George M. Jemison

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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and technique may flow to and from every worker in the field of forest fire control.

Volume 6 Number 2

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the TECHNIQUE OF FIRE CONTROL

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The value of this publication will be determined by what Federal, State, and other public Agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, personnel management, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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THE PRIEST RIVER FIRE MEETING

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Research and administrative men in Forest Service fire control met to appraise their technical problems at the Priest River Experimental Forest, Idaho, December 2–6, 1941. Twenty-seven men attended throughout the meeting. From Research were 9 men from the 6 stations carrying on fire research, plus 3 from the Washington office. Administration had 13 men from Regions 1 to 9, and 2 from the Washington office. In addition, Regional Foresters Watts and Kelley sat in on part of the meeting, doing their best, as Watts said, "to add to a healthy state of confusion."

The last general investigative meeting was in 1936, and substantial progress in fire control has been made since. According to Headley's recent report, the annual average acreage of lands within the national forests burned per million acres has dropped from 2,421 in 1930–34 to 1,418 in 1935–39, and the trend is still downward. The once seemingly far distant goal of one-tenth of 1 percent burned annually is rapidly being approached; in fact, it has been exceeded on some forests.

Research has progressed correspondingly. In the last 5 years, fire danger meters have developed from a somewhat newfangled device to a mainstay of the fire-control organization in most regions. Discussion of fire meters now centers around what kind of a meter and how to build a better one rather than why a meter. Thorough studies of visibility have helped round out a working knowledge of fire detection; a good start has been made on more fundamental studies of fire behavior to give the fire dispatcher and boss a better guide for action; and much progress has been made in determining fire effects to give a basis for controlled use and evaluation of damage. A region-by-region analysis of investigative needs in fire control was completed early in 1941. The time was ripe for a constructive over-all appraisal of the direction, emphasis, and organization of the fire-research program and the formulation insofar as feasible and desirable of a coordinated national program.

At the meeting fire-investigative needs were divided into 5 topics: Fire economics, prevention, effects and use, behavior, and organization and management. A committee for each topic was appointed in advance and made responsible for a well-rounded presentation and summary of the sense of the meeting. Each topic was opened by 3 to 4 more or less set papers by committee members and followed by open discussion, with the committee acting as an "Information Please" panel. Following topic presentations and discussions, the respective committees went into a huddle and produced recommendations for a final round of general consideration and summary.

The interest in and emphasis on the economics of fire control were high lights of the meeting. It was generally agreed that much hard-headed appraisal and study were needed of values at stake and liable to damage in relation to protection costs, to guide fire-control effort effectively and indicate its proper intensity.

Some background may help in orienting the present situation. Economic problems in fire control have long been recognized. But in the past, with control rather obviously inadequate, there was no great need for thoroughgoing economic analysis. The ratio of benefit to cost was strongly favorable. This perhaps explains in part why Sparhawk's comprehensive analysis of liability ratings nearly 20 years ago [1] and other past studies and proposed programs for economic research have not been aggressively followed. A contributing factor was lack of statistics on which to base sound analysis.

The situation now is somewhat different. Specifically considering the national forests, a degree of control is now being achieved on some areas—but not all—that even 10 years ago seemed a far-off dream. Retraction of CCC and other emergency aids responsible for much of this advance in control effectiveness has developed keen pressure to define how much protection is justifiable and how much it costs. Intermixed with this is increasing consciousness of the economic ramifications of timber losses and of the existence of many forest values other than timber. These factors have combined to make questions of achieving proper balance and intensity in fire control of immediate importance. So, while interest in fire economics is not new, there is evidence of considerable more wallop behind it to do something.

The committee recommended as a first step that investigative work be started at the national level to identify and develop methods of measuring the direct and indirect effects of fire on all forest resources in terms of dollars, so far as possible, but not overlooking values not now measurable in dollars. Also, to determine the cost of various intensities of protection and the probabilities of losses, and on the basis of this information to indicate justifiable expenditures for fire control. A big job and, it was soberly realized, one that would take continuing effort. Case studies could probably be employed that would yield useful answers to particular problems and also contribute toward a body of information generally applicable. Wide regional differences in economic problems were recognized and regional studies were encouraged, though it was believed they should be supervised at the national level to promote reasonable uniformity and avoid unnecessary duplication. A two-man project was recommended as a minimum beginning.

Another recommended extension into a new field of research was in fire prevention. Long recognized and wrestled with as a serious problem, it has not received much systematic research attention. For fire prevention effort to be effective, the underlying reasons why and how people start fires must be known, and convincing counter reasons must be advanced and put in such terms and form that they will reach

[1] Sparhawk, W. N. The Use of Liability Ratings in Planning Forest Fire Protection. Jour. Agr. Research 30 (8) : 693–762, 1925.

