FIRE PLANS FOR FOREST PROTECTION

SUPPRESSION PLAN

Introduction

Fire plans are devices used to assist in efficiently protecting the forests from fire and may readily be divided into four parts. The first part or presuppression deals with the effort in time and money incident to the organization, instruction, management, maintenance, and equipment designed to provide for effective work by guards, cooperators and other agencies depended upon for fire suppression. The second part is suppression which deals with all the work of extinguishing a fire, beginning with its discovery. The third is fire prevention which is the attempt to reduce the fires starting through law enforcement, education, and danger reduction. Fourth is the administrative phase which is the work of managing the above three parts.

The presuppression part has already been covered by a previous paper, and only the suppression part will be dealt with in this paper.

The nature of the suppression phase differs radically from that of presuppression. Presuppression is characterized by being more or less stable and somewhat predictable, whereas suppression, while the outcome is usually certain, the conditions under which the objective is reached are seldom alike. A fire season may pass without a fire and then again the number of fires may vary from few to many. Likewise when combating a fire the conditions are seldom the same. The weather may be hot and the fire spreads rapidly or the weather may be cool and the action of the fire retarded. Likewise wind, fuel, topography, and location all play an important part in the suppression of fires.
The Suppression Plan

OBJECTIVE: The idealistic objective of the master plan for forest fire protection as mentioned in the paper on fire presuppression is to keep point "p" of the Economic or Least Cost Theory to a minimum. Since part of that theory is based on suppression costs the same objective can apply here. Fundamentally the main thing is to get the fire out. Under the Economic theory the speed of fire control would depend on the amount allocated under that theory and would be based on amounts already spent for presuppression and the value of the timber burning. It is plain to see that a fire in valuable timber would receive more attention than one in timber of little present or future value. As mentioned before it is the wealth of data needed that makes this theory inoperative. Likewise the actual objectives of the master protection plan also apply to the suppression phase. One is that all fires be corralled by 10 A.M. of the day following discovery and the other that the burned area must be kept within certain limits of acreage so as to not exceed the amount previously established for that particular area. Both of these point to one conclusion - that the fire must be corralled or put out while still small. A small fire is far cheaper to suppress in time expended, area burned, and men used than is a large project fire. The smaller fire may have a higher per unit of labor and time cost but total cost will be the deciding factor.

CLASSIFICATION: A large fire is usually a small fire that got away, since a properly designed and efficiently operated system of hour control would see that enough men to suppress the fire would be on the fire while it is still small. Whether the fire is large or small the procedure of control is essentially the same and in order that the fire be put out certain definite steps need to be taken. The main differences in action taken on large or fires depends on the emphasis placed on the various steps in the procedure of suppression. On one some of the steps are elaborated, while on the other the same step may be of minor importance. For example, in either case, the sizing-up of the fire is an important step, but on a small fire it may consist of merely a quick "look-over" and a mental check-up of certain details of the fire before actual suppression begins, while on a large fire it may consist of scouting
and sizing up the fire from many angles. With a distinction between small fires and large fires thus explained the classification of the steps in the suppression plan can be listed. Incidentally, action on the first five steps varies little regardless of the size of the resulting fire since most of this action takes place while the fire is still small. Moreover it is somewhat of a routine affair and the action taken generally slips along through well-worn and well-greased grooves as a result of the presuppression activities. The steps used in suppression are as follows:

1. To discover the fire.
2. To find and report the fire.
3. To plat or map-locate the fire.
4. To dispatch men to the fire.
5. To find the fire.
6. To reconnoiter the fire.
7. To attack the fire.
8. To extinguish the fire which includes control and mop-up.
9. To gather data for the records and reports.

The first two are closely connected with the detection agency, the next two with the dispatching agency and the remaining five generally take place on the fire itself. Also the first five steps are here considered as part of the presuppression phase and need be covered but lightly since they were given in greater detail in the presuppression plan.

The first two steps are closely allied, and will be considered together.

1. Detecting, Finding and Reporting the Fire:
   a. Objectives: The objective is practically the same as that of the presuppression phase, namely, to see and report the fire to the dispatching agency with an elapsed time standard previously established and above all while the fire is still small.
b. Classification: Since fires are not always first by the established detection system, fires may be classified into two groups.

(1) Fires discovered and reported by the detection system.

(2) Fires discovered and reported by others.

