perspiring moderately; his pulse was full, strong, and somewhat accelerated, his khaki woolen shirt was dark with perspiration about the neck and wrists. He appeared alert, although somewhat tired, and responded quickly to commands.
>
> The second type was the man whose face was almost plethoric and covered with perspiration; his pulse was strong but quite rapid, his breathing was rapid and deep, his shirt was dark with perspiration about the neck, shoulders and wrists, and his skin hot to the touch. He looked tired as though he would welcome a cot in the shade and he responded slowly to commands and questions.
>
> The third type was the man whose face was pale and covered with beads of perspiration; his pulse was thready, his respirations were rapid and shallow, his khaki shirt was dark and soaked with perspiration, and his skin was cool and clammy. He looked as though he were ready to drop in his tracks, although he marched along doggedly and automatically, and responded to commands with great reluctance and effort. This is the stage just before he becomes a march casualty unless he is rested or given proper treatment.

Brodkin found these classifications to correlate directly with the amount of water consumed during the march. His opinion is that the chloride balance in the blood has been upset, and that salt taken either in drinking water or by encoated pills might alleviate many march casualties. His conclusion is offered as a suggestion rather than a specific preventative of heat disorders.

The question was referred to Dr. L. Porter, Dean of the University of California Medical School, who recommended Dr. C. L. A. Schmidt and his associates in biochemistry at U. C. as the men best qualified to speak with authority on such a subject. Dr. Schmidt has been most generous in his desire to cooperate, and met our request by bringing the question before a graduate seminar of his associates. They have discussed the question with great interest and Dr. E. S. Sundstroem, prominent authority on tropical physiology, has submitted the following comments:

When large amounts of water enter the body, this water leaves the body either through the kidneys, or through the skin as sweat, or it evaporates as insensible perspiration or through the lungs. Which of the routes the water will take will depend in large part upon the prevailing temperature and humidity of the environment.

Most of the water is excreted in the urine under normal atmospheric conditions. When both temperature and humidity are high, a considerable part may be lost in the sweat. When the temperature is high but the humidity is low, while visible perspiration may still play an important role, especially during heavy exercise, the insensible perspiration will acquire an increasing importance for removing water.

It is well known that when the water is excreted by the kidneys, the chloride excretion will rise considerably and that this may ultimately lead to a depletion of the body chlorides. Whether this chloride depletion is the only cause of the toxic symptoms which occur in such cases is not absolutely certain. That this depletion is responsible at least partly for the toxic symptoms is evident because adding salt to the drinking water will relieve them.

It is known also that similar toxic symptoms, although less severe, may arise when the water is removed as visible perspiration. The experiences in hot and humid mines serve as an illustration of this. Since the sweat contains considerable amounts of chlorides it may be inferred that chloride depletion enters the pathological picture also in these cases. Supplying salt in the drinking water is based upon sound physiological principles also in this kind of emergencies.

So far as we know, it has not yet been shown experimentally what happens to the chloride balance when the water evaporates directly. It would seem that the chances are relatively small that a more serious chloride depletion would occur in such cases. It could even be inferred that the chloride concentration in blood and tissues would rise, especially when the amount of visible perspiration is reduced proportionately to the insensible perspiration. It is doubtful, however, whether this could happen during such exerting work as, for instance, a fire fighter has to do.

Most forest fires occur on hot and dry days. It would seem then that the conditions with which the fire fighter has to contend fall in the class in which the insensible perspiration is, or at least ought to be, the predominant factor in removing the large amounts of water the fire fighter drinks. The insensible perspiration is, or should be, the main mechanism his body uses to prevent hyperthermia. It is undoubtedly the hyperthermia which causes heat prostration.

Suitable clothing, allowing efficient body cooling, and eventual wetting of this clothing to promote evaporation of water without drawing upon the water resources of the body too much are probably the most important measures to prevent heat prostration in the fire fighter. In case the clothes are wetted, the chilling effect should not become dangerous before the work is over. Proper measures should be taken, however, to prevent excessive chilling at rest.

Determining approximately the amount of work the fire fighter does in calories, it ought to be possible, knowing the environmental conditions, to calculate the volume of water a fire fighter will need per hour. If the water intake is kept within this limit, and if unnecessary water drinking is discouraged, the addition of salt to the drinking water does not appear necessary. On the other hand, a small addition of salt should not be harmful in any respects.

Discussion

A great volume of other references add but little to known facts, although a whole field of medical literature and of biochemistry bears on the subject indirectly.

It is evident that the chlorides bear an important relation to the ability of the body to regulate heat, and that salt plays a role hitherto unsuspected by the layman.

Doctors are not willing to say definitely that salt taken in the drinking water is a specific against heat disorders, though none have held that it would be detrimental.

The evidence seems to bear out the old timer's advice against drinking too much water under conditions of extreme exertion and sweating. Perhaps we can now add "unless accompanied by a corresponding intake of salt.

Dr. Sundstroem's comments may reveal the reasons for the remarkably small number of clinical cases of heat prostration in fire fighting. At the same time they call attention to the sound reasons for using salt as a prevention of heat exhaustion under certain circumstances.

In conclusion, it may be said that forest officers in charge of fire crews should inform themselves as fully as possible on this subject as a part of their responsibility and should give conscious attention to supervising the water intake of the workers, to preventing excessive sweating, and to insuring an adequate supply of salt in the fire mess diet. In addition, since experience is the best guide of all, the issuance of controlled amounts of salt to test crews under severe conditions of heat and exertion should by all means be tried and comparative results recorded in as much detail as possible. In many cases CCC army doctors might cooperate effectively in such tests.

Reading the Firefinder at Night—The Osborne firefinder can be easily adapted to night detection with no other special equipment than an ordinary flashlight. The volume of light which this affords should be cut down to a small pinhole beam by inserting between the reflector and the lens a disk of black paper in the center of which has been punched a small hole. The wire from a gem clip can be used for this purpose. The small beam of light thus produced causes no reflection from windows.

Talcum powder, or even flour or baking powder, is dusted lightly on the wire (or hair) of the sight. The beam of light can be so directed against the wire as to dimly illuminate it without interfering with vision.—*E. W. Donnelly, District Ranger, Ochoco National Forest.*

THE FUTURE OF FIRE CONTROL

John R. Curry

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The emergency aspects of fire control loom large. The ever-present possibilities of disaster tend to confine fire control thinking to matters of the moment, the day, and the season. Seldom, therefore, do foresters stand off to consider this problem in its broader aspects, or to consider the gains which fire control is making relative to long-time needs.

It would be well for the men interested in this field to scrutinize our present attitude toward this work and our organization for it, to determine whether this problem is being approached logically. Is our organization such as will enable us to obtain the maximum improvement within this field? Does fire control offer to professional foresters the opportunities found in other fields of forest administration? Should forest fire control be regarded as a major field of the profession of forestry in America? If so, is it gaining this recognition?

In the opinion of the writer, fire control development is handicapped by the old idea that the fire problem is one of temporary importance; that eventually, as a result of certain emergency measures to be taken during the present or the near future, this activity will rapidly diminish in importance. There seems to be a hope that fire in America will eventually reach the minor status which it has always held in the managed forests of Europe. This line of reasoning I hold to be wholly fallacious. Not only do present trends in fire business indicate this fallacy but our increasing knowledge of fire behavior also points the error.

It is a matter of record that the fire problem is increasing steadily in importance with increasing use and higher values. The time may arrive when fire losses will be reduced to a point where they do not offer a serious obstruction to forestry practice, but the period when fire problems will not challenge to the utmost the ability and ingenuity of American foresters will arrive only if American climate, American forests, and American people change essentially from what they are today.

Men who have been engaged in fire control work for the past 15 or 20 years are, I believe, ready to agree on the long-time, continuing importance of fire problems. If so, these men as a group should make their feelings known, that this activity may receive equal consideration with other professional problems.

Failure of foresters to recognize the long-time characteristics of the fire control job is responsible for the present lack of specialized organization and development in this field. Foresters have not approached the problem in a professional manner because they have hoped from the beginning that the fire problem could be solved by a few years of intensive educational effort. Despite such efforts a fire problem still exists. How should foresters approach it as professional men?

The professional approach as I see it starts with a detailed analysis of the job. Essential to the professional approach is a program of action which provides, first, for an understanding of the basic principles involved and, second, for the development of skills and techniques to gain the objectives.

Forestry's present store of information and accepted skills and techniques in fire control are meager. Consequently, the instruction provided in professional schools is entirely out of proportion to the importance of fire control in the field of forestry practice. The young forester finds himself ill prepared for the job which often consumes the greater part of his efforts. The difficulty seems to be principally a matter of organization. Fire control cannot complain of neglect in the relative distribution of funds. Have these funds been used to the best advantage considering the long-time nature of the work?

On the national forests at the present time there is little specialization in fire control. Fire work is handled by general administrators. Although these men may have a consuming interest in the job, they have scant time to give to the development of technical problems. Other important phases of forest administration, such as grazing, forest management, and engineering, have each their specialists, while the most important job of all is administered directly by the supervisor, necessarily a man whose attention cannot long dwell on a single activity. The complicated jobs of prevention, of selection and training of men, of planning detection, communication, transportation, and of organizing for fire suppression, are the responsibility of everyone, and consequently the direct responsibility of no one.

In the Regional Offices reorganization is also desirable. The attempt to organize the branches of fire control in certain western regions was, I believe, a move in the right direction and one which should be revived. At present, fire control is ordinarily administered by an assistant to an Assistant Regional Forester. It is placed, along with other miscellaneous or general jobs, in the Operation division. Fire control consequently does not receive the attention which it should in the formulation of administrative policies and plans. The chief of fire control attempts, even in important fire regions, to administer the job with a handful of assistants. Considering the amount of money spent in this field, the lack of administrative overhead is obviously inefficient management.

A Division of Fire Control has been created in the Washington Office, and this is a big step toward recognition of this field. As yet, however, the Division comprises only three men, a force which is obviously inadequate to promote this activity on a national basis.

The fact that present development of specialized technique does not always demand the use of specialists should not hold back the assignment of specialists to field control. The need exists for more intensive thinking and planning for all phases of this work. If able men are assigned to fire control jobs, the art will develop rapidly. It cannot develop until men of this type are given the opportunity to work on these problems to the exclusion of other pressing jobs.

Research in fire control is urgently needed to provide better basic information for the foundation of fire control work. The research men assigned to this work are few in number and their attempts to specialize in any one phase of the problem frequently meet with disfavor. If they spend their time on one fundamental problem, there is pressure to study something more practical, and this pressure often results in the disruption of long-time research projects urgently needed to establish our scientific footings. Research men in this field number scarcely a dozen workers, many too few to adequately approach this pioneering field.

If forestry had developed first in America, fire control would now be recognized as a major branch of forestry. A science of fire control would have developed, along with recognized highly developed techniques of attacking fire problems. In this country there is now developing a science of fire control. Growth must be rather slow; however, foresters can foster or retard this growth by their attitude toward the problem. If men in the profession recognize fire control work as a permanent pressing problem, and as a real part of professional forestry work, it can and should be organized on an adequate basis. The sooner fire control is thought of in this light, the sooner will knowledge and success in this field increase. Foresters should work toward a situation in which young men entering the profession with bent for fire control work may see a career ahead of them—a career offering opportunities comparable to those of other recognized fields.

HIGH AND LOW FIRE CONTROL COSTS BY REGIONS

M. R. Scott

Cost Accountant, Forest Service, Washington, D. C.

These high and low costs were determined by reference to totals per acre for prevention and presuppression for National Forests within each Region. The costs are per gross acre and are given in cents to the nearest mill.

	Prevention			Presuppression			Suppression			Total Costs		
	Exp.	Cost Adj.	Total Cost	Exp.	Cost Adj.	Total Cost	Exp.	Cost Adj.	Total Cost	Exp.	Cost Adj.	Total Cost
Fiscal Year 1934												
Region 1												
Clearwater	0.001	0.007	0.008	0.023	0.073	0.096	0.003	0.001	0.004	0.026	0.082	0.108
Beaverhead	.000	.001	.001	.001	.001	.002	.001	.000	.001	.002	.002	.004
Region 2												
Black Hills	.006	.032	.038	.032	.126	.158	.007	.015	.022	.045	.173	.217
Gunnison	.000	.000	.000	.000	.001	.001	.001	.000	.001	.001	.001	.003
Region 3												
Coronado	.000	.000	.000	.008	.019	.027	.003	.000	.003	.012	.019	.031
Cibola	.000	.000	.000	.001	.002	.004	.001	.000	.001	.002	.003	.005
Region 4												
Payette	.000	.000	.000	.006	.026	.032	.005	.008	.013	.011	.035	.046
Humboldt	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Region 5												
Angeles	.025	.069	.094	.046	.246	.292	.012	.037	.049	.082	.352	.434
Mono	.000	.001	.001	.000	.001	.001	.001	.000	.001	.001	.002	.003
Region 6												
Mt. Hood	.002	.017	.019	.026	.073	.098	.002	.002	.004	.030	.091	.121
Wallowa	.000	.001	.001	.008	.009	.018	.003	.001	.003	.011	.011	.022
Region 7												
Allegheny	.034	.074	.107	.005	.069	.075	.006	.008	.014	.045	.151	.196
White Mt.	.003	.006	.009	.005	.010	.015	.002	.001	.003	.009	.018	.027
Region 8												
Cherokee	.003	.019	.022	.018	.112	.130	.010	.012	.022	.031	.143	.174
De Soto	.000	.001	.002	.005	.005	.010	.007	.013	.020	.012	.019	.032
Region 9												
Chippewa	.004	.069	.072	.035	.049	.084	.081	.069	.150	.120	.187	.307
Illinois	.004	.000	.004	.002	.001	.003	.013	.006	.019	.019	.007	.026
Fiscal Year 1935												
Region 1												
Kaniksu	.037	.062	.099	.029	.070	.098	.065	.061	.126	.131	.193	.324
Absaroka	.001	.001	.001	.000	.001	.001	.000	.000	.000	.001	.002	.003
Region 2												
Harney	.060	.199	.259	.011	.031	.042	.004	.009	.013	.075	.239	.314
Shoshone	.000	.000	.000	.001	.001	.002	.001	.000	.001	.002	.002	.003
Region 3												