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REVIEW OF PROBLEMS AND ACCOMPLISHMENTS IN FIRE CONTROL AND FIRE RESEARCH

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This topic was assigned to the author at the recent fire research meeting at Priest River Experimental Forest, Idaho. When asked to permit publication of his paper in FIRE CONTROL NOTES, he replied that he had no notion that his paper was an historical opus of any kind. "It was prepared to be read to an in-Service, friendly group * * *. It was intended to be a mustard-plaster, counter-irritant, spiced-up cocktail." It doubtless brought the meeting up on its mental toes right at the start. But, in addition, it is a valuable beginning of a facinating and important chronicle—the saga of fire control for the last 35 years.

As the author expects, there will be disagreement with regard to some of his "milestones of progress." If, however, his stimulating article impels other men to submit article making corrections or additions, or questioning his emphasis on some "milestones," the foundation will be laid for a history of an amazing development in the conservation of natural resources of the United States. A perspective derived from some knowledge of our "milestones" is indispensable to our thinking now and in future years.

Selecting a Point of View

Whoever laid out the program for this meeting utilized one device which is recognized by philosophers and successful writers as essential to the productive development of discussion. At Spokane, a month ago, Dr. Carl F. Taeusch, of the Bureau of Agricultural Economics, told us that for common understanding of any problem it is essential that we first establish the "framework of ideas within which we are trying to work out the problem." Walter B. Pitkin stresses the same point when he says: "The next task is to take some position toward the subject you propose to discuss * * *. When you take a position toward a field of fact or fantasy, you do something strangely like the choosing of a vantage point from which you view a valley * * *. Point of view and perspective determine the special arrangement and design of the entire panorama. Any valley may be seen from a thousand outlooks. Always the same valley, it presents itself in a thousand manners according to the outlook."

Our present program makers obviously agreed with these authorities when they set up Topic 1 as a review of problems and accomplishments in fire control and fire research. They recognized the need of getting together and being sure that we are all looking at the same valley, not mistaking some of the minor gulches for the main valley, before we plunge into the examination of specific phases of the problem, each of which is minor to the whole. They apparently agreed

with Dr. Morris L. Cooke who states, under the title of "On Total Conservation": "Increasingly in human affairs—material, intellectual, and even spiritual—the effort is made to see things whole."

Personally, I welcome the oportunity to tackle this topic because I am convinced that failure in recent years to look at the whole problem first, and its parts second, has caused a large part of what we now call the fire problem. For the past 20 to 25 years, we have been so engrossed with certain exceptionally pressing phases of the fire problem that at times we have almost lost our perspective. I believe that I can demonstrate this to you. In the process I hope that I can establish a common vantage point and thereby reveal the true size and complex topography of our "valley."

To do this, I propose to go back to the beginning of Nation-wide fire control and come down the 35-year road, citing what I have selected as the outstanding accomplishments. In this selection I have had the help of Major Kelley, Axel Lindh, C. K. McHarg, Roy Phillips, W. W. White, and Clarence Sutliff. I take full responsibility, however, for all omissions of events which you may think should have been included in this historical series.

One basic presupposition seems to be essential, and to demand full agreement and understanding before we proceed. This is the premise that all of our experiment station divisions of fire research have just one justification for existence, just one function, just one objective. That is: To aid the present and future administrators of fire control, Federal, State, and private. We are not doing research for research's sake. We have a definite, decidedly practical goal, and it is still the basic, over-all goal that Graves stated in 1910: "The first measure necessary for the successful practice of forestry is protection from forest fires." Fire research is therefore intended to serve as directly as possible the fire-control men who must first be successful before any of the other arts or artists of forestry can function with safety.

There is one other and perhaps even more basis presupposition that should be raised here. I do not expect that we could get unanimous agreement on it, but it is a condition or factor which certainly should influence your reaction to my selections of the significant facts in the history of fire control. Furthermore, it is a basic factor in determining your reaction to much of the discussion of project program that will follow. It is, in my opinion, the biggest, the most overshadowing, the most all-permeating feature of our fire problem. It is, briefly: Does fire control have to be able to demonstrate with data that its expenditures, in toto or in part, will pay dividends in dollars of increased revenue?