Usually the one who reports the fire to the dispatching agency is the one receiving credit for having first seen it although he may not have been. For example, a miner may have been first to see a certain fire but because of his isolated position in the back country is unable to report the fire before the detection agency spots the smoke. However, all effort should be made by those responsible for the suppression of fires to have this second class "fire reporting" conscious as they can be a valuable secondary detection system and may if the fire is just beginning do the actual suppressing of the fire and report their action and discovery afterwards. Such cooperation is extremely valuable and money used cultivating it is well spent.

c. Job List: The personnel of the detection system will be considered in the job list phase for the most part since about all others can do is to report the location of the fire in general terms, such as local landmarks. However with the detection system it is different. When the employee stationed on a lookout sees a fire he has a definite job list to complete in reporting it to the dispatching agency. Possibly his job list would be similar to the following:

(1) Legitimate or reportable fire - Here the lookout has to determine whether the smoke seen is from a legitimate cause, such as smoke from a mill or farm house, or if it is a fire upon which action should be taken. The general practice should be when in doubt to report and let the suppression agency decide or discover.
(2) Reporting - The lookout should always give as accurate a location of the fire as equipment furnished will allow him. If he has a firefinder, a compass, or just a map, alidade, and azimuth circle, he should be able to furnish with a fair degree of accuracy the following:

(a) Report the fire by legal description.

(b) Give azimuth reading on fire.

(c) Give vertical angle reading if such equipment is available.

(d) Give location by local landmarks.

(e) Give description of fire as to estimated size, color of smoke and whether the base of the fire can be seen.

(f) Report the direction and approximate velocity (calm, light, etc.) of wind at the fire.

(g) Report type of fuel in which fire is burning.

(h) Report approximate number of men needed.

(i) Report data needed for reports and records such as time sighted, reported, possible cause and name of person reporting.

(j) Report from time to time progress of fire as requested by suppression agency.

(k) Keep record in diary form of all changes in the fire, progress of fire and items relating to it such as telephone calls, radio messages, and personnel movements that come within their jurisdiction.

Usually a form covering most of these items can be used to simplify reporting, since the detection man can fill out his form before sending in his report and the dispatching agency can copy the data down on a similar form as the data is forwarded.
d. Tools and Equipment: Again the personnel of the established detection agency will be considered primarily. Tools and equipment needed will depend on the importance of the position. If the position is occupied for short periods, lasting from one day to a month or more, the equipment may be skeletonized to the bare necessities such as some form of shelter, means of cooking and such things as maps, compass, communication facilities as are needed to report the fires with a fair degree of accuracy. Permanent stations will likely have substantial quarters, good cooking and living facilities, and such precision instruments as are needed to give accurate data. Other equipment such as axes, rakes and fire-tools will depend entirely upon the station, its importance and location.

e. Personnel: The members of the detection system need be chosen with care since it would be desirable to have the most capable men obtainable for each position. No attempt will be made here to enumerate those qualities desirable in the detection personnel since that phase is best handled by the administrators of the presuppression phase, but suffice for now to say they should be fully capable to handle the work assigned to them.

f. Training: In order to see the objective attained each man needs sufficient training to enable him to see and interpret fully the indicators of a fire. This training is best accomplished under the presuppression phase, and would entail special pre-fire season training and supplementary training while on the job.

g. Basic Facts and Records: In this field the detection personnel can do their part by keeping accurate records of all that occurs on a fire as far as they can accurately determine. By this they can enable those in charge of fire analysis to discover better methods of reaching the objective. Pertinent material could be: time of discovery, time elapsed
from discovery to reporting the fire and other incidental data that might be needed from time to time to better understand the nature of the fire.

III & IV Since steps III(to plat or map - locate the fire) and IV (to dispatch men to the fire) are closely connected, they will be considered as one item known as the dispatching agency. The two steps are somewhat allied in that they are usually carried out by the same person or in the same office. But there the similarity ends in that step III is mainly a mechanical operation while step IV is a judgment function. Not that judgment is not required for platting, for in a lightning bust judgment must be used to understand which cross shots are related, but that it is not called forth so much as in dispatching. Here the man must decide, under pressure of time, which is the proper man to send, the best route to be used, to visualize the location of the fire and project that vision to the one being sent, and to determine the follow-up action. A person who can qualify for step IV should have no trouble with the problems of judgment arising from step III. Mainly then the characteristics of step IV will be considered.

1. Objective: Since the fire has now been discovered and reported, the objective here is to take that data, interpret it, and accomplish such action that will insure men reaching the fire while it is still small.

2. Classification: Whereas the detection agency was concerned in the main with fires it discovered, the dispatching agency is responsible for action regardless of who reports it. Since a fire is dangerous regardless of the source of information, the action will be similar in all cases, and the steps insuring this action can now be considered.
3. Job List: The dispatching agency job list would be those jobs which would be most expedient in fulfilling the requirements of the objective. Two main jobs are perceptible, that of map-locating the fire and dispatching men to it. Among these two are intermingled many minor jobs and they might be listed as steps in the process.

a. Preparation to receive Report: This would require that a careful analysis be made, by the one responsible, of the material needed to best handle the data as it arrives. Equipment, such as forms, pencils, protractor, maps and communication system, should be ready for instant use.

b. Receiving the Report: A knowledge of the proper things to use and do is needed so that no time may be lost in recording the data.