Coconino	.000	.000	.000	.010	.024	.034	.004	.000	.004	.014	.024	.038
Carson	.000	.000	.000	.001	.002	.003	.001	.000	.001	.002	.003	.004
Region 4												
Boise	.005	.006	.011	.024	.022	.046	.029	.002	.032	.058	.030	.088
Nevada	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Region 5												
Angeles	.042	.057	.099	.056	.318	.374	.032	.022	.054	.130	.397	.527
Mono	.001	.001	.002	.000	.001	.002	.001	.000	.001	.002	.002	.005
Region 6												
Mt. Hood	.004	.018	.021	.035	.071	.106	.012	.006	.018	.051	.094	.145
Wallowa	.001	.002	.003	.008	.011	.020	.005	.005	.010	.015	.018	.033
Region 7												
Allegheny	.011	.169	.180	.009	.190	.199	.014	.010	.024	.034	.369	.403
Mtn. Lake	.000	.000	.000	.001	.000	.001	.000	.000	.000	.001	.000	.001
Region 8												
Choctawhatchee	.001	.001	.002	.034	.196	.230	.004	.004	.008	.040	.201	.241
Uharie	.000	.000	.000	.002	.004	.007	.000	.000	.000	.002	.005	.007
Region 9												
Gardner	.005	.029	.034	.027	.113	.139	.008	.069	.077	.040	.211	.251
Superior	.001	.006	.007	.011	.008	.019	.001	.001	.002	.014	.015	.028
Fiscal Year 1936												
Region 1												
Kaniksu	.003	.056	.059	.065	.091	.156	.004	.002	.006	.072	.150	.221
Beaverhead	.002	.001	.003	.002	.002	.004	.002	.000	.002	.007	.003	.010
Region 2												
Harney	.006	.016	.022	.016	.042	.058	.007	.009	.015	.029	.067	.095
Grand Mesa	.000	.000	.000	.001	.001	.002	.000	.000	.000	.001	.002	.003
Region 3												
Coronado	.001	.001	.002	.010	.029	.039	.009	.001	.010	.020	.031	.051
Carson	.000	.001	.001	.001	.003	.004	.001	.000	.001	.002	.003	.006
Region 4												
Boise	.005	.004	.009	.015	.039	.054	.006	.003	.009	.025	.047	.072
Nevada	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
Region 5												
Cleveland	.059	.095	.154	.083	.223	.305	.007	.007	.014	148	325	473
Inyo	.001	.002	.003	.001	.001	.002	.000	.000	.000	.002	.002	.005
Region 6												
Columbia	.002	.011	.014	.031	.108	.138	.004	.004	.007	.037	.123	.159
Wallowa	.001	.003	.004	.013	.016	.029	.005	.003	.008	.019	.022	.041
Region 7												
Cumberland	.026	.064	.091	.082	.198	.280	.018	.041	.059	.126	.303	.430
White Mt.	.006	.013	.019	.012	.025	.037	.001	.001	.002	.019	.039	.058
Region 8												
Nantahala	.005	.019	.024	.036	.159	.195	.005	.005	.011	.047	.184	.230
Uharie	.001	.003	.004	.014	.028	.042	.003	.003	.006	.017	.034	.052
Region 9												
Shawnee	.006	.012	.018	.050	.110	.161	.009	.018	.027	.065	.141	.206
Wayne	.002	.012	.015	.005	.002	.007	.001	.001	.001	.008	.015	.023

EXPENDITURES FOR FIRE PREVENTION AND PRESUPPRESSION ON NATIONAL FORESTS

DIVISION OF FIRE CONTROL

Washington, D. C.

The following table shows fire control expenditures per acre for prevention and presuppression only. The acreage used is gross area inside national forest boundaries for Western Regions. For Eastern regions "protection areas" are used. This excludes from the acreages of Eastern regions those portions of purchase areas on which protection has not been organized. All acreages used are those in effect for calendar year 1937.

These expenditure figures do not include anything for suppression, nor do they include cost adjustments (CCC enrollees and similar labor, depreciation and maintenance of improvements) for prevention or presuppression.

By comparing the first and last columns for each region one can readily see the increases for FY 1938 (beginning July 1, 1937) over FY 1936. By comparing the different rates in the last column one can see the differences in planned FY 1938 expenditures for prevention and presuppression.

Region	FY 1936 expenditures for prevention + presuppression ÷ 1937 protection	Increase per acre for FY 1937	Increase per acre for FY 1938	Total per acre for FY 1938
1	$ .0300	$ .0072	$ .0013	$ .0385
2	.0030	.0005	.00003	.0035
3	.0046	.0004	.0001	.0051
4	.0066	.0026	.0003	.0095
5	.0335	.0054	.0013	.0405
6	.0235	.0047	.0012	.0294
7	.0314	.0011	.0007	.0332
8	.0244	.0016	.0015	.0275
9	.0338	.0015	.0013	.0366
10	.0005	....	.00001	.0005
Total	$ .0173	$ .0029	$ .0007	$ .0209

SPECIAL ISSUES OF FIRE CONTROL NOTES FOR COOPERATORS

Region 6

Forest Service

Can Fire Control Notes be made worthwhile to the army of cooperators on which the success of fire control so largely depends? Region 6 believes it can and proposes a definite plan. A "Cooperators' Issue" for August is not possible, but in February such an issue could be put out for cooperators in Eastern States followed by a May or June, 1938, issue for Western States. Are State, Forest Service and other agencies interested? Will they agree to collect the necessary material—particularly from cooperators themselves?

It seems that Fire Control Notes could be used very effectively in stimulating interest on the part of certain classes of cooperators. Operators of saw mills, logging camps, contractors engaged in highway and other construction work, and key men in the various communities would, without doubt, really appreciate receiving the publication. In order to make the Notes of greatest value to this group more articles pertaining to fire prevention, suppression, and slash disposal on industrial operations should be included.

Fire Control Notes is probably a little too technical to have a very strong appeal to the great majority of local rancher-cooperators, who are usually interested chiefly in things with which they are familiar and which touch upon their own interests. In order to make the publication of maximum appeal to this class, the editorial policy would have to be modified to include a good sprinkling of items and articles which could be readily grasped and tied into their activities and experiences. Of course, it should not be difficult to do this two or three times a year but it might become difficult to accomplish in every issue. My idea is that an occasional "cooperators' issue" might be published to be sent to these people.

It is probably too late to prepare a special cooperators' issue for July, desirable as it might be to do so. However, if one could be prepared for issue early in August, it should have a highly useful effect in bolstering interest and action during the more critical period of the coming fire season. If this can be done, and it is hoped it can, Region 6 would like at least 1,000 extra copies of the publication. Limiting the circulation to certain of the forests which have taken the lead in cooperative effort would make it possible to determine the value of continuing and extending the idea.

FIRE DISPATCHING AND THE DISPATCHER

C. B. SUTLIFF

Fire Inspector, Region 1

The author believes that Fire Dispatching is probably the most vitally important single phase of the entire fire control organization and that the Dispatcher's position has that importance in relation to others in the fire control organization. Dispatching is important, and though some may differ as to the degree, it is stimulating to have presentations of this kind.

The degree of responsibility resting with each dispatcher position depends upon (1) the magnitude of the fire control problem presented, and (2) the protection organization and suppression force resources afforded by the individual protection unit or area concerned. If the fire problem presented and protection resources afforded are such that an unlimited suppression force can be dispatched to each fire as it is detected, the job of fire dispatching is a very simple procedure. Few protection units or forested areas are so endowed at present and for various obvious reasons it is very unlikely that a great many of them ever will be, which indicates the necessity for providing the dispatcher with all the implements of fire dispatching, including every possible source of pertinent information. Here it becomes clear that there still remains considerably more to be learned about fire behavior and the methods of obtaining adequate dispatching information than has been discovered to date.

The fire dispatcher as referred to in this discussion is any individual upon whom rests the responsibility of making the decisions in manipulating and directing fire control forces and effort within a given unit of area. When confronted with the more complex problems involved in fire dispatching, of which there are many, his decisions at times are momentous.

What is the main problem which immediately confronts the dispatcher when a fire is reported? It is that of calculating the probabilities of the fire and determining the size of suppression force necessary to control it within a certain time objective. In dealing with this problem he is concerned with three separate questions: (1) What will be the rate of spread? (2) What will be the resistance to control? (3) What will be the rate of held line output by the attacking force? Several influencing factors must be given careful consideration in each case if the correct answers are to be determined.

1. *Rate of spread*—What are the more important factors which govern rate of spread? These can be boiled down to four, each of which is comprised of from one or two to several important subdivisions. From a phys-

ical standpoint these factors are equally divided into classes; constants and variables.

CONSTANTS	VARIABLES
1. *Fuels*	1. *Wind*
a. Continuity	a. Velocity
b. Size	b. Direction
c. Volume	c. Duration
d. Arrangement	2. *Fuel moisture content*
2. *Topography*	a. Fine fuels and vegetation
a. Slope	b. Medium fuels. ½" to 2" dia.
b. Exposure (synonymous with fuel moisture)	c. Large fuels, over 2" dia.
	d. Humidity (existing)
	e. Precipitation (previous)

Subdivisions (d) and (e) under fuel moisture content are simply an aid to determining fuel moisture content itself. Neither has a direct influence upon rate of spread except as each affects the immediate moisture content of the fuels concerned.

Fuels obviously influence rate of spread to a greater extent than any other single factor. Without them there can be no fire; yet, in certain natural fuel combinations, a fire may spread rapidly with little or no influence from any of the three remaining factors other than that afforded by average summer weather conditions.

Wind is the second most important factor which influences rate of spread. Examination of weather records for days upon which disastrous fires have occurred indicates that wind is more influential than any of the remaining factors. With severe wind conditions, rapid spread has been known to occur, even with greatly reduced fuel influence and fairly high fuel moisture content.

Fuel moisture content is perhaps the third most important factor, with topography last, though by no means unimportant. Topographic influence (steepness of slope) acts in the same manner and has the same effect up to a certain point as wind. Exposure has nothing more to do with rate of spread than the effect it has on fuel moisture content.

2. *Resistance to control*—The answer to the question about resistance to control is governed pretty much by two constant factors which in turn are comprised of several sub-factors.

1. *Fuels*
   a. Character or kind
   b. Size
   c. Volume or density

2. *Topography*
   a. Soil conditions
   b. Steepness of slope

Some fire control men are inclined to consider heat from a going fire as a factor in resistance to control. This involves rather a hair-line distinction as to where rate of spread leaves off and resistance to control begins. Obviously a fire which is spreading at a rapid rate will be difficult, if not impossible, to work against anywhere near its head. It is felt, for this reason, that if rate of spread is properly calculated, appropriate allowance will have been made for the heat resistance factor at the time of calculating probable final perimeter and job size.

3. *Rate of held line output*—What governs the rate of held line production? Resistance to control is one of the main factors. The others are directly concerned with the type of suppression force employed. Several factors and sub-factors are involved:

1. *Size of crew*
   a. No. men
   b. No. overhead
2. *Character of crew and O. H.*
   a. Experience
   b. Training
   c. Adaptability
3. *Fatigue* (effect of this factor varies with type of men employed)
   a. Length of work period

The calculation of probabilities thus far appears to be a somewhat complicated task involving innumerable intricacies. In addition to the consideration which must be given each of the factors mentioned, there also remain four others which must come into the picture. They represent the various time elements and method of attack to be employed.

1. *Discovery time*
   a. Actual
2. *Arrival time*
   a. Estimated (time of arrival of sufficient force to deter spread as calculated)
3. *Corral time*
   a. Objective
4. *Metrod of attack*
   a. Frontal
   b. Flanking

With but little study of the several factors indicated, the possibility can be seen of innumerable combinations, each of which would produce a different fire suppression job. Such circumstances make the present day fire dispatcher's job most complicated and difficult, if not impossible.

What is the answer to the dispatching phase of the fire control problem: that is, how can the probabilities of each fire be calculated immediately following discovery with a degree of accuracy productive of a thoroughly sound basis for adequate but not extravagant suppression action? Opinion seems to be divided along three lines of thought:

(1) There are those who are confident that the developing of super intelligent dispatchers, men who will be capable of dispatching by relying chiefly upon judgment and past experience, is entirely within the realm of possibilities.

(2) Some feel that not until such time as the art of dispatching has been

reduced to a simple process of reading a few mechanical recording gadgets, referring to a chart or two and doing a few simple calculations with pencil or aid of an automatic slide rule—all of which may be done without background or previous experience—will all obstacles have been surmounted and the problem solved.

(3) Others believe that perhaps a combination of a little sound judgment gained through a reasonable amount of training and experience, and a few basically sound mechanical devices developed from such data as are available and with provisions for amending and maintaining them abreast of developments as further knowledge is gained, is probably the most logical immediate solution to the problem.

Consider the first of the three solutions advanced: Is there any reason to believe that there is greater probability of developing super-intelligent dispatchers in the immediate future than have been developed in the past? Most likely not as much. Even though it may be possible, is it practical when compared to alternative methods already in various stages of development?

The second solution advanced leans toward the opposite extreme. Considering such obvious prerequisites as the vast amount of research, study, development work, etc., which must be accomplished, the advent of such devices can readily be seen to exist only in the distant future, if at all. Granting the possibility of developing such a dispatching scheme, there again arises the question, "Is it practical?"

In the meantime fires occur and fire dispatching must go on. After studying the various opinions advanced and the possibilities afforded, the logical course to pursue would seem to be along the lines advanced by the third scheme, which is a course midway between the two extremes. Region 1 has developed to this end a set of guide charts containing the best data available at present which are used by fire dispatchers as guides when calculating probabilities. The charts will be amended to make full use of more and better basic data as rapidly as such data become available.