Mileposts of Progress

In venturing to select and designate certain events as mileposts of progress, I realize now, better than I did when I started, the difficulty of the task. Probably no one will agree with all of my selections. But in this game it is dealer's choice and anyone can deal who is willing to write. My own major criterion has been whether or not the event was of national and lasting significance in fire control,

Federal, State, or private. In some cases I have used the first proposal or broaching of an idea if it "took." In some cases the original idea failed to take, or to become nationally effective, until clarified, amplified, or given the right push by some individual. In those cases I used the push that put it over. In a few cases there has been real progress along broad lines, but I have not been able to name the event or date it. I have also probably overlooked some deserving events.

I have tried here to distingish three types of events: (1) Progress toward better objectives in fire control, (2) better methods used in pursuing the objectives, and (3) better finances permitting the use of better methods. My reasons for selecting these particular events are as follows:

1904. The creation of a widespread framework of forest reserves in 1904, 1905, 1906, and 1907.

Here was the real beginning of all future Nation-wide problems in fire-control objectives, methods, and finance. All previous problems had been relatively local. All State and private major problems of fire control have likewise appeared since the Federal Government began to practice forestry on a national scale. Hence, although Sargent compiled the first fire statistics in 1880, the active history of fire control seems to me to commence in 1904.

1905. In 1905 there was born the first cooperative agreement and work plan between private and State timber protective agencies. This move proved to be so profitable and so beneficial that the formal cooperative protection movement spread rapidly, first throughout the Northwest and subsequently throughout the Nation. This first cooperative association greatly improved both the objectives and the costs of State and private protection. It was so beneficial that similar "cooperation" has even been forced by law in many States, beginning with the Oregon compulsory patrol law of 1913.

1906. The Use Book for 1906 was a definite milepost in bringing all of our major problems of objectives, methods, and finance into focus in terms of the job ahead. These problems are all evident in one short sentence in that book. "At the beginning of the summer season, or before March 15, each supervisor will recommend to the forester the number of men needed adequately to protect his reserve, the rate each should be paid, and the number of months each should serve." There, in one pregnant sentence, are all of our problems—beginning, ending, and degree of fire danger, manpower placement, what constitutes "adequate" protection, the problem of temporary employees, and finances—the wherewithal with which to do everything. Even Mr. Headley's pet problem was there, in the next sentence, reading: "After consideration of these recommendations the forester will fix the number for the full summer force of each reserve, and this allotment will be final." As Gowen and Headley will probably be willing to testify, the forester's office is still "considering" these recommendations and still trying to make allotments that will be "final." Hence, I believe that "The Use Book" of 1906 constitutes a distinct milestone along the road of fire control.

1909. The formation in 1909 of the Northwest Forest Protection and Conservation Association was more of a national milestone of progress than many of you may think. This organization soon became the Western Forestry and Conservation Association and under the

exceptionally aggressive leadership of E. T. Allen, the steady guiding hand of C. S. Chapman, and the farsightedness of Geo. S. Long, it had a Nation-wide influence for more than 25 years. It was especially helpful on Federal appropriations for fire control, fire research, and fire-weather forecasting. It exerted and still exerts an extremely beneficial influence on many State legislatures for the improvement of fire laws, brush disposal requirements, and other objectives. It has contributed steadily to the improvement of methods of fire control, especially on State and private land, through its several editions of the seven chapters of "The Western Fire Fighters' Manual." This text on fire control is probably used in every forestry school in the country. If not, it should be.

1910 (*a*). A milepost contributed by a Chief Forester of the United State. If any man here has not read Forest Service Bulletin No. 82, "Protection of Forests From Fire" by H. S. Graves, he should take time—make time—to do it. There you will find such a keen and clear analysis of the fire problem that, although it was published in 1910, many of its statements have not yet been improved upon.

For instance, if you think that methods of fighting fire, crew organization problems, skill in sizing up and attacking fires, are recent discoveries or new problems, listen this: "The following are of first importance: (1) Quick arrival at the fire; (2) an adequate force; (3) proper equipment; (4) a thorough organization of the fighting crew; and (5) skill in attacking and fighting fires." What factors have we added to that list in the past 30 years since Graves saw these phases of the problem and described them so clearly? While many old-timers have probably now forgotten this bulletin, many later events indicate that such subsequent progress began right here.

1910 (*b*). I may be wrong in erecting a milepost of progress to the great Idaho fires of 1910, but I am told that before they occurred public interest in forestry and the Forest Service was almost non-existent. The dramatic incidents and loss of lives in those fires made newspaper headlines all over the country and "the people" were awakened to two things. First, that timber wealth was burning up; second, that there was a Federal organization trying its best to protect that wealth. These fires probably were the greatest object lesson in forestry that ever occurred, anywhere. A marked upswing in public interest and in funds for fire control was evident immediately after the 1910 fires.