c. Platting: To best utilize the time spent in platting the data on the map, the operator should be so familiar with that function that it becomes mechanical. Here judgment is required to interpret the readings and cross shots and whether more cross shots are needed to arrive at a conclusion as to the location of the fire. To best comprehend his findings, a knowledge of the weaknesses of his equipment and method must be had.

d. Use of Additional Helps: Other aids such as photographs, both panoramic and aerial can assist in the locating and visualizing the fire, and deciding the action needed, and who to send. It is probable that as these aids, such as aerial photographs with all their possibilities, are developed they may prove to be of far greater importance than they are to-day. Aerial photographs look as if they might help fill the gap of incorrect decisions caused by a lack of knowledge of the country in which the fire is located.
Weather reports and telegrams are another important aid in making one's decisions in regards to any particular fire. Past experience is probably the greatest aid of all.

e. Dispatching: After the fire is located there comes the job of who to send and how many. Since the objective says the fire must be put out while still small, the dispatcher must make the decision of whom to send. Usually this can be the member of the suppression personnel who can reach the fire first and is best equipped to take action. Whether the dispatcher is to send more men depends entirely upon the circumstances of the case. To assist in his decision he can make use of a more or less mechanical device known as the calculation of probabilities. This device takes into consideration all the factors that might affect action on the fire, but attempts to reduce these factors to tangible figures. It considers first the rate of spread and the objective which states that the fire be controlled by 10 A.M. of the day following discovery, or what will be the perimeter in chains of the fire by 10 A.M. of the day following discovery. To assist in arriving at a decision and to help eliminate guess work the dispatcher needs to have at hand information which will give him some idea of the rate of spread in the area where the fire is. He may alter his finding on rate of spread to conform with conditions prevailing, such as on hot, dry and windy days he might need to increase the rate of spread figure, likewise on cold, damp and calm days the figure might be decreased. The second step in the calculations is the estimated amount of held line that can be constructed per man per hour. Again information is needed at hand to assist the dispatcher in his decision, and such information will be adjusted to fit the conditions. (A fuel-type map, as described under the presuppression plan, gives the basic information required...
in steps one and two and can be of considerable value to the dispatcher). After the amount of fireline that has to be built and the amount that can be built and held per man-hour is determined, the next step is purely mechanical. By applying the rate of fireline construction to the amount of line that needs to be built (dividing step one by step two), the resulting figure will indicate the number of man-hours of labor needed to build the fire-line. Step four is a judgment calculation in which the dispatcher computes the total number of hours of work on the fire-line between the time the first crew starts to work and 10 A.M. of the day following discovery. To arrive at an accurate solution the dispatcher needs to consider the route and condition of travel, time of day and the availability with which men may be secured. The last step consists of dividing the result found in the fourth step into the sum determined in the third step, which will indicate the number of men needed to complete the fire-line in time. As additional information is forwarded, the dispatcher can revise his figures and recalculate the number of men needed. After the number of men has been determined, then arrangements for their tools, provisions (including bedding) and transportation follows. If the presuppression plan has been functioning men, supplies, and transportation can be ordered with a minimum of delay.

f. Follow-up: In order to keep the fire-line construction going smoothly the dispatcher must be aware of the follow-up action needed. Depending on the conditions this will involve sending or detaining additional men, supplies, and equipment. Much of the actions taken by the dispatcher will be based on future information applied to the calculating of the probabilities.
g. Basic Facts and Records: At this point in the suppression agency comes the greatest need for accurate records. Large or small whichever the fire may be, the dispatcher office becomes a clearing house for records and reports. The more complete and accurate the records are the better the opportunity for intelligent analysis of the action taken on the fire. Various methods can be used, but one in which the action of a major nature is recorded should be the base from which to start.

4. Equipment: Equipment needed by the dispatching agency is a service to be performed under the presuppression phase. Suffice to say here that the equipment needed should be that which will best enable the dispatcher to fulfill his duties and make correct decisions. A minimum list might be: a map and protractor so constructed that the data from the detection agency can be utilized with a minimum amount of time lost; pencils and forms adequate, the latter so designed to facilitate rapid use; a competent communication system; and all the aids which can help the dispatcher arrive at more accurate decisions, such as weather data, fuel-type maps, visibility maps, photographs, both aerial and panoramic, and adequate, accurate, up-to-date records of sources of supply—men, provisions, and equipment.