The rate of spread data used in compiling the charts was obtained, for the most part, from analyses of records of past fires. The rate of held line output data was obtained from both records of past performance and from answers to questionnaires by carefully selected men of experience.

The Region 1 dispatcher guide charts comprise the four items shown.

Item One is the rate of spread danger meter from which spread danger classes are obtained. This meter employs all of the factors which influence rate of spread that are used in the Region 1 Forest Fire Danger Meter developed by the Northern Rocky Mountain Forest and Range Experiment Station, and now used extensively throughout the Region. In addition, it gives consideration to steepness of slope.

Item Two contains two charts. Chart one provides the perimeter increase or spread rate factors for the four recognized fuel types according to the various spread danger classes. The spread rate factors indicated represent approximate perimeters at the end of the first hour of free burning after discovery. Chart two contains the time factors and the corresponding multipliers to be used to determine the probable perimeter of a free burning fire for any given period of time within the first burning period after discovery. These factors were obtained by working out, according to formulae, the probable perimeter of a fire for each of the many time factor combinations. They take into account accelerated spread according to time of day.

Item Three is a guide chart for determining manpower needs to accomplish a given job of held line construction within an established time objective. The factors influencing rate of output (except fuel resistance) have been accounted for in the unit output figures shown. The figures at the extreme right represent percentage of efficiency according to number of hours of continuous work. The figures at the bottom represent the percentage of efficiency according to size of crew employed. The figures also take into account the probable character of crew to be employed.

Item Four is an instruction card pertaining to the use of the guide charts. It is also a tickler list of the various factors to which consideration must be given regardless of method of calculating probabilities employed.

At the time the charts were compiled the fact was both known and accepted that they were far from being infallible and that there were many "bugs" yet to be found and corrected. The charts were offered for use throughout the 1936 fire season and the results were more encouraging than had been anticipated. Wherever possible, checks were made upon their accuracy. It is yet much too soon to draw any definite conclusions, but the results clearly indicate the superiority of this chart system to offhand judgment fire dispatching. Whether the charts should remain in their present form is questionable. Undoubtedly, there is some need for simplification, but until such time as the pertinent data contained have been thoroughly checked for accuracy and adjusted to meet acceptable standards, the problem of final arrangement should remain secondary in importance.

The greatest handicap which confronted many of the dispatchers when endeavoring to make use of the guide charts was the lack of facilities for obtaining accurate information regarding weather and fuel conditions at the time and for the immediate area concerned in each fire. Such information must be available if the charts are to serve the purposes for which they are intended. The lack of facilities for obtaining such data cannot be considered as a weakness in the charts. Whether this or any other method of calculating probabilities be employed, weather and fuel conditions at the time of discovery and for the vicinity of the fire must be known.

The charts are still in a stage of experimental development, and no attempt has been made to cover in detail in this manuscript the methods involved in their construction. Doing so at this time is not warranted because a few changes are now pending and it is quite probable many others will be made before a state of perfection is reached. The present charts are being offered not as finished products but as a possible source of information for others having similar problems.

ITEM ONE

Conditions at Location of Fire — WIND	Over 25%	19-25%	14-18%	11-13%	8-10%	5-7%	Under 5%
0-3 MPH	2	3	4	4.5	5	5.4	5.7
4-7 MPH	3	3	4	4.5	5.4	5.7	6.3
8-12 MPH	3	4	4.5	5	5.7	6.3	6.9
13-18 MPH	4	4	5	5.4	6	6.6	7
19-24 MPH	4	4.5	5	5.7	6.3	6.8	7.2
Over 24 "	4.5	5	5.4	6	6.6	7	7.4

Moisture Content of Fuels ½" and Less

Spread Danger Class

RATE OF SPREAD DANGER METER

Season and Slope Indicator (2)

FRONT

Conditions at Location of Fire

Moisture Content of Fuels ½" and Less

WIND	Over 25%	19-25%	14-18%	11-13%	8-10%	5-7%	Under 5%
0-3 MPH							
4-7 MPH							
8-12 MPH							
13-18 MPH							
19-24 MPH							
Over 24"							

Spread Danger Class

RATE OF SPREAD DANGER METER

Season and Slope Indicator ○

SLIDE

1

2

3

2	2	2	3	4	4.5	5
2	2	3	4	4.5	5	5.4
2	3	4	4.5	5	5.4	5.7
3	3	4	4.5	5.4	5.7	6.3
3	4	4.5	5	5.7	6.3	6.8
4	4	5	5.4	6	6.6	7
4	4.5	5	5.7	6.3	6.8	7.2
4.5	5	5.4	6	6.6	7	7.4
5	5.4	5.7	6.3	6.8	7.4	7.5

(P)

(1)

(2)

(3)

BACK

INSTRUCTIONS

1. Pre & Post-Season - Set slide at (P) for fires before July 6 or after Sept. 10 if slope and exposure are normal.

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2. Mid-season - Set slide at (1) for fires during period July 6 to Sept. 10 if slope and exposure are normal.

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3. Slope and Exposure - If slope is long, steep and exposed to prevailing wind, set slide as follows:

Slope	Season	Indicator
35-60%	Pre & Post	(1)
Over 50%	Pre & Post	(2)
35-60%	Mid-season	(2)
Over 60%	Mid-season	(3)

------

4. Relative Humidity - If below 15%, read next fuel moisture content class to right. If already under 5%, read next higher wind-velocity class.

5. General - Weather conditions should be determined as accurately as possible at the time and for the vicinity where fire is located.

ITEM TWO

DISPATCHER'S GUIDE CHARTS - PERIMETER-INCREASE DATA

NOTE: Chart data assumes free burning conditions, therefore corral period perimeter increases indicated must be adjusted according to strength and method of attack in each case, if begun during first period.

Chart One

Spread Danger Class	Fuel Type: Low	Med.	High	Ext.
	Perim. Incr. Factor (First-Hour Perimeter)			
2	.04	.08	.16	.2
3	.08	.2	.32	.6
4	.6	.8	1.0	1.6
4.5	1.0	1.2	1.6	2.8
5	1.6	2.0	2.8	4.8
5.4	2.6	3.8	5.0	8.1
5.7	3.7	5.8	7.5	12.
6	5.6	8.4	11.	17.
6.3	8.2	12.	16.	25.
6.6	11.	15.	20.	33.
6.8	12.	18.	23.	39.
7	14.	20.	26.	46.
7.2	16.	23.	30.	51.
7.4	17.	25.	33.	55.
7.5	18.	26.	35.	59.

Chart Two

Time of Discovery	Time Objectives: 1st Per'd	12 p.m.	11 p.m.	10 p.m.	9 p.m.	8 p.m.	7 p.m.	6 p.m.	5 p.m.	4 p.m.	3 p.m.	2 p.m.	1 p.m.	12 noon	11 a.m.	10 a.m.
	Perimeter-Increase Factor Multipliers - According to Time Objectives Used															
9 a.m.	82	78	75	70	63	56	49	42	35	28	21	15	10	6	3	1
10 a.m.	75	72	69	63	56	49	42	35	28	21	15	10	6	3	1	
11 a.m.	68	65	61	56	49	42	35	28	21	15	10	6	3	1		
12 noon	61	58	54	49	42	35	28	21	15	10	6	3	1			
1 p.m.	49	47	44	39	33	27	21	15	10	6	3	1				
2 p.m.	39	37	34	30	25	20	15	10	6	3	1					
3 p.m.	29	27	25	22	18	14	10	6	3	1						
4 p.m.	21	19	17	14	12	9	6	3	1							
5 p.m.	18	16	14	12	9	6	3	1								
6 p.m.	15	13	11	9	6	3	1									
7 p.m.	12	10	8	6	3	1										
8 p.m.	8	7	5	3	1											

Night Fires: For discoveries between 5 a.m. and 9 a.m. increase the discovery hour by the required number of hours to advance it to 9 a.m. Then advance both the estimated arrival time and the corral objective the same number of hours and work out probabilities on the basis of a 9 a.m. discovery. Example: 6 a.m. discovery, 8 a.m. arrival and 10 a.m. corral would be worked thus - 9 a.m. discovery, 11 a.m. arrival and 1 p.m. corral.

For all other night fires (between 9 p.m. and 5 a.m.) simply reverse a.m. hours to p.m.'s and p.m. hours to a.m.'s and use charts direct as for a daytime discovery. Example: 11 p.m. discovery, 1 a.m. arrival and 6 a.m. corral would be worked out as an 11 a.m. discovery, 1 p.m. arrival, and 6 p.m. corral. Remember - the danger class used must represent night conditions at site of fire.

(The data contained herein is intended for use as a guide for dispatching.)

ITEM THREE

REGION ONE | ALL FORESTS

DISPATCHER'S GUIDE CHARTS – CORRAL-LINE OUTPUT DATA

SMOKECHASER OUTPUT FIGURES BASED UPON ESTIMATES OF APPROXIMATELY 150 EXPERIENCED MEN, 1000 ESTIMATES TAKEN IN 1930 AND 600 IN 1935 AND 1936.
OUTPUT = EXTREME, .25 CH.; HIGH, .8 CH.; MEDIUM, 2.0 CH.; LOW 3.3 CH.

HOURS OF WORK	SMOKECHASER UNITS OF OUTPUT ACCORDING TO SIZE OF CREW EMPLOYED AND NUMBER HOURS WORKED — NUMBER OF MEN																			FATIGUE FACTOR APPLICABLE ACCORDING TO NUMBER HOURS WORKED
	1	2	3	4	5	7	10	15	20	25	30	40	50	75	100	125	150	175	200	
1	1.00	2.00	3.00	4.00	4.95	6.86	9.50	12.7	14.0	15.0	15.9	19.2	28.5	30.0	35.0	40.6	45.0	48.1	50.0	100
2	2.00	4.00	6.00	8.00	9.90	13.7	19.0	25.5	28.0	30.0	31.8	38.4	45.0	60.0	70.0	81.3	90.0	96.3	100.	100
3	2.97	5.94	8.91	11.9	14.7	20.4	28.2	37.9	41.6	44.6	47.2	57.0	66.8	89.1	103.	121.	133.	143.	149.	97
4	3.82	7.64	11.5	15.3	18.9	26.2	36.3	48.7	53.5	57.3	60.7	73.3	86.0	115.	134.	155.	172.	184.	191.	85
5	4.51	9.02	13.5	18.0	22.3	30.9	42.8	57.5	63.1	67.7	71.7	86.6	101.	135.	158.	183.	203.	217.	225.	69
6	5.06	10.01	15.2	20.2	25.0	34.7	48.1	64.5	70.6	75.9	80.5	97.1	114.	152.	177.	205.	228.	243.	253.	55
7	5.52	11.0	16.5	22.1	27.3	37.9	52.4	70.4	77.3	82.8	87.8	106.	124.	166.	193.	224.	248.	266.	276.	46
8	5.92	11.8	17.8	23.7	29.3	40.6	56.2	75.5	82.9	88.0	94.1	114.	133.	178.	207.	241.	266.	285.	296.	40
9	6.27	12.5	18.8	25.1	31.0	43.0	59.5	79.9	87.7	94.0	99.7	120.	141.	188.	219.	255.	282.	301.	313.	35
10	6.60	13.2	19.6	26.4	32.7	45.3	62.7	84.1	92.4	99.0	105.	127.	149.	198.	231.	268.	297.	318.	330.	33
11	6.91	13.8	20.7	27.6	34.1	47.4	65.6	88.1	96.7	104.	110.	133.	155.	207.	242.	281.	311.	333.	345.	31
12	7.21	14.4	21.6	28.8	35.7	49.5	68.5	91.9	101.	108.	115.	138.	162.	216.	252.	293.	324.	347.	361.	30
13	7.50	15.0	22.5	30.0	37.1	51.4	71.2	95.6	105.	113.	119.	144.	169.	225.	263.	305.	337.	361.	375.	29
14	7.78	15.6	23.3	31.1	38.5	53.4	73.9	99.2	109.	117.	124.	149.	175.	233.	272.	316.	350.	374.	389.	28
15	8.05	16.1	24.1	32.2	39.9	55.2	76.5	103.	113.	121.	128.	155.	181.	241.	282.	327.	362.	387.	403.	27
16	8.31	16.6	24.9	33.2	41.1	57.0	78.9	106.	116.	125.	132.	159.	187.	249.	291.	338.	374.	400.	415.	26
17	8.56	17.1	25.7	34.2	42.4	58.7	81.3	109.	120.	128.	136.	164.	193.	257.	300.	348.	385.	412.	428.	25
18	8.80	17.6	26.4	35.2	43.6	60.3	83.6	112.	123.	132.	140.	169.	198.	264.	308.	357.	396.	423.	440.	24
19	9.03	18.0	27.0	36.1	44.7	61.9	85.8	115.	126.	135.	144.	173.	203.	271.	316.	367.	406.	435.	451.	21
20	9.25	18.5	27.7	37.0	45.8	63.4	87.9	118.	129.	139.	147.	178.	208.	277.	324.	376.	416.	445.	463.	22
	100	100	100	100	99	98	95	85	70	60	53	48	45	40	35	32.5	30	27.5	25	← SIZE OF CREW FACTOR

OUTPUT FIGURES SHOWN ARE BASED UPON DAYLIGHT WORK. OVERHEAD HAS BEEN ASSUMED TO CONSIST OF ONE QUALIFIED FOREMAN AND THREE QUALIFIED STRAWBOSSES PER 25-MAN UNIT WITH CORRESPONDING NUMBER OF FIRE OR SECTOR FOREMEN, FOREST OFFICERS, ETC. THIS DATA FOR USE AS A GUIDE.
(DIVIDE CHAINS OF WORK BY SC OUTPUT RATE BEFORE USING THIS CHART TO GET MAN POWER.)