1911 (*a*). The first forest-fire deficiency appropriation in 1911 was certainly a milepost of progress. Some of you may not know that in 1910 several supervisors in Region 1 furloughed all of their unmarried rangers for one month in order to acquire the funds to pay fire-fighting bills of the previous summer.

This situation shows clearly the distinctivness of finances as a separate phase of the fire problem, and reveals the great and serious weakness in that phase existing up through 1910. The provision in 1911 of EFFF, emergency fire-fighting funds, more commonly known as FF, remedied this weakness.

Most unfortunately somebody made this godsend of 1911 into a Damocles sword and has been dangling it over our heads ever since. Looking back at its origin it does not seem conceivable that Congress could possibly return to the fire-financing methods of 1910, forcing furloughs to pay fire-fighting bills.

1911 (*b*). While the Weeks Law of 1911 was primarily aimed at the acquisition and protection of the headwaters of navigable streams, and hence was a milepost in objectives, it also appropriated Federal funds for the first time for fire control in cooperation with the States. It was therefore the forerunner of the monumental and highly effective Clarke-McNary Act that followed 13 years later. All the old-timers tell me that the Weeks Law was a distinct milepost of progress.

1912 (*a*). "The National Forest Manual,' issued in some six or more sections, 1911 to 1913, contained in the volume on "Protection" the first detailed break-down of the fire problem which I have been able to find. There is not time here even to list all the features separately recognized. "The Fire Plan" was named, however, and this was clearly the forerunner of DuBois' "Systematics for California," which followed 2 years later, and for Hornby's highly detailed integrations which followed 12 years after that.

Firebreaks were given great emphasis; in fact, here seems to have been the origin of a fire-phobia which 30 years have not entirely eliminated. Permanent lookouts were indicated as possibly desirable as follows: "Main lookouts are those from which an exceptionally large territory can be seen and where *it might pay* to keep a permanent lookout." The same year that this Manual was distributed, Forest Service Bulletin No. 113 appeared with photographs of permanent lookout towers and houses already in actual use on what was then the Arkansas National Forest.

This Manual of 1912 also took one definite step ahead in objectives when the statement was included: "Practically all of the resources of the national forests are subject to severe injury, or even to entire destruction by fire. Besides the direct damage which fire may do to merchantable timber, to the forage crop, and to watershed cover * * *." For the first time that I can find, "the forage crop" is included in addition to commercial timber and the old stand-by—watershed cover. Here for the first time was an objective definitely broader than "timber alone for dollars alone."

Here also was the real origin of fire prevention research, in the statement: "Since the best way to stop fires is to prevent them, a fire plan must include a careful study of prevention methods." Note that they said, "Prevention methods." I believe you will all agree that we were a long, long time getting past the mere listing of prevention cases and concentrating on the study of prevention methods. There is a vast difference.

Here I would like to digress for one-half minute on the subject of cases versus methods. I have attended quite a few fire meetings, and at most of them I have been struck by the time spent in attempting to solve cases, with so little effort intentionally directed to draw from those cases either methods or principles. A lot of us here today were present at the Washington fire meeting in January and February 1939. My notes for one national meeting contain this statement: "If there has been a single feature of this meeting that has been conspicuous by its absence, it is the phrase: '*There* is a good method, there is a good principle, which all regions should be able to follow or apply.' " Twenty years ago Howard Flint wrote, in a comment on Sparhawk's liability rating: "Why not stick to a *method* that is

fundamentally sound, using figures that are admittedly arbitrary?" I think that Flint hit the nail on the head. I certainly believe that we, here at Priest River in 1941, should keep our eyes open for methods and avoid quibbling over the split-hair accuracy of minor figures or cases that are, perhaps, being used in an unsound method.

1912 (*b*). Daniel W. Adams' "Methods and Apparatus for the Prevention and Control of Forest Fires," Bulletin No. 113, published in 1912, is so clearly the forerunner of both the Fire Control Equipment Handbook and the various fireman's guides and fire-suppression handbooks, that were to follow 20 years later, that it certainly rates a monument. Yet I will venture the guess that not more than two men here ever heard of D. W. Adams or have any recollection of this bulletin. But if you doubt that this was a "first" and should be recognized as such, look at the drawing. in figure 8, showing where to locate a fire line on a ridge and compare it with the drawing for problem 6, page 21, in the Region 5 Fire Control Handbook issued in 1937; or problem 1, page 88, of the Region 1 Fireman's Guide issued in 1940; or Bob Monro's figure 4 in his article (Fire Suppression) in the October 1940 Fire Control Notes. That old drawing of 1912 shows not only the best fireline location but also the wind current involved, just as well as many of the similar attempts 28 years later.