5. Training: Even with a supply of the best equipment available, the dispatcher is handicapped if his training has been neglected. Always keeping the objective in mind, one finds that at least a minimum of training is essential. Some items of this training might be as follows, remembering that the detailed outline would appear in the presuppression phase.

a. Use of the "Calculation of the Probabilities". One cannot expect an
untrained man to take that process and swallow it hook, line and sinker. Immediately, if he has any ability to see beyond the present, arises a question, "How can I fit in the many variables to which it must be adjusted when I am not fully aware of the actions of those variables?" Such problems as the one above can be best handled by training in that particular field prior to it ever being used in the field. Actual problems to demonstrate its use are good with the emphasis placed on how to apply it and how to adjust the variables and not on the mechanics which are relatively simple.

b. Use of Equipment: This phase should be thoroughly understood by the dispatcher since most of it becomes mechanical after a time through constant use. However, equipment in whose use the user is not well trained is wasted effort and money as it will be discarded in times of stress for other methods with which he is familiar. If equipment is worth designing and constructing, then it is worth the additional expenditure to see that whoever uses it is sufficiently trained to understand it. One can go into some dispatcher's office and see articles of equipment about which the operator appears to be somewhat hazy and when asked why it is kept replies that the manuals require it to be there. If equipment isn't worth its salt, then make away with it and keep the process of dispatching as streamlined as possible.

c. Use of Forms: Lack of knowledge in the use of the proper forms is as bad as lack of training in the equipment phase. The proper use of forms can be made a smooth-running affair through proper training. A form should contain space for just what needs to be known, any more cuts down the efficiency of the dispatching action. No attempt should be made here to say what forms should be used, but there are basic forms that can be used in any office and additional ones for
particular localities. The design and number of forms can help make or break the effectiveness of any agency. Here and elsewhere in the suppression plan, Mr. Morgensen's "Work Simplification" plan could be used just as it is being used in the top-flight industries of the United States.

d. Use of Aids Other than Equipment and Forms: Regardless of what the item may be it is of little value to the dispatcher unless he understands its use. This includes Fire Danger Boards, fuel-type maps, the weather reports, fire-plans, etc. The better use of these is understood, the better they can be applied to making properly his decisions on who and how many men to send to a fire.

e. Process of Follow-up: Occasionally after the men have been dispatched to a fire, a mental let-down occurs, and, if the dispatcher is not alert to this fact, otherwise good work is on the road to being lost. Now is the time for him to catch up on those items that during the first rush of getting the fire organization started were slighted. Also the time to check-up and see that all orders have been carried out and that no slip-ups are liable to occur. That food and bedding are following the crews of men, and frequent rechecks with the detection force for last minute data. The importance of this follow-up can not be stressed too much, since much of the later action on the fire depends on it. For the dispatcher to devise himself a check-list of follow-up duties or actions might be a wise step. A person with wider experience than his might assist in the making of the check-list.

f. In Keeping Records: One of the steps in the follow-up technique, the keeping of records, is liable to be slighted during the rush
and bustle of getting action started and by the time they are thought of the information is "cold" and hard to recall accurately. A systematic method of recording pertinent data would be desirable so that none of the important facts will be overlooked.

g. Field Training: The dispatcher needs actual field training in order that he can better calculate the probabilities. Knowing his country will give him a better insight on the burning conditions in any particular area, where the fire might burn and how fast it would get there. Aerial photographs with their possibilities may help compensate for a lack of field knowledge in that he can get a visual picture of the area in which the fire is burning. From them he can also get the best route in, some idea of the topography of the ground, and the particular fuel-type, the latter to double check the fuel-type maps.

h. Training in Teaching: A few problems are bound to arise between the detection force and the dispatcher, and it appears that it would be better if these difficulties were all ironed out before one of them arose during an actual fire. Through a proper educational course the dispatcher can discuss the problems that are likely to arise and reduce the number that could disrupt or retard action on a fire. In order that this be done the dispatcher needs training in what is likely to go wrong and the best methods of presenting the problem to those he depends on for his reports.

6. Personnel: Obviously the man needed for the dispatching position is one of far more training and experience than those needed for the detection system. Qualities desired in the man would be numerous, but those which stand forth are: ability to form decisions rapidly; to some extent foresee what is likely to occur; judgment in taking care of details in order of their priority; stick-to-it-iveness; and the ability to work with men.
7. Basic Facts and Records: The items to be gathered as basic facts and records have been indicated from time to time throughout the discussion on dispatching. A summation of them might be as follows: elapsed time from time lookout reported fire until first man was on his way to it; reasons for any abnormal delays; who notified to go to fire; any costs incurred incident to dispatching; number of men and the time of their departures; supplies ordered and equipment used; and any suggestions of improvement. All of these will help on future fires to reduce costs and speed up the action of getting the fire while it is small.

V. Step V, finding the fire, is a situation that can be considered alone. It is a distinct step and is the last one under the jurisdiction of the presuppression phase. Usually the process is concerned with but one thing and that is finding the fire. Whether the fire is large or small, the main thought is to get to the fire as quickly as possible so that action may be taken on it before it gets too large for the initial crew to handle. Whether one man goes alone or is accompanied by a crew the action or steps taken to find the fire are essentially the same.

1. Objective: Whereas the objective of the detection system is to see the fire while it is still small, the objective here is to find the fire while it is still small.