ITEM FOUR

INSTRUCTIONS FOR USING REGION ONE DISPATCHER GUIDE CHARTS – WESTERN FORESTS

A. FACTORS THAT MUST BE CAREFULLY CONSIDERED IN ANY METHOD OF CALCULATING FIRE PROBABILITIES OR DETERMINING MAN-POWER NEEDS. THE INFLUENCE OF THESE FACTORS HAS BEEN GIVEN CONSIDERATION IN THE REGION ONE CHARTS, INSOFAR AS POSSIBLE TO DETERMINE FROM THE LIMITED AMOUNT OF DATA AVAILABLE:

1. FUELS:
   - A. CONTINUITY
   - B. SIZE
   - C. VOLUME
   - D. ARRANGEMENT
2. TOPOGRAPHY:
   - A. SLOPE
   - B. EXPOSURE
3. WIND:
   - A. VELOCITY
   - B. DIRECTION
   - C. DURATION
4. FUEL MOISTURE:
   - A. HUMIDITY (EXISTING)
   - B. 1" AND LESS FUELS
   - C. PRECIPITATION (PREVIOUS)
   - D. LARGE FUELS (2" PLUS)
5. SIZE OF CREW:
   - A. NO. OF MEN (LOSSES THROUGH PLACEMENT AND SUPERVISION).
6. CHARACTER OF CREW AND OVERHEAD:
   - A. EXPERIENCE
   - B. TRAINING
   - C. ADAPTABILITY
7. FUEL RESISTENCE:
   - A. SAME AS 1–A,B,C,D EXCEPT AS EACH AFFECTS HELD-LINE OUTPUT
8. FATIGUE:
   - A. LENGTH OF WORK PERIOD (VARIES GREATLY WITH TYPE OF MEN USED).
9. DISCOVERY TIME:
   - A. ACTUAL
10. ARRIVAL TIME:
    - A. ESTIMATED (SUFFICIENT FORCE TO DETER SPREAD AS CALCULATED).
11. CORRAL TIME:
    - A. OBJECTIVE (ESTABLISHED ARBITRARILY).
12. METHOD OF ATTACK:
    - A. FRONTAL
    - B. FLANKING

B. SUGGESTED METHODS OF OBTAINING TIMELY MEASUREMENTS OF FACTOR INFLUENCE

1. THROUGH OBSERVING AGENCIES: LOOKOUTS, SMOKECHASERS, CREWMEN – GLASSES OR TELESCOPE MAY BE USED.
2. INTIMATE PERSONAL KNOWLEDGE OF DISPATCHER OR OTHER PERSONS IMMEDIATELY AVAILABLE.
3. NEAREST INFLAMMABILITY STATIONS: WIND GAUGES, PSYCHROMETER LOCATIONS, ETC. SEVERAL READINGS DAILY.
4. FUEL TYPE MAP: FOR GENERAL INFORMATION AND TO BE RELIED UPON WHEN 1 & 2 FAIL TO SERVE NEED.
5. CURRENT WEATHER RECORDS: FUEL MOISTURE, WIND, HUMIDITY, RAINFALL, ETC., AS RECORDED SEVERAL TIMES DAILY.

C. CALCULATING PROBABILITIES WITH REGION ONE GUIDE CHARTS

1. ASCERTAIN DANGER CLASS FROM SPREAD DANGER METER. ADJUST ACTUAL MEASUREMENTS, SECURED FROM SOURCES NEAREST TO FIRE, BY CAREFULLY COMPARING SLOPE, EXPOSURE, TIMBER STAND (DENSE, AVERAGE OR OPEN), EXPOSURE TO WIND, ELEVATION, RAINFALL (RECENT AND PAST), TIME OF DAY, ETC.
2. ASCERTAIN RATE OF SPREAD FACTOR FROM CHART I. SELECT PROPER DANGER CLASS, IN FIRST COLUMN, THEN REFER TO PROPER RATE OF SPREAD (FUEL TYPE) COLUMN, ON SAME DANGER CLASS LINE, AND RATE OF SPREAD FACTOR WILL BE INDICATED. DETERMINE PROPER RATE OF SPREAD (FUEL TYPE) BY METHODS SUGGESTED UNDER B 1, 2 & 4 ABOVE.
3. ASCERTAIN PERIMETER INCREASE FACTORS FROM CHART II. IN FIRST COLUMN SELECT TIME OF DISCOVERY OF FIRE (TO NEAREST PRECEDING HOUR), THENCE ACROSS CHART TO PROPER ARRIVAL TIME AND CORRAL TIME COLUMNS. THEREUNDER WILL BE INDICATED THE PROPER MULTIPLIERS TO BE USED IN DETERMINING THE PROBABLE FREE BURNING PERIMETERS FROM DISCOVERY TO ARRIVAL AND FROM DISCOVERY TO CORRAL TIME. THE PERCENTAGE OF THE DIFFERENCE BETWEEN THE ARRIVAL TIME PERIMETER AND CORRAL TIME PERIMETER WHICH SHOULD BE ALLOWED DEPENDS ENTIRELY UPON STRENGTH OF ATTACKING FORCE AND THE METHOD OF ATTACK ANTICIPATED. THE ARRIVAL TIME PERIMETER PLUS THE CORRAL PERIOD ALLOWANCE EQUALS TOTAL JOB SIZE ANTICIPATED.
4. ASCERTAIN MAN-POWER NEEDS FROM CHART III. DIVIDE TOTAL CHAINS OF ANTICIPATED PERIMETER BY THE SMOKECHASER OUTPUT RATE FOR THE FUEL TYPE CONCERNED. THIS GIVES THE NUMBER OF SMOKECHASER HOURS OF WORK TO BE DONE. IN FIRST COLUMN SELECT NUMBER OF HOURS CALCULATED IN CORRAL PERIOD, FOLLOW THIS LINE TO RIGHT UNTIL AN OUTPUT FIGURE EQUAL TO NUMBER OF HOURS OF SMOKECHASER WORK IS FOUND. AT TOP OF COLUMN WILL BE SHOWN NUMBER OF MEN REQUIRED TO DO THE JOB, WITH ALLOWANCE MADE FOR FACTORS A 5,6,7 AND 8, AS SET FORTH ABOVE.
5. NIGHT FIRES: BETWEEN 9 P.M. AND 6 A.M. CHART II MAY BE USED IN THE SAME MANNER AS FOR DAYTIME DISCOVERIES EXCEPT FOR MULTIPLIERS SHOWN IN COLUMN TWO. THESE ARE FOR DAYTIME DISCOVERIES ONLY AND ARE APPLICABLE WHEN A DISPATCHER DESIRES TO DETERMINE THE PROBABLE PERIMETER OF A FIRE WHICH HAS ESCAPED CORRALLING THROUGHOUT THE FIRST DAY — TO DETERMINE JOB SIZE FOR SECOND A.M. CORRALLING.
6. EXAMPLE: AUGUST 7, NORMAL SLOPES, NORMAL HUMIDITY, 4-5 MILE WIND, 9% FUEL MOISTURE –D.C. 5. FUEL TYPE IS MEDIUM SPREAD AND MEDIUM RESISTENCE; DISCOVERY TIME IS 10 A.M.; ARRIVAL TIME IS 12 NOON; CORRAL OBJECTIVE IS 2 P.M. CHART I GIVES A SPREAD FACTOR OF 2.0. CHART II GIVES AN ARRIVAL TIME MULTIPLIER OF 3 AND A CORRAL TIME MULTIPLIER OF 10. THUS PROBABLE PERIMETER ON ARRIVAL IS 2.0 X 3 OR 6 CHAINS. DISCOVERY TO CORRAL TIME PERIMETER IS 2.0 X 10 OR 20 CHAINS. 20 MINUS 6 IS 14 CHAINS OR FREE BURNING INCREASE DURING CORRAL PERIOD. IF FRONTAL ATTACK IS PLANNED 25% SHOULD BE SUFFICIENT ALLOWANCE. THUS 6 CHAINS PLUS 25% OF 14 CHAINS EQUALS 9.5 CHAINS OR PROBABLE TOTAL JOB SIZE.

TRACTOR TRAILS VS. HORSE TRAILS

C. S. Cowan

Chief Fire Warden, Washington Forest Fire Association

The timeliness of Mr. Cowan's article is emphasized by a coincidence. Without knowledge of this article, a similar proposal has been advanced for consideration in the Forest Service. Specific recommendations in that proposal were:

> Obtain a supply of high power, high speed trucks of three or five ton capacity.
>
> On each truck keep a crawler track trailer and a tractor equipped with brushbuster or other suitable rig, and a high speed auxiliary transmission (if desirable).
>
> Go in for *tractor* trails to supplement existing road systems. Clearing, but no excavation except when slopes exceed 30 per cent or so.
>
> Focus on plans and specifications which will put the tractor-brushbuster-trailer rigs at the fire as soon as a crew could get there by usual methods of transportation, the machine rigs to be used for line construction, use of foam or transportation of supplies, equipment or water as circumstances might dictate.

The problem of the pack horse country is a complicated one. The average pack horse is capable of taking a 175-pound load some 15 miles a day. Carrying a ton of supplies should therefore require a string of 13 to 14 horses. If the trip involves a distance in excess of one day's travel, complications begin, especially in the Coast country, where natural feed is simply nonexistent. Pack horses also must be provided to pack feed for the animals. The time taken in packing and unpacking and the necessity for the wrangler to have at least two saddle horses (one for his helper) also mean more trouble for the same results.

Horse trails must be kept to a grade which is below that of a foot trail for men. The straight line delineation is therefore out of consideration when locating horse trails. Pack horses are also getting scarce, and if a forest organization decides to own several strings, the animals must be fed and cared for the greater part of the year in times when as nonproducers they take but do not give.

The mechanical era has just begun and a way out of the pack horse business can be seen. And, if I am correct in my guess, foresters can greatly increase the efficiency and the radius in which mechanical aids can be utilized at a decrease in cost.

The tractor is already a known factor in fire control. The trend is now toward greater and bigger tractors. In forestry, this is *not* an advantage. Transportation becomes a problem, investments are heavy, and construction of "cat" trails for equipment such as a fifty, sixty-five or R D 8 means falling of timber, building of heavy bridges and culverts and side sloping cuts, if the road is to be kept open.

But a light tractor of perhaps 10-15 horsepower, with a 36 to 40-inch blade, will cut trail of sufficient tread to enable such a tractor to pull a wheeled trailer hauling approximately 2,500 pounds weight with ease. Grades of 17 to 20 per cent can be utilized. Even fairly closely growing trees can be negotiated without trouble.

Such a tractor would be of tremendous assistance on the fire line, for it would build a trail wide enough for a backfire line, and it would be of much help in swamping. The tractor I suggest would therefore be of multiple use, and the honest application of this appellation should mean much to the budgeting authorities, who so coldly weigh dollars and cents against ideas, practical and unpractical alike. The tractor for transportation is a simple problem. I had occasion to establish a camp 12 miles back in the hills. Horses for the weights required to be moved became a problem, so the following method was tried:

The old horse trail was swamped out, making it possible to keep a straighter, albeit steeper, trail for some 9 miles to an elevation of 2,860 feet. This was done with nine men in six days. In two days, a 15-cat had swamped out the logs which had but a single saw cut in them, pulled logs out of the trail and reached the end of the swamped road in 3 days, plus trailer and 2,600 pounds of grub, tentage, gasoline and oil, men's dunnage, wire rope, bolts and nuts, cement, and cooking utensils—a mess of articles which would have caused any self-respecting horse wrangler to say at least, "Oh, dear." You know how horse "ski-men" are when sorting articles into pack loads.

The trailer consisted of front axle and wheels of a light car, with the steering arms welded so that the wheels were locked, a 4 x 4-inch wood sill mounted the axle, two pieces of strap iron 3½ inches by ½ inch to form a triangular coupling to the tractor and a box mounted at three points, two on the axle and one at the front, bolted so that it could be readily removed. Total cost $13. It was not the best sort of trailer, but it did the work and proved our ideas. We know now what can be done with this method. We would greatly desire a bulldozer of the type suggested on a small tractor, as we believe that with such an outfit, a six-man crew for emergency tractor trail work (to take the place of the old horse trail), would be a most efficient unit. Costs, of course, must be considered. A light 10-15 horsepower tractor costs about one-quarter that of a 60. A 60 can be in one place only at one time. Four light tractors can be in four places at one time.

The 10-15 is a more efficient unit than a 60 for the type of work under consideration. It is also much more efficient for general forest work than 24 head of horses. The initial costs are about the same, the number of men required to feed the horses, take care of them and house them as compared with the number to care for the tractor is much in favor of the tractor. Such a tractor would also be invaluable in maintaining and grading the many miles of truck trails constructed during the past four years by the CCC.

Not the least consideration is that of primary transportation. A light tractor can be transported on a 1½-ton truck on truck trails. The transportation of a 60 tractor presents many problems, especially on country roads and county bridges. The small trail building tractor is a possibility no forest protection agency can afford to overlook.

Lacquer for Lookout Maps—In seeking a lacquer that would meet the requirements of a good coating for lookout maps, the best solution we have found is DuPont Paper Lacquer No. 395 and DuPont Thinner No. 3991. This lacquer is waterproof and transparent at any thickness desired. It should be mixed in the ratio of 3 parts of thinner to 2 parts of lacquer, and the best results are obtained by applying 3 thin coats with a brush, the second and third coats tending to make the surface smoother and more transparent. These coats also render the surface more waterproof and wear resistant. Surfaces so applied have been put to several severe tests, such as immersion in water for 24 hours, exposure to sunlight, wind and rubbing.

The lacquer can be used effectively for gluing the map to the galvanized iron base of a fire locater. Apply a thin coat to the back of the map and place it on the fire locater immediately; the lacquer dries very quickly. Brushes used in this lacquer must be cleaned at once after using.

The material is highly inflammable and caution must be used to keep it away from fire or heat. It is difficult to remove from any part of the body and care should be used not to come in contact with it.—*Clay V. Castleman, Project Superintendent, Gardner National Forest.*

PROGRESS MAPPING OF FIRES

B. H. Paul

Department of Forestry, County of Los Angeles, California

Following the big fires of October, 1935, at a fire review in which all phases of the action were discussed and studied, there was one significant fact outstanding: In the heat of battle fire fighters lost track of time and place especially in regard to the location of the line at particular times.