As for equipment, if you think the Los Padres shield for a flame thrower, illustrated in the July 1941 issue of Fire Control Notes,[1] is something new, take a look at figure 2 of plate III of Bulletin 113 published 29 years earlier. For chemicals on the fire line see figure 2 of that same bulletin. For a quick get-away with water tanks on a pack horse, see figure 3 of plate IV. For railroad tank cars, see figures 3, 4, and 5. For something really new, see the logging system suited to better fire control, outlined by figures 6 and 7.

Incidentally, this pioneer work in fire control in Arkansas seems to have borne fruit. Dean Walter Mulford recently stated that "Arkansas, which has 15 million acres of active forest lands, is probably the foremost State in the United States as regards forestry matters." I believe that we here should salute D. W. Adams and the Arkansas National Forests. They were so far ahead of us in some respects that we haven't caught up yet, but if we are not careful we may include in our research program a project or two aimed at features of the fire problem that were pretty well thought out as much as 30 years ago.

1914. 1914, Region 5 tried to scoop the country and keep all good things to themselves, but they were unsuccessful. Coert DuBois' publication, "Systematic Fire Protection in the California Forests," an unnumbered item is not labeled as either bulletin or circular and is marked, "Not for public distribution," was very definitely a milepost in progressive thinking on a national scale, even though the Californians did try to keep it exclusively to themselves. I read that bulletin from cover to cover several times when I was a lookout in 1915. It was all new to me then. Every time I read it now I still find something that is new and useful.

If you will read DuBois you will find that he actually pointed the way for nearly everything that Hornby and I ever did, when he said:

[1] A Portable Flame Thrower, by Neil L. Perkins.

"A way must be devised of reducing all of these factors (inflammability, season, risk, controllability, liability, and safety) to concrete terms, so that any forest area, after careful study, can be given a rating which will convey to our minds something in the nature of an exact measure of its total fire danger." The expression "class 5.8 danger in a high-high fuel type" does that for Region 1 men today, for any instant and spot, with one exception—"liability" or values are out. Hornby wanted to include those in his "total danger rating" and they were in his first formula, but the 10 a. m. policy came along about then and under it "values are out." So Hornby left them out, to all ostensible purposes, although he fully agreed with DuBois.

Someday we will go the rest of the way for Coert DuBois and put those "liabilities" or values back into the prominent place they deserve, but there is one small matter which must be settled first, the subject of "objectives in fire control." When we clarify that the road will be open again.

1916. It may have been a coincidence, but if so it was a monumental one, when in 1916 Silcox first proposed the one-tenth of 1 percent objective of fire control and about the same time Headley proposed the "least cost plus damage" or "economic" objective. To me, the flat "tenth of 1 percent" was an expedient, but a little bit more sound than the 10 a. m. policy which was to come 19 years later. To me, Headley's theory was and is fundamentally the soundest ever proposed. It has its difficulties, but if we can ever do with it, as DuBois said we must do with danger ratings, "devise a way of reducing all of these factors to concrete terms," we can make that economic theory work. When we do that we will have *applied economics*.

1919. Although there is some evidence to indicate that the Canadians were ahead of us in the use of airplanes in fire control, this phase was not reached until 1924 or 1925. Long before that Howard Flint was investigating lighter-than-air craft and by 1920 the United States Army had become interested. The latter is witnessed by Erle Kauffman who, in an article in the April 1930 issue of American Forests, quotes an army officer as follows: "The day will come when large numbers of men and equipment will be carried by airship to the scene of a forest fire, both men and equipment dropped by parachute, while the airship will rain down fire extinguishing chemicals from above." From this use of the term "airship" it appears that the Army officer was, like Flint, thinking primarily of dirigibles.

The earliest printed record of Flint's interest, which I can find, is in an issue of the Forest Patrolman (Western Forestry and Conservation Association), which quotes Major Kelley, then fire inspector out of the Washington office, as follows: "H. R. Flint, fire chief in District 1, holds credit as the first forest officer to recognize the possibility of real value in the dirigible as a vehicle for transporting fire crews and supplies, and as a means of effective patrol and detection service. In the fall of 1919 Flint corresponded with a concern in the East about the use of a "lighter-than-air machine." Flint, himself, in the December 7, 1931, issue of the Northern Region News, says that airplanes were first used on fire-control work in this region in 1925. Possibly other regions antedated this.