2. Classification: Fires may be readily divided into two main classes: those which have been positively located before anyone has been sent, and those which the location is uncertain. Since all that is necessary in the first group is to get to the fire as quickly as one can safely, then it is the second group that needs consideration. Should a fire, whose location was thought to be certain, be hard to find then it automatically falls into the second group.
3. Job List: The main item on the job list is a repetition of the objective -- to find the fire. This may be broken down into several parts.

a. To get down on paper or have firmly fixed in his mind all the pertinent data needed to find the fire before he starts.

b. To have ready all the equipment that will be needed in finding the fire, such as a compass, or a map, and be sure they go with him. His car, horse, or whatever means he uses for travelling need be in readiness for instant use.

c. To have planned beforehand what route he would use to reach any particular area and then use it when the time comes.

d. To travel at a speed that will get him there both quickly and safely and yet have a reserve of energy to use in extinguishing the fire once it has been found.

e. To use the method of fire-finding best suited to the particular country or situation in which he finds himself.

f. To not hesitate to seek further information should such action be to his advantage in finding the fire quicker.

g. To know his country until he is familiar with the trails and routes of travel so that when the time comes he will know whether cross-country travel to a certain fire will be better than sticking to the trail or vice versa. Such information he can secure by doing trail work in the area, by studying maps and photographs (both aerial and panoramic), and through interviews of people familiar with the area.

4. Equipment: The actual equipment needed to find the fire is not very much, with the exception of his means of transportation. It will probably be a small part of his load since his fire-fighting tools as a rule are bulky and heavy in comparison. Every piece of the following equipment is not an essentiality, but a smokechaser so equipped is in a
better position to find the fire quickly and to give better reports after it is found.

a. Transportation Means: May consist of an automobile, horse, motorcycle, or just afoot. In any case the latter is usually used in combination with the other three and the smokechaser who has to "hit the dust" will see that his wearing apparel is in its best shape so that he will not be slowed down.

b. Communication Means: Best is a lightweight portable radio or telephone and the use of the one best suited to the occasion. Obviously a portable telephone would be of no value in an area where no telephone lines exist. Such equipment gives the smokechaser an opportunity to recheck his data should he get into difficulties.

c. Route of Travel Aids: A compass and a map are the essentials of this type of equipment. With them he can check his location. The compass if easy to operate and fairly accurate should give good results and maps showing all trails, waterways, creeks, rivers, peaks, roads, springs, campsites, section-line markers posted, lookout stations, and any other data which the smokechaser can use to his advantage will be included. Other aids such as forms to be filled upon departure and arrival, pencil, and miscellaneous material such as printed diagrams to assist in orienting himself when in doubt of his location should be furnished for the smokechaser.

d. Means of Subsistence: Since we can do better work when hunger is not gnawing at our "innards", it is well for the smokechaser to carry some food with him when he starts. While beating through the underbrush hunting an elusive lightning fire, for instance, the tendency to call a fire a false alarm can easily increase with the
call of the dinner bell. But with some form of rations to ease the hunger pain makes even the most discouraged smokechaser feel like trying some more. Obviously the food should be light and nourishing and packed to prevent early spoiling. The amount to be carried will depend entirely upon the country and the average time in which additional food may be forwarded. In addition to food, water is a necessity and provision should be made for the smokechaser to carry it. A canteen of gallon capacity or less is satisfactory as any larger amount would tend to slow down the man.

e. Minor Items: Sometimes night travel could be done if some sort of illumination were provided. Probably the best type is the electric headlight which enables the man to travel with both hands free for other purposes. Various other lights have been made and can still be used but the best opportunity lies in the field of the flashlight which still needs improvement. They should be made less troublesome. For protection in case of injury a few essentials for first-aid treatment should be included. This will enable the man to continue his work without further damage to his wound.

f. Clue Hunting: The smokechaser on his way to the fire may find clues that might lead to the conviction of the fire-setter in cases where the fire was man-caused. A close watch on all the people he meets may help later to identify the person responsible.

5. Personnel: A simple objective to use in picking men for smokechasing is this one, "to use men who can find the fires while they are still small." While easily said the job is hard. To be a good smokechaser a man needs training in this type of work which consists of both field and school training. So one qualification of the man would be that he has had some
training. Since this man may have to hike many long miles, a man is needed that has good physical stamina. And because some fires are very elusive, a man needs a large amount of "stick-to-it-iveness" so that he or others will not have to be sent out repeatedly to find a fire the first man failed to find or said did not exist. Since fires sometimes lead smokechasers into unfamiliar country, a man is needed that can use his head to save his feet, one who can make use of his training practices instead of walking miles in blind hope of stumbling upon the fire.