Conflicting opinions from reliable and experienced Wardens indicated that memory alone could not be relied upon. Periodic runs, flash-overs, patterns, spreads and "tie-ins" of converging lines were hopelessly lost in the variance of eye witness testimony.

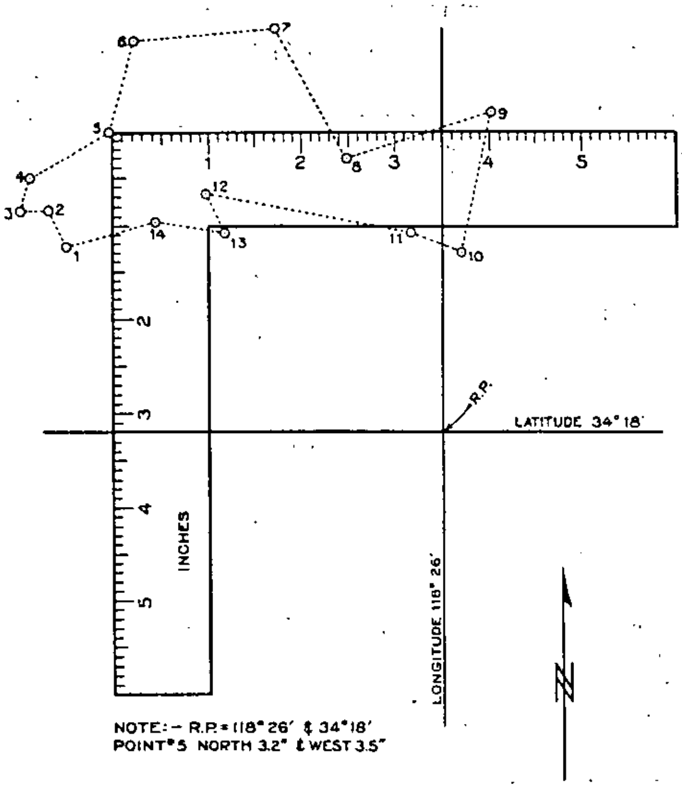
Clearly it was evident that some means had to be taken to overcome this particular problem and prevent its recurrence. In the accomplishment of this, there has been developed a new fire line unit. Two men of the Department's Intelligence Division, both experienced topographers and map men, now are assigned special duty as fire line mappers. It is their job to proceed at once to the scene of a major fire and begin charting the perimeter by time intervals. The object is to obtain data on rate of spread and pattern design, and to delineate a permanent chronological record of the behavior of the fire. If the burned area becomes too great for two men to adequately cover, additional mappers are assigned.

One of the objectives is to determine the position of the fire line at the end of the first hour. Another traverse is completed at the end of three hours, and thereafter the line is recorded by six-hour periods.

Intimate knowledge and familiarity with the terrain and road system by mappers is mandatory in order that travel time and distance may be reduced to an absolute minimum in reaching different sectors and observation points. Actual observance of the line is required, for even reasonable guesswork is discounted. The Pauline altimeter is used to facilitate this work. This instrument, reading to the nearest five feet of elevation, is adjusted and set at the closest U. S. G. S. bench mark to the scene of survey. It is possible by using the altimeter in conjunction with a reliable topographic map to follow accurately or spot the fire line in all its meanderings and deviations. The advantage of this method over that of transit and stadia is obvious.

The line is charted as fast as the observer can travel over the ground. At regular intervals the position of the line is in turn plotted and recorded at headquarters and in the fire camp through telephone communication.

This is accomplished by the simple method of describing a chain of traverse points whose location is designated by coordinates. A reference point is first given, being the nearest intersection of meridians of latitude and longitude. Measured either left or right and up or down, or east and west and north and south, from this point, prominent or control points along the line are spotted and, by connecting these points, the line is defined. A celluloid coordinate scale is employed to facilitate this operation. This scale measures both coordinates at the same time. The outer edge of this "L" shaped scale is graduated in inches and tenths of an inch. The designated point on line is located by sliding the scale along both meridians in radial direction from their intersection or reference point.



Coordinated Square Scale Used in Fire Line Platting.

The phoned message from the mapper to the dispatcher is carefully logged, repeated and verified. A typical example of this is:

6 . m. Partial fire line report from E. N. October 19. Call from phone-box 29. Base sheet Sylmar Quad. R. P. 118° 28′ and 34° 18′.

1.	North 2.0	West 4.0	
			Cold trailed Fire burning northerly
2.	North 2.4	West 4.2	
			Hot line
3.	North 2.4	West 4.5	
4.	North 2.7	West 4.4	
5.	North 3.2	West 3.5	
			Cold line
6.	North 4.2	West 3.3	
			Hot line
7.	North 4.4	West 1.8	
8.	North 2.9	West 1.0	
			Burning slowly
9.	North 3.4	East 0.5	
10.	North 1.9	East 0.2	
11.	North 2.1	West 0.3	
			One lick line, few hot spots
12.	North 2.5	West 2.5	
13.	North 2.1	West 2.3	
			Cold Trailed
14.	North 2.2	West 3.0	
	Closure to Point 1		

Repeated by Roth, checked back E. N.

The first actual application of this method of chronological fire line recording was on the Cold Creek fire of September 7, 1936. This fire spread for approximately three days before being brought under control. At regular intervals the position of the line was plotted as described, and concurrent with this plotting, the fire line map at the fire camp and at headquarters was charted. The latter was important in that accurate and definite description could be supplied at any time for press notices, dissemination of information to individual property owners whose interests were concerned, and for technical purposes.

When the fire was over and the final lines checked, this method had provided a permanent record covering the course, rate of spread, and typical patterns of the burn in all its stages. The original field map is subsequently reduced or enlarged in scale to a size which conforms to standard sheet in the Fire Burn Map Book.

BACKFIRING EQUIPMENT

Fred W. Funke

Fire Equipment Specialist, Region 5

Clean burning of lines is sometimes risky. When this is true it is often still more risky not to clean burn. Many fires have been lost because men chose, in effect, to run the greater risk of not burning out the lines. In many other cases fires are lost because the burning out of lines is neglected even though burning would have been safe and simple if done promptly. Part of the remedy lies in providing better backfiring equipment. Most men who see Mr. Funke's flame thrower work in competition with other backfiring equipment believe that the flame thrower has rendered other torches obsolete.

One of the favorite methods of controlling large fires in the early days of organized fire suppression was to withdraw to a convenient road or other barrier and ignite the fuel on the ground. The backfire thus created soon spread, leaving in its wake an increasing width of burned area which isolated the main fire from the barrier. "Acres Burned" did not receive as much consideration as "Cost Per Acre."

Matches, cedar bark and other local fuel torches usually provided a ready means of carrying the backfire along the line selected. Even today, such devices are a valuable supplement to regular mechanical equipment.

Improvement in fire control technique indicated the need for equipment which would speed up the firing of control lines so that such lines might be placed close to the main fire. The goal: a material reduction in the acreage burned on the average fire. The record is not quite clear but it is probable that some rancher in Southern California introduced the orchard heater (smudge pot) lighter to the field of fire suppression by starting a good backfire to protect his property.

Since the advent of the smudge pot lighter various mechanical designs have appeared. Each has contributed a share in the development of method for greater speed in the control of forest fire.

Mechanical backfire equipment may be loosely grouped in three classes:

1. Gravity Feed.
2. Blast type pressure torches.
3. Flame Thrower.

1. There are several designs of the gravity feed type. The smudge pot lighter is probably the most popular due to low cost. The great number of models available in this type are essentially the same, having a container in which the kerosene fuel is carried and a long spout through which the fuel is fed by gravity to the object at which it is directed. Attached to the spout is a tube which holds a cotton wick or taper. This is saturated with fuel.

ignited and thereafter receives a few drops of fuel each time the lighter is tipped to flow the fuel on some object.

Low temperatures caused difficulty in the ignition of kerosene and eventually an ingenious, but unthinking person added gasoline to the kerosene to make it burn more rapidly. The result was disastrous in a number of cases and this type of device is not now in general use for backfire work.

There are many types of gas pipe wick torches which have trailing wicks. The hot wick warms the kerosene as it flows to the ground and ignites the material covered by the oil.

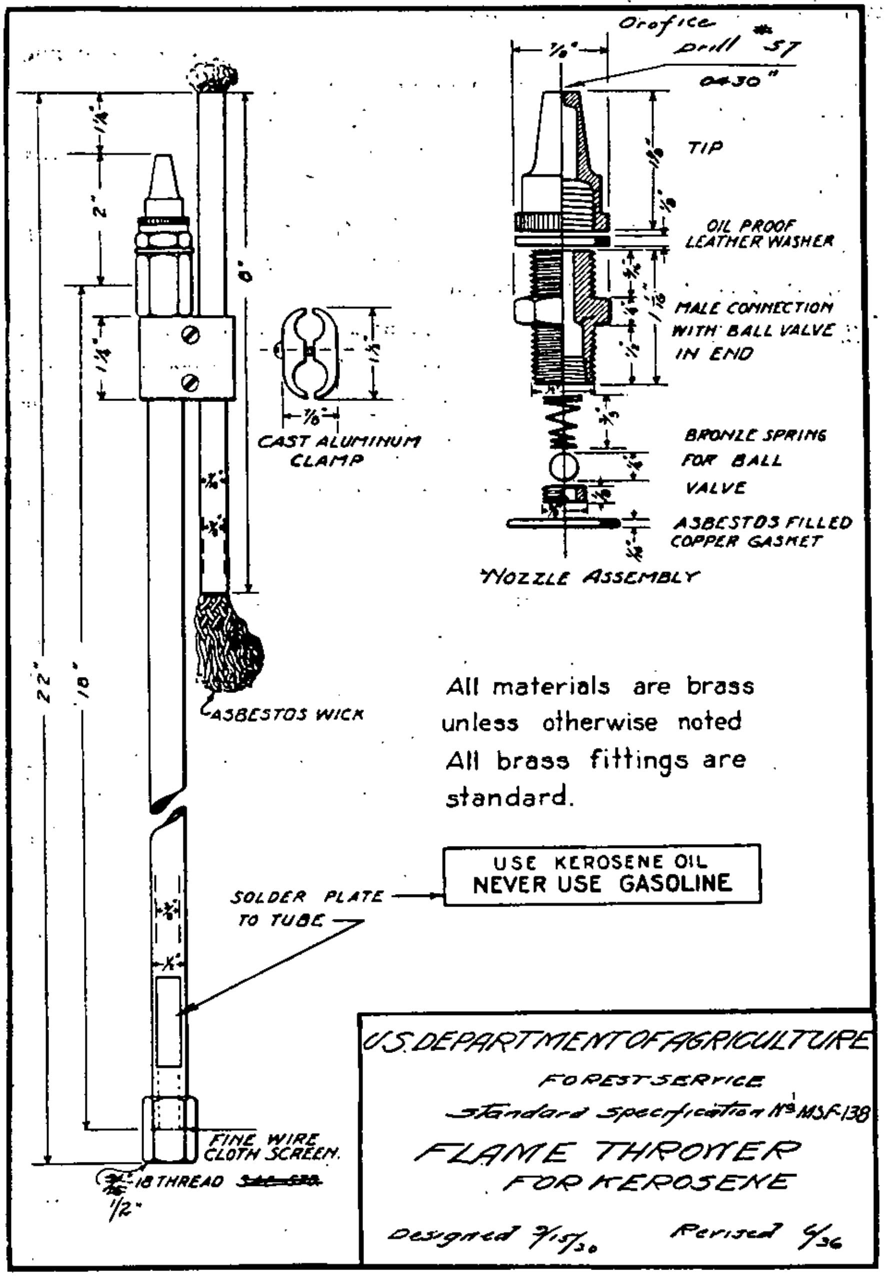
2. In the blast type group are the familiar kerosene torches which are enlarged models of the plumber's blowtorch. The early types used kerosene fuel. Gasoline also could be used in such torches and it is probable that in most cases a mixture of the two fuels was found to be most satisfactory. The troublesome preheating required in torches of this type along with carbonizing and clogging of the orifices in the burner soon caused the kerosene torch to fall into disfavor.

A number of agencies became interested in 1929 in the development of a burner which would handle a liquid gas fuel which, up to that time, was largely waste product in the separation of gasoline from crude oil and wet gas drawn from oil wells. The application of this type burner to backfire operations was sponsored by Region 1 of the Forest Service in 1931 and many outfits of this type are now in use. As compared to the kerosene torch, the preheating troubles are eliminated; one container of fuel will outlast many times its volume in kerosene and deliver approximately twice the amount of heat. The fuel is cheap. Performance of the burner is reliable and it is not affected by low temperatures.

3. The Flame Thrower is a device developed in the California Region by the Forest Service. It has been patented by the Forest Service and is dedicated to the Public.

The Flame Thrower attachment consists of a tube having a ¼-inch iron pipe thread on one end which will fit the Indian and Forester type pump furnished with standard back pack outfits. The fuel used is kerosene, saw oil, Diesel oil and fuels of similar grade. Gasoline should never be used with this device.

The fuel is passed through a check valve on the pressure stroke of the pump which causes a definite type of turbulence in the oil. This is collected in a specially designed chamber in the nozzle so that the fuel leaving the orifice consists of a solid stream surrounded by a fine wall of oil vapor.