There are three features of this development well worth noting. First, the long, slow, uphill drag (indicated by part of Flint's "News" note: "In the seven seasons since that time, backed up by a little real support, a great deal of discouragement, and some ridicule, I have seen the airplane slowly taking a definite place in our work. It has come to stay." Second, an entirely unforeseen value of this new departure almost usurped the place of the original idea. Photographic mapping, pioneered in 1925 by Flint, Jim Yule, and T. W. Norcross, almost stole the show and for several years was more significant nationally than was the fire-control idea. Third, whereas Flint's original idea was aviation by use of blimps, that has not yet come to pass. But the blimp idea obviously led to airplanes, and it is not at all inconceivable that the latest development in airplane use—parachuting men and supplies—may later lead back to the blimps.

1920. I believe that all fire chiefs, fire bosses, and rangers will agree that when Orin Bradeen began in 1920 to centralize the purchasing, packaging, and delivery of fire-fighting food, tools, and other equipment he removed one of the greatest headaches of previous fire control and made the future job both more efficient and less costly. Bradeen erected a milepost from which we have forged ahead, still under his leadership, probably to as near perfection as in any phase of our problem.

1921. Radio, like airplanes, also opened a new epoch and while the Radio Laboratory of the Forest Service has made steady progress, credit for the milepost should go to R. B. Adams who first made radio actually work on a going fire in 1921 and to Dwight Beatty, who, 6 or 7 years later, produced the first truly Forest Service sending and receiving set.

1922. Sometime in the early 1920's, a new idea began to be practiced which has since swept the country and become standard practice in all Forest Service regions. This is organized training. While it began as general administrative training, the value of this procedure in fire control was soon appreciated, and fire-training schools and correspondence courses are now recognized as indispensable to the attainment of adequate fire control. The one man who deserves all the credit for this milepost of progress is Peter Keplinger. His full contribution amounted to much more than the first idea, for he, like Bradeen, stayed with it and developed the method, showing all of us how to use it.

1923 (*a*). Up to 1923 I cannot find a single event produced by research that should be called a milepost of national progress in fire control. Clapp's first working plan for fire research, written about 1916, and the research work of Sparhawk, Show, Larsen, Hofmann, and Osborne from 1916 onward would rate a tremendous monument in the history of fire research alone, but fire research is only one means to an end and here we are discussing all means of progress toward the big END.

Publication of the relative humidity theory in 1923 by J. V. Hofmann and W. B. Osborne seems to me to be the first contribution by research which was of Nation-wide signifiance. The "relative humidity" idea literally and actually swept the country. For a while it appeared to be the total and final answer to the 1916 Work-

ing Plan request for "some simple, single index" of fire danger. For certain fuels and fuel types it is still the simplest and best.

There is one feature of this milepost which should be of special interest to this Priest River assembly of fire-control and fire-research men. While "J. V." (Hoffmann) was an experiment station director engaged in full-time research, "Bush" Osborne was chief of fire control in this region, and an administrator. But there was no "fence" here between research and administration, and this happy combination of a researcher and an administrator proved to be highly efficient. Bevier Show, then a full-time researcher, and Ed Kotok, fire chief, like Osborne, had also joined forces about that same time, and the world knows how productive that was.

To me the milepost to relative humidity in 1923 is therefore a monument not only to the first simple index of fire danger, but it is also a symbol of the great value of combining the efforts of the man experienced in practical problems and the man trained in the methods of solving problems. It is a known fact that nearly all kinds of engines operate best with a balance wheel or governor.

1923 (*b*). When Show and Kotok, in 1923, distinguished between the "economic" and the "minimum damage" theories, I believe that they erected a milepost which should have accelerated future progress more than many of their later contributions. Unfortunately, that particular feature of their "analytical study" did not "take" in the sense of inoculating us against the danger in the economic theory.

By their own words, on page 59 of Circular 243, Show and Kotok demonstrate that even while proposing the minimum damage theory, they also favored the hypothesis of least cost plus damage. For they state, in their summary: "Successful protection is reached at the point where the cost of prevention, suppression, and damage is a minimum." Hence, "minimum damage' 'was offered not in contradiction of the records from all over the country, Sparhawk was not attempting to clearly evident when they state, on page 4, that their main objection to the economic theory is that it will not work when too much emphasis is given to holding down the costs of prevention and presuppression.

1924 (*a*). The Clarke-McNary Act of 1924 hardly needs any justification as a milepost of national progress. It recognized for the first time the Federal interest, hence responsibility, in fire control on private as well as State forest lands, and it provided those highly essential funds, without which the best ideas and interests lie dormant.