6. Training: Since the smokechaser needs to be trained so that he can find the fire while it is still small, his training program can be best analyzed by dividing it into two parts; field training and school training. Field training will consist of experience gained in going to fires from time to time and from actual periods of trying out the information given him at the training school. School training will attempt to help him fulfill the items in his job list and how to best make use of his equipment. Some of the details he will need training in are:

a. Map Reading: This is necessary so the smokechaser can make intelligent use of the wealth of information furnished on a fireman's map.

b. Pacing: Unless a smokechaser has some means of calculating the distance he has traveled from a known point, it is useless for the dispatcher to determine a route of travel which involves measurements. Unless the smokechaser knows how far he has gone he does not definitely know when to stop traveling and where to start the grid-iron method of fire finding. He is likely to pass by the fire, but not so much so as to fall short of reaching it.

c. Compass reading and Use: To locate a fire it is sometimes necessary to run a compass line to it from a known point on a trail or road, especially when the ground is nearly level, the fire is small, and the cover is fairly dense so as to hide the column of smoke. The
same can occur in rough country where the timber is thick and tall. The compass can help the smokechaser to keep himself oriented, to orient his map, to run traverses and compute areas, and be used as a protractor.

d. Use of Communication Means: A thorough understanding of how they operate is not necessary to the smokechaser in order to get successful use from his radio or telephone. Better it is that he understand the limitations of each type so that when he attempts to use them he can provide the best possible conditions within his power. He would know then when he wishes to communicate over one of the ultra-high frequency radio sets that his chances of communing with his home station would increase as he moves himself to a position which would eliminate as many as possible of the ridges or mountains interfering with a straight line view of the home station. Also he would learn that when in doubt over a serious decision to make use of his telephone or radio.

e. Equipment Standards: So that he could get away from his station within limits set up by the headquarters officials, he would need training on how his equipment needs to be kept in a condition which is always ready for use and in a place where it can be picked up and started with in a minimum amount of effort and time.

f. Methods of Finding the Fire: Once the smokechaser has reached the limits of the territory with which he is immediately familiar then he has to depend on other means to carry him direct to the fire. It is then that some of the training mentioned herein comes into play. There are various methods used to locate a fire and nearly all deal with getting the smokechaser to the immediate vicinity of the fire. The rest deal with the means of finding the fire after the previously mentioned point has been reached. Some of the methods
used in the former are:
(1) How to get on lookout's line of sight.
(2) Locating fire from known points.
(3) Two-point intersection in the field.
(4) Two-point intersection by backsight to lookout.
(5) By compass and protractor.

In the second group are variations of the gridiron method which consists of covering intensively a small portion of ground.

In addition to training in the mechanics of fire finding the smokechaser needs to realize the importance of staying with the fire until it is found. It is easy enough to find a fire when a steady column of smoke is rising over the top of low brush and the like, but when the valleys are filled with smoke and only occasional puffs have been seen then is when they have to be "smelled out." It is at a time like this that all the doggedness and will power in a man is called on to stay with the hunt until either the fire is found or he is definitely sure that the fire is out or never existed.

7. Basic Facts and Records: Two main items stand out on his list of basic facts and records that are needed; namely, time of departure from his station and the time of his arrival at the fire. Other items useful would be wind and weather conditions upon arrival, fuel type in which the fire is burning, and the apparent source of the fire.

VI. Up to the point of finding the fire the action has been more or less the same whether the fire was large or small, the reason being that if a fire suppression agency is to be of any value there will have to be someone headed for the fire while it is still small. In Step VI there seems to be a definite division in the means used to reconnoiter a small fire as compared to a large one. Basically they are very similar, the slight difference being in the objectives of each. If the objective of getting the fire out while small
has been lost, then the second objective, which is to stop the rate of spread of the fire by 10 AM of the day following discovery, comes into being. In either case the sub-objective becomes; to get and supply the pertinent facts regarding the fire to the one in charge. On a small fire this would be done by the first man to take action. He would reconnoiter the fire mentally and once his decision was made, he would plunge into the task of extinguishing the fire. On the other hand if the fire is large and requires many men, the fire chief may find it necessary to get the assistance of others to supply this pertinent data to him. With this general introduction, one might next follow through the steps of the reconnaissance phase.

1. Objective: The objective has already been pretty well brought out in the general discussion above but repeating it here will do no harm. Namely it is; to gather all the pertinent facts which will be needed by the fire chief in controlling the fire within the limits set up.

2. Job List: The job list of the man on the small fire is very similar to that of the chief on a large fire, the difference being the intensity with which the data is gathered. To illustrate, on a small fire the man may circle the fire once to determine the conditions, make some mental calculations, and start to work suppressing the fire, while on a large fire the data needed may take hours to gather and by the time it is reported to the chief it has become old and more and more must be gathered until at last the fire is out. Of course on larger fires more details must be considered and some items will crop up that might never occur on a small fire. By analyzing the job list of the reconnoiterer of the large-class fires we cover also the steps taken in the reconnaissance of a small fire. Following are some of the items the one responsible for the reconnaissance needs to consider if the objective is to
be reached.

a. Analysis: So that the fire chief can have as true a picture as possible, the fire must be analyzed as to burning conditions, fuel in which the fire is now burning, adjacent fuel, topography, wind direction and velocity, time of day, rate of spread, location of spot fires, hot spots, location of crews, location of firelines, possible fireline locations, possible location of future fire camps, water location, routes of travel, location of routes to fire edge, and location of line which has some weak spots and is in need of immediate reinforcement. Also any evidence that might lead to the conviction of whoever started the fire if it was man-caused.

b. Summation: The data gathered above could be put in such a form that the fire chief can make his calculations of the probabilities with a degree of accuracy and without having to take valuable time to sort out the pertinent data himself.