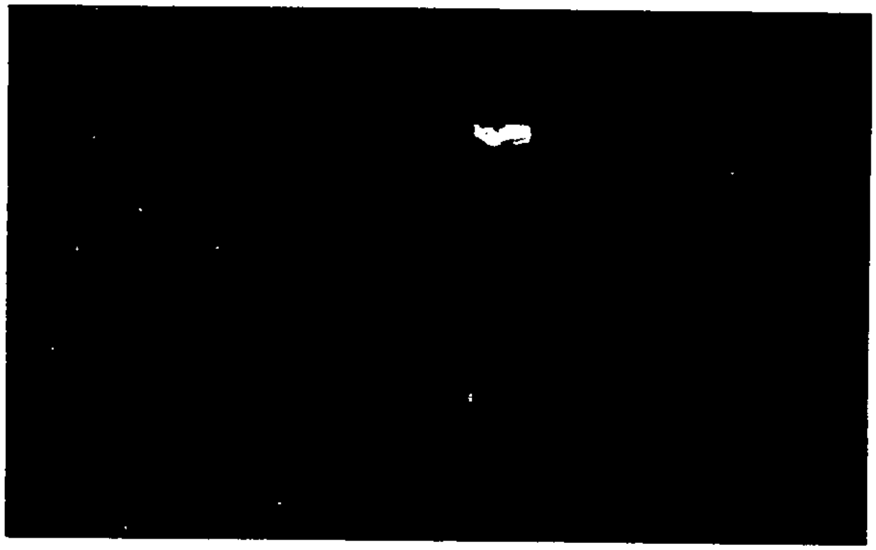

Orofice drill #57 .0430"
TIP
OIL PROOF LEATHER WASHER
MALE CONNECTION WITH BALL VALVE IN END
BRONZE SPRING FOR BALL VALVE
ASBESTOS FILLED COPPER GASKET
NOZZLE ASSEMBLY
CAST ALUMINUM CLAMP
ASBESTOS WICK
All materials are brass unless otherwise noted
All brass fittings are standard.
USE KEROSENE OIL
NEVER USE GASOLINE
SOLDER PLATE TO TUBE
FINE WIRE CLOTH SCREEN.
18 THREAD
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Standard Specification No. MSF-138
FLAME THROWER FOR KEROSENE
Designed 7/15/30
Revised 4/36

Attached to the upper end of the flame thrower is a bracket which holds a taper or wick tube in place. The end of the tube should be approximately 1½ inches beyond the nozzle tip and the wick should overhang the tube the same length.

The back pack outfit is prepared for use by filling it with fuel and pumping through sufficient oil to saturate the wick. The wick is ignited and the pump is operated in the usual manner. On the pressure stroke of the pump the oil vapor surrounding the oil stream is ignited and carries fire with the projected oil to a distance of approximately twelve feet with considerable unburned oil reaching the objective. The wick should be held below the nozzle so that the last few drops passing through the nozzle will keep the wick saturated. If there is a strong wind blowing it will be necessary to hold the wick against the wind so that the flame from the wick will cross over the projected oil stream.

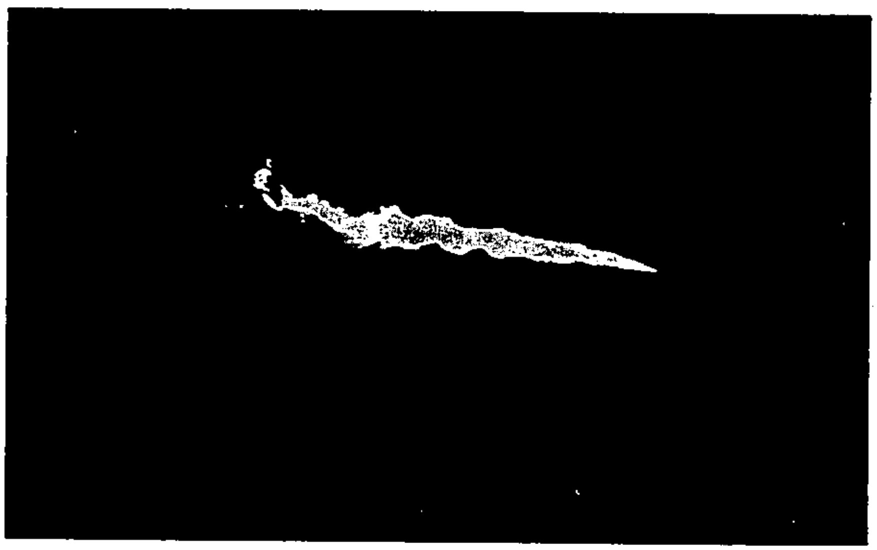
The oil is used cold and there is never any heat present at the nozzle tip except that supplied by the wick. As a safety measure, the oil is cut off at a pressure of approximately five pounds and will not leave the nozzle until a greater pressure is supplied on the compression stroke of the pump. A strainer in the base of the tube removes foreign matter from the fuel. The purpose of the long tube is to place the nozzle a convenient distance away from the operator. While the flame created does not approach the nozzle closer than six inches, the radiated heat from the blast is intense and it is more practicable to keep the operator at a distance for comfort.

A Comparison
The Flame Thrower vs. The Blast Type Torch



The above view is a night photograph which illustrates the difference between a propane torch flame and the lighted wick of a flame thrower.

The propane torch will be readily recognized as the lower flame. Distance from camera—10 feet.



Flame produced by the flame thrower on the pressure stroke of the pump. Distance from camera—40 feet.

The above views show the dispersion of the flame when directed to ground. Distance from camera—35 feet.

The blast type torch creates a small volume of high heat; the flame thrower a large volume of comparatively low heat.

In any igniting or firing device, if ignition temperature is reached, it would seem that all that is required has been accomplished. The development of excess heat is wasteful and the propane torch will develop temperatures well over ten times that necessary to fire ordinary forest fuel. A concentrated but high heat will burn the material near it but has little effect several feet away from the flame. Obviously then, the material must carry the fire from the point of ignition.

Practically every Forest Officer has experienced the following situation: Elaborate preparation has been made during the night in order to burn out a line in the early morning hours. Due to a sudden shift of wind during the night atmospheric changes cause the humidity to rise and the indirect method of attack leaves the Fire Boss with large islands or patches of unburned material between his control line and the fire. His problem must be solved on the basis of time within which control must be effected. He has the choice of resorting to direct attack to clean out the line left by the fire or attempting to burn out the intervening strip. The line left by a fire under the condition described usually is ragged and of large perimeter. It is seldom that sufficient man power is available to directly work the line within the limit imposed by burning conditions. The alternative is to burn it out.

Analyzing the situation:

1. There is a condition on the fire where the ground cover, whether it be brush, needles, leaf mold or other fuel refuses to burn due to increased humidity.

2. There are not enough men to work the fire line directly and complete the job before the heat of the day will change the condition and cause the fire to again advance.

3. The solution to the problem is in judicious use of efficient back-fire equipment. This interjects the question, "What is efficient back-fire equipment?"

4. "Efficient back-fire equipment" is defined as that which has the ability to create a fire in standing or down forest fuel under adverse burning conditions.

Under the situation as outlined it should be obvious that a blast type torch is no more efficient in starting a fire to burn out the area between the fire line and the control line than a cedar bark torch or wick type burner.

The volume of flame is entirely too small to change the condition in the immediate vicinity of the torch with the result that the only cover burned is that to which the torch is directly applied. If this fact is accepted foresters must also reconcile themselves to the idea that the blast type torch is a *convenient* method of starting back fires when burning conditions are such that fires will spread. In most cases it is a convenience only since, when fires readily spread, the forest fuel can be ignited equally well with matches or other burning material. It is only when speed is required in starting a long line of back fire that the blast type of torch can be considered a necessity.

When burning conditions are such that fire will not spread in forest fuel, it becomes necessary to change the condition at the point where the fire is to be started. With the flame thrower this can be accomplished in two ways:

1. By applying sufficient heat and flame to remove the surface moisture from the forest fuel, causing it to burn.

2. By projecting fuel oil after ignition of the cover and thus firing it.

The choice of method must be dictated by local conditions.

The flame thrower has been criticised in the past as being a heavy fuel consumer. Perhaps this is true in many cases but it should be borne in mind that when conditions are such that it becomes necessary to apply fuel to create fire, the objective in time and work to be done should be sufficient justification for the means with which it is accomplished.

The flame thrower will completely defoliate standing brush and ignite the ground cover. It will start crown fires in standing reproduction or other fuel which is of a density to carry fire once started. After fire has been started in standing cover it is more convenient to extinguish the wick and project vaporized fuel to the burning material. The fine particles of fuel breaking in contact with the standing cover develop an intense heat which the operator cannot withstand for more than a few minutes at a time.

The device permits firing of relatively large areas of standing material in a comparatively short time but it requires fuel to do it. Basically, it is a question of whether the expenditure of fuel is worth the saving in time and the accomplishment of the objective. It can be stated that a five-gallon can of oil will last approximately the same length of time as a five-gallon can of water in the conventional back pack outfit.

The flame thrower is useful for many purposes other than back-firing.

Burning green cut slash on right-of-ways during wet weather is an important application in areas where the fire hazard is great. Many other uses have been found for the device, some of which are totally unrelated to fire protection work.

Flame Thrower Operation

The flame thrower is, in the hands of an experienced operator, a highly efficient tool and can be used with perfect safety. Like any other equipment in the hands of an inexperienced person, the flame thrower can be a lethal weapon. Men of mature judgment and experience only should be permitted to use the device. CCC enrollees should not be permitted to use flame throwers under any circumstances.

Care should be taken that fuel oil is not spilled on the clothing of the operator and that the outside of the container and straps are dry. The danger is not so much from the flame thrower itself as from passing too close to burning material.

Caps on the container should be tight.

Pump packing and hose connections should be tight. Every precaution should be taken to prevent leakage of the fuel oil.

It is hoped that forests which have not tried the flame thrower will attempt a few experiments with it in comparison with regular propane or other type blast torches. The device is inexpensive and can be obtained through requisition on Supply Depot, Oakland, Calif., or jobbers in San Francisco.

PRELIMINARY AIRPLANE DELIVERY EXPERIMENTS ON THE CORONADO

A. M. GARDNER

Senior Forest Clerk, Coronado National Forest

The Coronado National Forest made several experiments in dropping supplies and tools from airplanes in preparation for the possible use of airplane transportation of materials to isolated fire lines during the fire season of 1937.

Experiments were carried out with two planes which had been put under agreement for the season; one a Waco 4-place, cabin biplane and the other a Travelaire 4-place, cabin, high-wing monoplane. The experiments were conducted along lines of those described in the April 12 issue of FIRE CONTROL NOTES, retarders (parachutes) being used for all drops. A total of eleven drops were made, as shown on the following tabulation:

The first four drops were made from the Waco biplane. No difficulty was experienced in dropping the packages from the plane. The door opening directly over the lower wing was removed beforehand and seat cushions were removed from the rear seats. A large step plate is located on the wing at the door. As the plane approached the target, the package to be dropped was rested on the step plate just outside the door. When the target was reached, the package was shoved back off the wing.

The other seven drops were made from the Travelaire plane. The door had been removed from this plane and the packages were rested on the doorsill until the target was reached and then pushed out, there being no wing in the way.

The parachutes used were 7 x 7 feet and 9 x 9 feet, burlap or woolsack material with braided sashcord shrouds tied to each corner. These shrouds were about 18 feet long. Small blocks of wood were tied in the corners to prevent slipping of the shrouds.

The chutes were spread out, doubled once and then folded from the side by an accordion fold, the folds being about the width of the top of the package to be attached. This folded chute was then doubled down to the other dimensions of the top of the package by again using an accordion fold. The shrouds, which are attached to both package and chute, were straightened out and then, all four together, were knotted loosely in a chain stitch type of knot, beginning at the package end, taking up the full length of the shrouds. This "chain" must be loose enough to pull out without any trouble. The shrouds and chute were then doubled up on the top of the package, chute on top, and light-weight cord was used to tie over the chute holding it to the package.

In the plane, a heavy sash cord about 12 feet long was fastened by one end securely to the plane (safety belt fastener in one instance and strut in the other). When ready to drop, the other end of this rope was tied to the light cord which holds the folded chute in place on the package. The package and chute drop together until they hit the end of the rope, where the rope breaks the light cord lashing the chute to the package, and releases the chute. The rope is pulled in and tied to the next package.

Two chute failures occurred. The first one, folded as described in the April 12 article, failed to open completely and the package was damaged. The second failure, drop No. 8, was due to the cord lashing the chute to the package being too strong. The rope fastened to the plane broke instead. This method of discharging the packages greatly simplifies the job of the dropper. There is little danger of the chutes becoming entangled with the control surfaces of the plane as the chute is released full length of the rope away from the plane and directly beneath it.

With the exception of the first two packages, which landed from 100 to 150 yards from the target, all the drops landed within about 50 yards of the target. The following is a tabulation of the packages and the results of the drops on April 29 and May 1, 1937:

Drop No.	Ht. Ft.	Appr. Wt.	Chute Size	Package	Results
1	650	30 lbs.	9′ x 9′	Small box packed inside powder box, to approximate fragility of type "S" radiophone (eggs, etc.).	Chute failed to open completely, eggs and light bulbs broken. Ink bottle and box OK.
2	650	54 lbs.	7′ x 7′	Four 1-gallon canteens packed in horseshoe keg, stacked on sides, excelsior in bottom of keg.	Chute opened OK but impact of landing forced caps off two canteens, losing contents.
3	800	30 lbs.	7′ x 7′	Same package as No. 1 except eggs and bulbs were not replaced.	Chute opened OK and package landed without damage.
4	800	45 lbs.	7′ x 7′	Same package as No. 2 except canteens were packed upright.	Chute opened OK and package landed without damage.
5	200	30 lbs.	9′ x 9′	Same package as No. 1 with two radio tubes in package.	Chute opened OK and package landed without damage.
6	200	40 lbs.	7′ x 7′	Five-gallon canvas water bag filled with water, inside burlap sack.	Chute opened OK and package landed without damage.

7	200	50 lbs.	7' x 7'	Six I. h. r. p. shovels wrapped in canvas.	Chute opened OK and package landed without damage.
8	150	60 lbs.	7' x 7'	20 cans vegetables in wooden box.	Chute failed to open. Contents demolished except four cans dented but retaining food.
9	150	40 lbs.	7' x 7'	Same package as No. 6 with same water.	Package landed without damage.
10	150	50 lbs.	7' x 7'	Same package as No. 7.	Package landed without damage.
11	150	30 lbs.	9' x 9'	Same package as No. 5.	Package landed without damage.