The Clarke-McNary Law did one other thing that is significant. It revived a phrase from the Use Book of 1906— "to adequately protect." That was the stated objective of fire control on the national forests in 1906. It is repeated as the objective of Federal, State, and private cooperative fire protection under the Clarke-McNary Law in 1924. Here are some simple words coming down through history. But, I ask you in 1941: "What do those words mean?" "To adequately protect?" "Provide adequate protection?" Do we even yet, in 1941, know just what those words mean? I am quite sure that *we do not know what we are talking about when we put these words into our Federal laws and fire-control manuals.*

1924 (*b*). The first written agreements between the Weather Bureau and the Forest Service providing for "fire-weather warnings"

were dated August 11, 1916, and March 12, 1917. They provided for measurements of only wind velocity form the forest stations, although the forecast was to cover other meteorological elements. As late as 1923, however, these forecasts, when furnished, were of such doubtful value that I cannot rate either or both of the old first agreements as a milepost of progress.

In about 1924, however, a meeting of Weather Bureau and forest protective agencies was called by the Western Forestry and Conservation Association. At Portland, Oreg., and at the Wind River Experiment Station methods of measurement and types of forecasts were thoroughly discussed. Out of this came the first congressional appropriation of funds specifically for fire-weather forecasting. I believe that that meeting in 1924 rates the milepost.

1925. Everyone here is aware of the vital and extremely practical problem of allotting fire-control funds. Regional fire chiefs probably appreciate it most keenly. It cuts them most. Headley and Gowen undoubtedly know more about it than anyone else in the world. How many of you knew that Sparhawk worked on this particular problem from 1915 to 1921 and wrote a bulletin on it, that was published in 1925? [2]

In his tremendous compilation and analysis of Forest Service fire records from all over the country, Sparhawk was not attempting to tell Operation or anyone how much money should be allotted that year or the next year to each region, forest, and ranger district. He was hunting for a method by which that could be done. He says so, very specifically, in the third sentence of his report.

But even more than this, Sparhawk was hunting for an over-all justification for fire-control expenses. He was trying to answer that extremely basic question: "What is the cost of adequate protection?" In the light of our admitted ignorance today, just pause a moment to consider Sparhawk's task: "What is the cost we can justify to do a job which we cannot define, using many elements which cannot be measured?" Then look at the miserable, incomplete, inaccurate fire reports which he had to work with! No; Bill Sparhawk was not born too soon, and he was not tackling an impossible task. It is not his fault that we are not all thoroughly familiar with his report. It is ours. We have so lost touch with our own literature and so lost our perspective of the basic features of our job, that we now piddle around with fire danger meters and argue whether we should use 5 classes or 7 classes or 100 classes, while Bill Sparhawk's clear vision of the really basic problem gathers dust on our bookselves.

As evidence of Sparhawk's attitude toward the economic theory, you will find as figure 1 in his report a diagram illustrating the effect of the law of diminishing returns. This last summer Mr. Headley was carrying around and distributing to all willing listeners a very similar diagram. From 1925 to 1941 is 16 years. This feature of the problem must be something.

As another bit of evidence of Sparhawk's vision and the effect of his work on later efforts, you will find in his report published in 1925 and in a memorandum written after he had completed the manuscript in March 1922, the words, "hour control." Show and Kotok

[2] The Use of Liability Ratings in Planning Forest Fire Protection. Jour. Agr. Research 30 (8): 603–762. 1925.

picked up this ball and kept it moving in their 1930 "Determination of Hour Control," but they rather dragged their feet on the subject of the justifiable cost of any particular hour control. What is the operational function of hour control anyway? It is to get adequate protection. And what is "adequate protection"? Does anyone know? Don't we need to know?

Sparhawk knew that we have to know, for on page 694 of his report he listed, for the first time to my knowledge, all the kinds of values of forest resources which justify protection. No one has since added *anything* to that list of timber, including mature timber, young growth, the forest capital, and soil productivity; forage for livestock; regulation of stream flow and the prevention of erosion and floods; game resources; recreational use; improvements; and other occupancy values. That list is a true masterpiece of perception. Note, for instance, the inclusion of "the forest capital." When the silviculturists get a working circle into managed age classes, it is obvious that fire wiping out one or two particular classes would do damage far exceeding the maturity value of those particular trees discounted to date. The whole working circle would be thrown seriously out of orderly future progression, and there is a form of loss that is still far ahead of us in 1941. Sparhawk saw it, and named it, in 1925! Research program makers of 1941 can well go back and begin at the 1925 milepost in many respects.