3. Equipment: No attempt need be made here to list all the equipment which would be needed to accomplish the job list given above. First, the list would vary with every fire and second, no attempt was made to break the reconnaissance phase into its minor steps from which could have been determined what would have been needed. On a small fire the equipment list might not exceed that which the smokechaser has with him, while on a large fire the equipment list would increase as the size of the fire increased. Suffice to say that the equipment needed is that which will best enable the man, or men, to gather the pertinent facts about the fire.

4. Personnel: Like the amount of equipment needed on a fire the personnel will vary with the size of the fire. As each man is given more responsibility he will need more experience to assist in making and backing up his decisions. This then would indicate that men used in any
particular position should have experience enough to enable them to come through with their part, thus assuring no break down in the suppression system. The men, for even the minor jobs, if trained correctly will have a desire to do the job right, make honest reports, and stay with it until it is finished. A fireline is no place for the physically unfit and members of the reconnaissance phase hit tough going nearly all the time.

5. Training: To give a man a list of the duties he is supposed to accomplish is one step in his training. However, it should not end there as he can get off to a wrong start and then wash-out. So that he will gather only the pertinent data and not a lot of miscellaneous, insignificant facts, the man will need training prior to his making actual use of his job-list. Thus the policy of training men in various positions on going fires is one of virtue, because sometimes book-learned material and actual experience appear to be from different worlds, at least to the man who has had nothing but the former.

6. Basic Facts and Records: By building of the basic facts and records future firefighters will know better ways to combat fires. Thus it is essential throughout the various steps of the reconnaissance phase to gather data which will enable such information to be recorded. For instance it may be thought unwise to set a figure indicating the speed of fire line construction as this seems so variable at times, but if over a period of years it is found that such and such a figure remains consistently the average amount of fireline that can be built in an hour, then a fire chief would not be unwise to use that figure when calculating the probabilities for that particular area in future fires. For use in the reconnaissance phase, all data gathered would have to be mulled over to see which was really of value, which was of little value, and which was hindering the establishment of worthwhile methods. Such data as
good fire camp locations, fire pump shows, and other important items used in firefighting could be put on future maps for future use to save future firefighters from having to discover the same data again.

VII. The step of attacking the fire is based on the data gathered in the reconnaissance step. All or many of the items brought out in that step have to be assembled into the plan of action. The objective of this step could be to attack the fire in such a manner as to suppress the fire while it is still small. The man on the small fire figures out his plan of attack after a brief reconnaissance of the fire and then starts to suppress it. On the large fires the man in charge may have to make some decisions regarding attack before his data is complete, but as additional information is available he will revise his plans so as to fight the fire in the wisest way. His plan of attack will be made up of many little plans. On one front he may decide to use one type of fire-line construction and on another front an entirely different one, all depending on the conditions present in each case. The person who handles the plan of attack will probably be the fire chief and in his capacity represents the best for the position.

VIII. The objective of the eighth step, which is the last step in the physical part of suppressing the fire, is to put out the fire before it has a chance to get any larger, or, in terms of some definite time, effectively check the spread of the fire before 10 A.M. of the day following discovery. The objective is flexible and should efforts expended fail to realize the objective in the first fire period, the working plan can be revised so that an attempt can be made to obtain the objective during the second fire period or by 10 A.M. of the second day following discovery.

The fire chief is the king pin of the suppression step. His job list, equipment needed, personnel needed, and training for himself and his assistants will vary as the size of the fire varies. Rather than attempt to consider
fires of various sizes and the kind of fire chief and help needed to suppress them. Figure 1, page 27, shows as a diagram, how the job list and personnel needed, also indirectly the equipment and training needed, are developed as the fire increases in size. Someone has said that one picture is worth 10,000 words and that applies to Figure 1. It portrays the fire chief as the keystone of an arch made up of the firefighters on one side and on the other the organization which is needed to keep the firefighters working efficiently. As a keystone the chief is only as effective as both of his supporting sides and if either side crumbles the arch falls. Likewise a failure in the keystone also results in a failure in the strength of the arch. The job list of the fire chief can be seen to increase as the organization becomes more complex. At the start when the fire is small the organization may be just the fire chief himself and he also takes the part of the two sides. It is just as true here as elsewhere in the diagram that a failure in the fire chief or his work on either side can be disastrous to the set up as a whole. As the fire increases in size, so does the responsibility acquired by the fire chief. Likewise the experience and training needed by him increases. To the left of the fire chief the fire fighting overhead need greater experience and training as the size of the fire increases. Likewise those who assist in the organization to the chief’s right. As more firefighters are used, more fire fighting equipment will be needed, more men to condition tools and more equipment for them to use in conditioning tools, more cooks to feed the men, and therefore more kitchen equipment with which to do the cooking.