Communication between plane and ground was maintained by means of two Type "S" UHF Transceivers. Considerable difficulty was encountered in receiving in the plane due to the open door and the roar of the motor and it was necessary to cut the motor to idling speed in order to understand the transmissions of the ground set. The transmissions from plane to ground, however, were all received in fine shape.

It is believed that with the experience gained from these tests the Coronado should be able to make dependable emergency delivery of supplies to inaccessible fire lines within an hour or two, which would otherwise require a very much longer time.

THE LOOSE AXE-HANDLE BOGEY

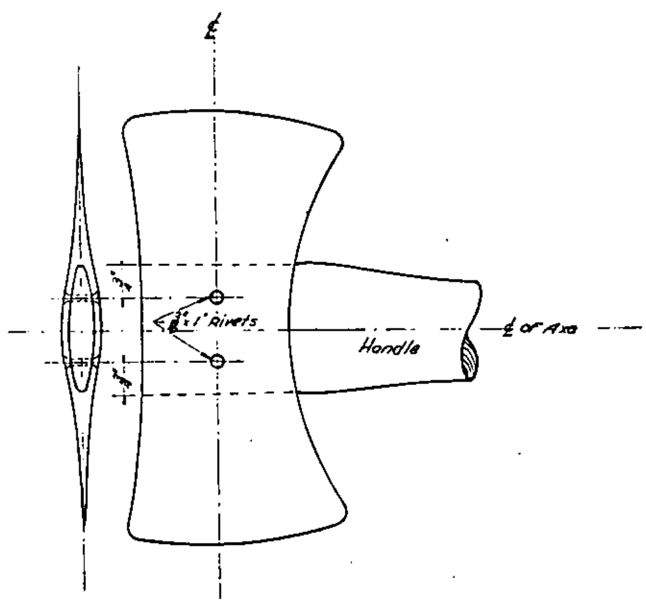
Fred W. Funke

Fire Equipment Specialist, Region 5

Much has been written on the subject of tightening loose handles in axes. Various methods by which handles can be made permanently tight have been suggested. Treatments recommended usually require immersion of the axe and handle in special compounds, boiling in linseed oil or other solutions. After all the years, however, loose handles are still a problem.

An analysis of the problem indicates that most of our thinking has been concentrated on a remedy for a condition, rather than an investigation of the cause. Knowing the cause, it should be possible to devise a control which, while not complete, would be effective in a practical sense.

Why not dig into the problem a little more deeply? An axe handle as received from the manufacturer contains a variable degree of moisture. One shipment might contain a high percentage of moisture; the next a lower amount. In short, there is little uniformity, and while it is true that handles of a given grade and quality are supposed to have a stated maximum moisture content, it is safe to assume that in handles supplied to the trade this will vary over a rather wide range. Even if the handles furnished were reduced to the maximum moisture content acceptable to a particular buyer, subsequent storage in a moderately damp location would cause the handle to absorb moisture above the percentage which the handle contained when received.



Wood is hygroscopic; that is, it will absorb moisture from the atmosphere when its moisture content is less than that of the surrounding air. It will return moisture to the atmosphere when the air is less moist than the wood. In absorbing moisture the wood cells expand; and alternately, drying causes shrinkage. The alternate expansion of the wood structure as it absorbs moisture and shrinking as it dries out cause no particularly harmful effect unless the wood is confined under pressure as is the case in the eye sheath of an axe. Under such conditions there is a partial crushing of the cell structure with each cycle of expansion and contraction, until a partial permanent set takes place in the wood. A loose handle in the axe is the result. Rewedging of the handle is a temporary remedy only since the process continues and eventually the axe handle again becomes loose.

The normal method of tightening an axe handle is to insert a soft wooden wedge. This action produces a springing effect in the head and sets up a heavy pressure between the inside face of the axe eye and the wood of the handle. Properly hung and wedged, handles should remain tight and would do so but for the hygroscopic quality of the wood.

Now; if, instead of producing an expansion effect in the wood of the handle by wedging, a compression effect is introduced from the outside of the axe eye, the same result will be attained and also a method of tightening the axe is provided which is much more practicable than rewedging.

The method consists of drilling $\frac{3}{16}$-inch holes through the axe at two points approximately ¾ inch in from the edge of the eye along the center line of the axe, countersinking each face and inserting $\frac{3}{16}$ x 1-inch, countersunk-head, steel rivets. In setting these rivets in place a normal sidewall pressure is exerted on the axe eye which will lock the handle in place. Wedging the handle is not necessary. Should the handle become loose in service it is necessary only to hammer down the rivets a little more closely to restore the sidewall pressure on the eye and tighten the handle. Riveted axes will never rock on the handle and will not fly off. On the forests which have tried the method, no difficulty has been experienced in removing the rivets for rehandling.

This particular idea has been tried with considerable success on the standard Forest Service brush hook, and thus far there is no record of loose handles in such tools. It is hoped that the field will find the idea of sufficient interest to try it out during the coming season and, if found to be of value, to so report through regular channels with a recommendation for adoption of such a requirement in axe purchase specifications.

DEVELOPMENT OF THE BOSWORTH TRENCHER

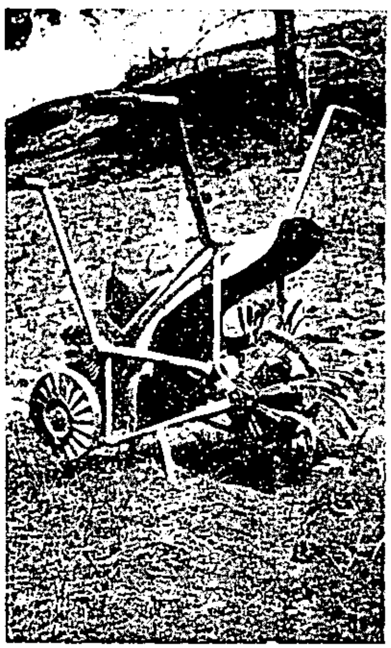
C. S. CROCKER

Fire Inspector, Region 1

The attempt to develop a machine which would build trench through the action of a rotary brush has received previous brief mention in FIRE CONTROL NOTES. This is the first progress report on the project.

The idea for a trench-building power-driven brush came from J. H. Bosworth, Assistant Supervisor on the Kanisku Forest. Construction and experimental tests are handled by the Regional Equipment Committee.

One machine has been assembled, largely from material salvaged from junk piles and nondescript gadgets picked up at random. Bicycle frame tubing built the chassis. An air-cooled outboard motor provides the power; an automobile fan belt transmits the power to the brush. The working model, completely equipped and fueled, weighs 60 pounds. When the handles and fuel are removed, the weight is roughly 50 pounds. It is designed for back pack transportation.



Two views of the power-driven rotary brush.

Recent tests indicate that the principle of brushing out a trench is practical. It eliminates excess depth and extra width usually found on hand-made trenches. It eliminates the pile-up of debris immediately inside the trench. The brush scatters light fuels over a distance of 4 to 12 feet inside. If desired, by deeper trenching a layer of dirt can be evenly distributed or concentrated on spots within this distance.

The present model lacks the power necessary for fast construction in heavy sodded or matted duff. New machines will be powered with larger motors if it is possible to purchase or build air-cooled engines of the required power within weight limitations.

In yellow pine, lodgepole, and grass type fuels the present model builds a trench 8 to 12 inches wide at the rate of 2,000 feet per hour, requiring the use of two men. This is at a rate of 15 chains per man-hour. It is expected that the proposed power increase will raise this production 50 per cent.

Difficulty to be overcome, other than power set-up, is largely confined to obtaining a brush which will withstand the severe use. Spring steel, cushioned in crepe rubber, is used at present. The field is being canvassed for other types. Another alteration will change the handles so that one man will not need to travel backward.

A brush trencher of wheelbarrow type, to be a one-man machine, is being designed and will be reported on later.

Two more units similar to the one illustrated are being built to be put in the field for testing on actual fires this summer, and a report of these experiments will be made through the NOTES at the close of the season.

Aerial Control in Russia—Planes are also utilized for extinguishing steppe fires, which are a serious menace to pasture land. An illustration of this danger is the fire which occurred two years ago at the Nishan Persian Lamb State Farm in Uzbekistan during which 58,000 acres of the best sheep runs were destroyed. Ordinary methods of fighting the steppe fire are not very effective, while scattering caustic soda from a plane has proved very successful. A ton of caustic soda is enough to form a protective belt stretching for five kilometers.—*Quoted from* MOSCOW NEWS, *Moscow, Russia.*

WATER TRANSPORTATION BY TRUCK

ARTHUR M. EMMERLING

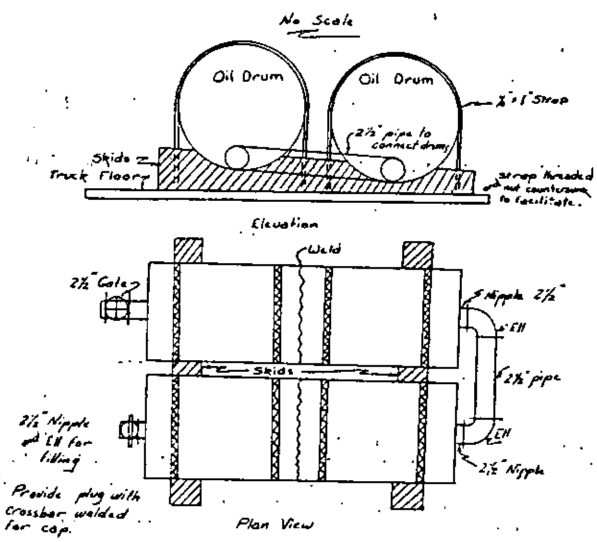
Project Superintendent, Manistee National Forest

A satisfactory truck tank can be made from four oil drums and if properly arranged will prove acceptable in replacing some of the present water containers.

The attached sketch illustrates a tank constructed from four 55-gallon oil drums (not Sinclair) welded together in a double hook-up, giving a capacity of 220 gallons. It has a single inlet and outlet. Back-pack pumps and pails are easily filled and a hose may be attached.

The tank is stationary, but it is not difficult to transfer to another truck when empty. Seats may be built over the top or a platform constructed so as to haul additional fire equipment. Undoubtedly the life of this tank will be considerably longer than any of the present water containers used on the forest.

SKETCH OF OIL DRUM WATER TANK



Capacity 220 gals.

QUESTIONS AND ANSWERS

Suggestions have been made that a Question and Answer column might **become an enlivening and perhaps** provocative feature. We are inclined **to give it a try and here are four** leading questions sent in from the field. **More are invited. They can be signed** or unsigned. Unlike most such col**umns the Editors will not answer** the questions. That is a function it **is hoped the subscribers will perform.** Answers which throw light on **these questions will be welcomed** and published. Please keep them short.

1. How do lookouts discover fires? Is it by casually looking over a familiar scene with a subconscious thought of noting any unfamiliar object? Or, is it by carefully searching out every nook and cranny of the surrounding terrain with both mind and eye constantly on the alert for smoke of unconsciously preconceived dimensions, color and shape?

2. What is the annual cost to the Forest Service, not only in dollars, but also is loss of time and performance efficiency due to the use of ostensibly inadequate specifications, and to the lack of standardization of specifications for equipment items of inter-regional use?

3. Is it possible to develop super-intelligent fire dispatchers, who, through exceptionally intensive training plus the necessary background of diversified fire control experience, can perform adequate fire dispatching at all times and under all conditions, without the aid of fire weather, fire behavior, fuel type, manpower, transportation guide charts, tables and other dispatching devices, many of which at present lack considerably in satisfactory precision and accuracy? If so, is it practical and how may it be done?

4. Assuming that fire control must carry on with the average dispatcher and that basic information readily available and in usable form is necessary to insure adequate performance, pertinent to what basic factors must reliable information be provided? How can it be obtained? How should it be prepared in order to be in readily usable form?

CALIFORNIA SUPPRESSION TRUCKS

Merritt B. Pratt

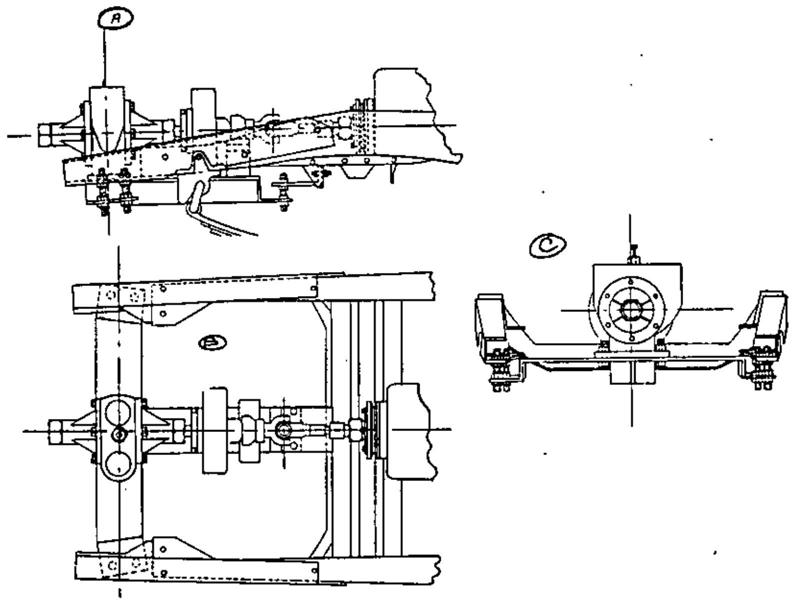
State Forester, California

Tank trucks are always a live equipment subject, and improvements are constantly being made both by the Federal and the State forestry agencies. In California particularly, there is much such activity and the State Forester here describes what appears to be a very nice job.