In this step are needed basic facts and records which will assist future fire chiefs to so build their organization that they as the keystone will be amply supported. Records from past fires can be examined and lists made to determine what fire tools are needed, how much kitchen equipment is needed for
each 100 men, etc. All this will tend toward putting the art of fire fighting on a more efficient basis. From this step can come the greatest source of material relating to the science of fire, and when compared to present records, the latter can be revised so that our data on the science of fire does not become obsolete.

IX. The objective in gathering basic facts and records is that better methods and means of suppressing the fires while they are still small can be developed. Such methods cannot be evolved unless the data is gathered scientifically and of sufficient amount to reduce erratic variations to a minimum. The data needed would be drawn from every step of the suppression phase. From such data could be developed a system of tactics for use on fires of all sizes. Such a system would be used to revise fire plans yearly and would include pre-fire tactics and on-the-fire tactics. With this data and system the fire chief could develop his fire plan using that which was most applicable to his situation. For instance in the step of planning the attack on the fire he could determine which method was best suited, at what time of day, and where his attack should be made. Carrying the process one step further he could determine which method of fire line construction would be best suited, what method of checking the fire, and the type and intensity of mop-up to be done.

Equipment: The equipment to be used in the suppression phase should always be considered with a critical eye. As new facts, which are ferreted from past fire records, tend to speed up the rate of fire suppression, new equipment will need to be developed. Such a policy would be entirely in keeping with the objective of the presuppression phase. Suggestions from the field could be a rich source of material for ideas of new equipment, and manufacturers could be encouraged to develop new ideas. Any device which can increase the amount of work accomplished for the same number of ergs expended,
or decrease the number of ergs expended for the same amount of work, has the
right to be considered even if somewhat radical to present ideas at the time.
It is difficult to set up a standard by which to measure the efficiency of
new ideas, but if they do not exceed the amount of work that can be done by
the average man in the same locality, type of work, initial and resulting
costs and quality of work done, it is hardly worth considering. While new
equipment is being developed, from the records and reports may come ideas
on how to get better results from equipment now in use. Since it is the
equipment that we have today that is going to fight today's fire, one should
try to get all that any type or piece of equipment is capable of giving
before condamning it in favor of another. So while it is desirable to be
open-minded toward new ideas and new equipment it is also desirable to be
wellversed in what we have today.

PERSONNEL: It goes without further explanation that in order to get fires
out when they are small the personnel must be of the kind that can accomplish
it. Therefore the personnel of any suppression agency will have certain
qualifications to meet, and the more specific the job the more exacting the
qualifications. For instance a one-legged man is of little value stringing
emergency telephone line but he might be very capable pushing a pencil at a
timekeeper's desk. In order to keep the ranks of overhead full, each man
should have the opportunity to advance and yet for the sake of efficient fire-
fighting he should not be left in a position where he is an obvious misfit.
We can not all be excellent fire-line men but that doesn't prevent us from
being capable elsewhere. Closely allied with personnel is the training
program. Actual experience is probably one of the best teachers yet it needs
to be supplemented with other basic and theoretical material. Men to be used in minor positions need not be trained as intensively as men slated for higher positions. Yet we should consider every beginner as a potential fire chief and plan for him a long term training program. This will tend to prevent a man from getting stuck in a particular rut because he happens to be especially good at that job, even though he may be capable of far more. Such a training plan could help to reduce labor turnover in that men would see that they have a chance to be advanced and would keep up an intense interest for their work. To take men from the streets of any large town, transport them to a fire miles back in the woods, stick a tool in their hand, put them to work, and then hope to get anything accomplished efficiently has seemed like the impossible, yet it has been done. Just how efficiently such a crew would be as compared with a crew of men hired by the summer, for instance, and trained intensively, is not known exactly. However such experiments are being carried out and the results are favoring the trained crews. Thus far to make a fire suppression organization work we have had to have the right kind of personnel with the right kind of training. So far so good, but to really make the organization "click" the personnel must have the right kind of morale. Without it the best fire chief is practically licked before he starts. Morale is one of those intangible things that when it is good it is very very good but when it is bad it is mighty hard to get anything done until a change for the better occurs. Like electricity it can be made to do things if handled properly and morale training should be included in the training program of each individual. Not only training to keep his own morale high but also how to keep a high morale in those with whom he works.
CONCLUSION: This paper has attempted to show that fireplans can be made to fit the objective of putting fires out while they are small. Also it can be seen that personnel plays one of the biggest parts in making the plan operative. To make the personnel click they need experience and training to act as lubricants so that the resulting action can slide along a well-greased channel and the driving power sparked-off by a high morale throughout the organization.