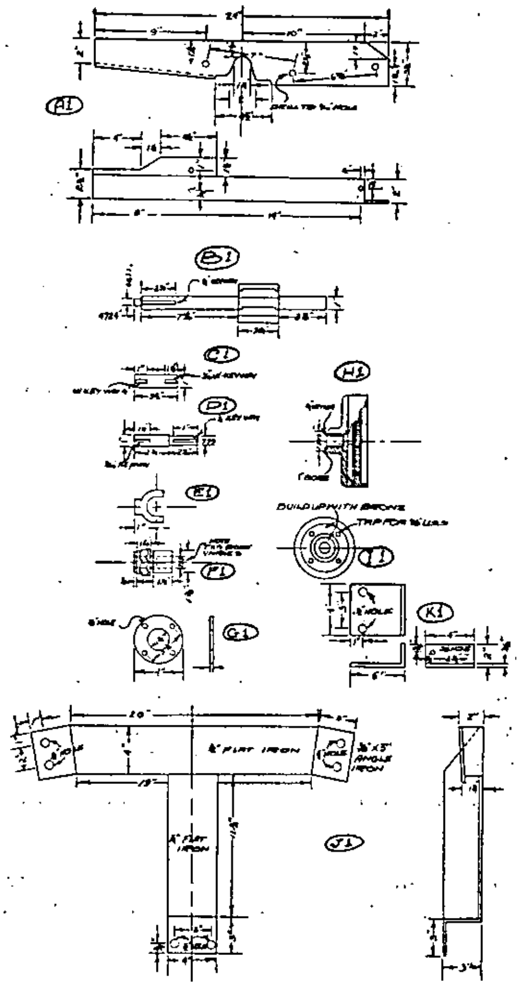
The tank truck that is finding most favor with the men in the field is a unit designated as a "suppression truck" built for combined use as tanker and as a transportation unit to carry suppression crews not exceeding ten men.

The latest trucks have been equipped with the Hercules Roller Type Pump, Model 6-A, mounted on the front end of standard makes of 1½-ton trucks, 131 inches wheel base, low gear ratio differentials and oversize radiators, with a steel express body. The pump is driven by fastening a flanged, hydraulic-type universal joint to the fan pulley, extending a short shaft under the radiator and connecting to another universal, both joints

HERCULES TYPE "6A" WATER PUMP FRONT END MOUNTING FOR 1935 AND 1936 CHEVROLET 1½-TON TRUCK



A Side view showing complete mounting
B Top view showing complete mounting
C Front end view showing complete mounting



A1	Frame extension showing holes and cut-aways
B1	Rotary and shaft showing key-ways and pilot bearing end
C1	Pillow block shaft showing key-ways
D1	Universal Joint shaft showing key-ways
E1	Face one end of universal joint; use No. 6857-7-SE spicer joint
F1	Garwood joint 15/16" bore face of female end and weld to plate G1
H1	Use No. 3A Diamond "D" Friction clutch
I1	Build up crank shaft pulley with bronze and face
J1	Pump frame; weld angle iron to flat iron
K1	Cross-member plate

being held in line with the crank shaft by a pillow block bearing placed between the front joint and the clutch. A Model 1 A Diamond D cut-off clutch is used with the control lever entering the cab between the left door and the steering column.

The mounting used to carry the pump, clutch and pillow block bearing is constructed of two ⅜ x 2 x 3½-inch angle irons that are bolted to the front end of the frame from a point back of the radiator to the tip end, from where they extend ahead six inches beyond the frame, the bumper being fastened to the end of this mounting. The part extending beyond the frame has a piece of iron ⅜ x 3 inches welded to the angle making a channel. A cross piece ½ x 4 inches is fastened to each side by means of two ½-inch studs with nuts on each side of the channel and the cross piece to allow adjustment up or down. Another piece of iron is welded to the back edge of the cross piece and extends back to the front cross member where it is fastened to a bracket in the same manner as the cross piece, to allow for an additional adjustment to give the pump perfect alignment with the crankshaft.

There is a suction and discharge connection on each side of the pump with the necessary piping running back to the rear of the cab, where additional suction and discharge connections are placed on each side of the truck, the suction side extending under the tank where a valve, controlled from the left side of the truck, may be closed to allow for drafting from outside sources. The discharge side enters the tank at the top through a 1½-inch valve for filling with a 1-inch lateral going to a 300-foot-capacity live reel mounted on top of the water tank and parallel with the bed of the truck.

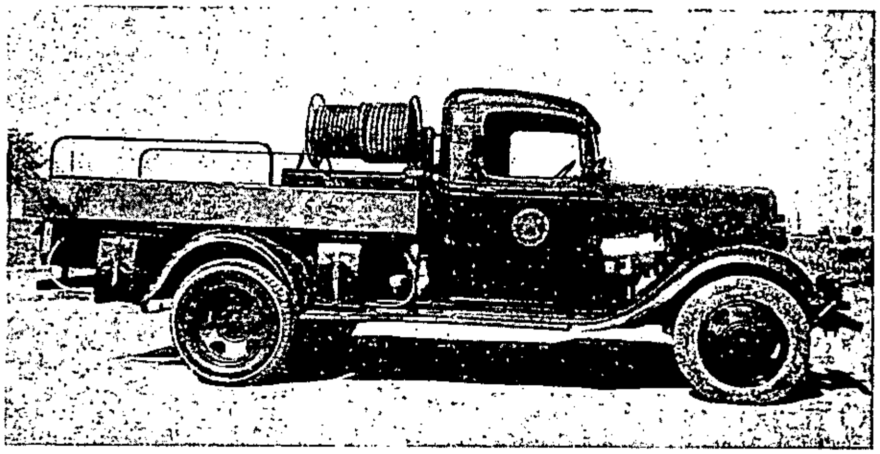
The tank is approximately 45 x 39 x 24 inches high with a capacity of about 190 gallons. The last tanks built were of 14-gauge, black iron, welded with baffles running both ways. After welding the tank is treated with a rust-proof compound.

Back of the tank, on each side, is placed a combination tool box and seat, 66 inches long, 18 inches wide, and 20 inches high, the cover being upholstered. A pipe railing is placed back of each box as a back rest. Two additional boxes are built to fit the outside of the body, full length, 10 inches high and 10 inches deep. On one side three lengths of 2-inch suction hose and necessary adapters, spanners, etc., are carried, and on the other side 500 feet of 1-inch cotton hose. Four back pack pumps are carried, two on each side.

The pressure gauge is mounted on the dash, and a lead taken off through a valve to the cooling system of the engine. An extra overflow pipe is installed to prevent any chance of rupturing the radiator.

Our patrol cars (pick-ups) are equipped with the same size pumps, and piped the same as the suppression trucks but using a 50-gallon tank with the reel mounted on top and a smaller number of hand tools. All pumps used on the patrol cars to date have been the number two Viking driven from the transmission, but in the future it is expected the front end mounting which gives a constant pressure that is lost on the transmission hookup whenever it is necessary to stop or shift gears will be used.

Our straight tank trucks have all been of a capacity of from 235 to 275 gallons, the tank setting close to the frame, and of a dimension the same width and length of the frame back of the cab. Tool boxes are mounted the full length of the tank and are 12¾ inches high by 13 inches wide, and are mounted so the bottom of the box is even with the top of the tank, thus forming a hose rack on top of the tank that will carry 500 feet each of 1-inch and 1½-inch cotton hose.



Right side view of 1936 Suppression truck built by California Division of Forestry.

The reel is mounted at the front and above the tool boxes. The suction hose is carried over the fender. A full width rear step is provided and allows for the mounting of two pack pumps and one back fire torch, two additional pumps being carried on the running boards.

The piping arrangement is the same as on the suppression truck, with the exception that there is a suction outlet at both the front and back of the tank with a three-way valve to allow closing either or both of the outlets. A float valve is being developed to be used on the inside of the tank which will close either opening when the water is too low on that end of the tank when on an incline. One gate valve will be placed in the line to shut off the supply from the tank when drafting. This it is hoped will eliminate some trouble experienced with the three-way valve.

Another feature that is being embodied in the tank trucks is a foot-valve on the end of the overflow that opens to full capacity when the valve is opened for filling the tank from the pump. This eliminates the possibility of rupturing the tank from pressure. The tension is so slight that the valve will automatically open if there is a vacuum, which prevents collapsing the tank, and while on the road prevents any loss of water from the tank. Some trouble has been experienced from skidding on turns when the overflow was open at the front end due to the surge and the water being deposited ahead of the rear wheels.

THE "ONE LICK" METHOD ON THE CHIPPEWA

CHIPPEWA NATIONAL FOREST

The principle of the One Lick Method is receiving more and more application and shows signs of turning up something revolutionary in fire line construction practice. This record of comparative results comes from a Ranger District on the Chippewa and is a spur to more rapid development of a most promising technique.

The method used is that described in the article on page 23 of FIRE CONTROL NOTES of December, 1936, with some modifications. The system was discussed somewhat on this Ranger District in 1936, but since we were fortunate in not having fires of any size, the system was not tried out until this spring.

The factors which influence the line organization are as follows:

1—The number of men available.

2—The type of cover.

3—The ground condition. (Rocks, peat, heavy roots, etc.)

4—Intensity of the fire.

In aspen-brush type with sandy soil, our organization has been about as follows:

Men	*Tools*
1 "trail blazer"	cruiser axe or machette
2 men	one cross-cut saw
5 men	brush hooks, preferably the finn type
10 men	long handle round point shovels
1 man	mattock
1 man	back fire torch
2 men	back pack pumps
2 foremen	no tools

This size crew was timed during the spring fire training. The crew at that time made 18 chains of line through medium heavy aspen-brush type in 20 minutes. The control line was cut and cleared 8 feet wide, and the trench was dug half a shovel deep and two shovels wide. The length was measured with tape—not pacing. On inspection, the line was found to be quite uniform except a few places where a finishing touch was necessary. The two foremen were used to coordinate the work and see that the men moved on at a uniform pace. They had to move on a "trot" in order to be useful. On a well-trained crew, one foreman behind the line might be sufficient.

We have not done any special timing on our fires, but we have used this same organization with some variations. When we review the accomplishments with those of last year there is a distinct difference. The number of man hours spent in constructing a safe line around the fires after corralling has been cut in half.

On the Amen Lake fire of this year not over 35 man hours were used to build a safe line around a 4-acre fire—25 chains. On the North Boundary fire of 1936, we used at least 90 man hours to construct a safe line around a 2.8-acre fire—43 chains. The ratio is almost two to one in favor of this year's accomplishment.

On the Big Fork fire of this year we used 54 man hours to construct a safe fire line of 50 chains. On the South Suomi fire of 1936 we used at least 120 man hours to construct a safe line of 67 chains. The ratio here is also 2 to 1 in favor of this year.

The results on these fires may not be exactly comparable, but every effort was made to pick comparable conditions.

The one lick method is difficult to use without prior training and it takes much energy out of the men. During the spring training, all the overhead on the district took their turn at the work in the line. It was agreed that four would be the maximum number of hours one man could work continuously at such pace.

The system does not increase the need for overhead as had been expected. There is no need for pushing the line. The problem is to keep the men from getting too close to one another and to keep the right proportion between the different tools. It is necessary to trade tools at times or have an extra man carrying surplus equipment.

RECORD OF PREVENTION PROGRESS

REGION 8, FOREST SERVICE

The occurrence of man-caused fires this season on two of the new Forests of Region 8, when compared with last year's record, indicates that prevention efforts are beginning to take effect. This article and tabulation are quoted from the publication of the Texas National Forests and the statistics of the Mississippi National Forests.

What, if any, has been the change in attitude of residents of East Texas regarding burning the woods since the coming of the U. S. Forest Service to that section?

The following is an attempt to present a statistical answer with a minimum of editorial comment. It is well, however, to suggest that the following tables be studied with care, inasmuch as weather conditions and location have decided effect upon acreage, whereas the number of fires offers a surer reflection of the public attitude. Furthermore, more fires are classed as reportable this year than in 1936.

COMPARATIVE RECORD FOR THE FIRST FOUR MONTHS

TEXAS NATIONAL FORESTS

Cause	1936			1937		
	No. of Fires	Private Acreage	Govt. Acreage	No. of Fires	Private Acreage	Govt. Acreage
(Sabine)						
Smokers	7	39.0	55.83	15	25.7	90.67
Campers	6	9.0	18.85	4	35.6	71.8
Debris	2	1.5	89.0	3	5.6	128.5
Incendiary	102	...	2696.36	23	813.2	349.15
Miscel.	2	2121.0	8.0	...	...	...
	119	2170.5	2868.04	45	880.1	640.12
(Davy Crockett)						
Smokers	16	15.16	136.5	13	28.75	18.0
Campers	5	10.0	43.5	...	...	...
Debris	4	44.0	5.0	10	589.0	666.0
Incendiary	9	16.0	220.25	10	22.5	280.25
	34	85.16	405.25	33	840.25	964.25
(Angelina)						
Smokers	63	...	...	12	...	...
Campers	4	...	...	4	...	...
Debris	15	...	...	10	...	...
Incendiary	156	...	...	19	...	...
	238	2932	6686	45	298	228
(Sam Houston)						
Smokers	13	2.0	124.0	8	...	55½
Campers	...	...	...	2	7.0	1
Debris	5	6.0	8.0	1	...	3
Incendiary	7	13.0	139.0	..	...	..
Lumbering	4	0.3/10	...	1	14.0	..
	29	21.3/10	271.0	12	21.0	59.5"
(Total Texas Forests)						
Man Caused	420	5208.96	10,230.29	135	2039.35	1891.87

Comparative Record for First Six Months

MISSISSIPPI NATIONAL FORESTS

Cause	1936 No. Fires	N.F. Acres Burned	1937 No. Fires	N.F. Acres Burned
Railroads	15	....	1	3
Smokers	26	....	38	277
Campers	34	....	6	37
Debris Burners	156	....	31	1613
Incendiary	149	....	92	3102
Lumbering	315	....	20	1150
Miscellaneous	8	....	6	179
	703	17,048	194	6361

(OAKLAND-8-9-37-6,000)

INFORMATION FOR CONTRIBUTORS

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

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

If there is any introductory or explanatory information it should not be included in the body of the article, but stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Text for illustrations should be typed on strip of paper and pasted on back of illustration. All diagrams should be drawn with the type page proportions in mind, and lettered so as to reduce well. In mailing illustrations, place between cardboards held together with rubber bands. Paper clips should never be used.

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