1926. This milepost, "A National Program of Forest Research," by Earle H. Clapp, is too well known and so well appreciated that it needs no explanation. There are certain features of the forest protection section, however, which I should like to emphasize.

First, protection from fire, fungi, and insects are grouped and tied together so closely here that every time I read these three sections over again I wonder why the Forest Service has a solitary division of fire control when the job, on the ground, could be so much more efficiently handled by a division of forest protection. Here may lie one of the most effective methods of solving the problem of the temporary employee or—keeping a trained organization.

Second, in 1925 Sparhawk came out and named all of the many reasons for fire control, of which commercial timber was only one. A year later, Mr. Clapp implied, by his words "forest management" and "to grow timber," that timber alone for dollars alone is our major and perhaps sole justification.

Third, that Mr. Clapp subscribed to the economic theory is shown by his statement: "Possibly they (foresters) should also be able to set limits beyond which expenditures for protection are not justifiable, that is, the determination of that point where the law of diminishing returns becomes effective." In his next sentence he opened the door to the ultimate answer when he said: "But if used at all, these limits should be set upon very comprehensive rather than narrow considerations." As will be brought out later, the dollar value of destructible resources is not the sole criterion of damage and a much more comprehensive basis, as Mr. Clapp called it, is absolutely essential.

Fourth, under "Protection Standards," Mr. Clapp stated 15 years ago: "Satisfactory timber crops cannot be grown unless certain definite standards or objectives of protection are attained." And he

continued: "Those standards must be definitely determined." And: "This is a task best attempted by research methods."

Let's keep this milepost in mind when we get to our 1941 research program.

1928 (*a*). The McSweeney-McNary Act of 1928 is perhaps merely a result of the 1926 national program, but it is well to point out one difference. The "program" was an idea, a plan for a "functional operation." It could not function, however, without finances. The McSweeney-McNary Act liberated these essential dollars, like putting water into an irrigation ditch.

A lot of fine work had gone into building the ditch and laying out the orchard, but until some water was turned into the ditch the orchard could be neither planted nor irrigated. The McSweeney-McNary Act did that.

Here, again, when we come to our fire-research program, let's remember our history. We here at Priest River are merely extending that same ditch and laying out some more orchard. And that's all. The other half of the job still remains to be done. Somebody has the specific job of diverting water into our ditch. Whose job is that anyway? Unless that job is specifically assigned, and a McSweeney-McNary Act puts golden water into our ditch, our job here at Priest River will join Sparhawk's fine work on the bookshelves.

1928 (*b*). Another milestone of progress was erected in 1928, or thereabouts, which should be credited specifically to the Chief of our Division of Engineering, T. W. Norcross. The Norcross-Grefe report was not published until 1931, but apparently, "Transportation Planning" was well under way as early as 1928.

When Norcross saw the opportunity, planned a systematic attack, and rang the bell with his "Transportation Planning Methods," he gave all future forest researchers and administrators a well designed tool. In my opinion that is a major contribution.

1930 (*a*). Although Sparhawk may have originated the "hour control" idea in fire control in the early 1920's, and Norcross was designing transportation planning to meet hour-control standards in the middle twenties, still there is no doubt that Show and Kotok made a milestone of that concept when, in 1930, they published Technical Bulletin No. 209, "The Determination of Hour Control for Adequate Fire Protection in the Major Cover Types of the California Pine Region." This popularized the idea and the term sufficiently to produce action in many parts of the country.

In this bulletin, Show and Kotok also added to all previous concepts of "adequate protection" when they went one step beyond Silcox by setting "an annual average of 0.2 percent for the commercial and potential timber types and at 0.5 percent for the nontimbered types" as the criteria of adequate protection in their region. Here was recognition of a "variable standard" varying according to economic demands. There were many other outstanding features of this particular publication, but none, to my mind, either in this bulletin or in their earlier "Role of Fire" and "Cover Type" bulletins, which so strongly influenced national ideas and action as this variable standard.

1930 (*b*). The milepost erected by the District Foresters' Washington meeting in 1930 seems actually to have been primarily and

largely a Nation-wide application of the "variable standard" originated by Show and Kotok.

In view of all previous statements of objectives of fire control, it is well to note here how the district foresters affirmed the past basis of damage as a criterion, as follows: "Damage from fires to forest values varies considerably in the different forest types and the objectives in fire control must be based mainly upon consideration of these variations in damage." The fire control committee, of which Kotok was chairman, then listed (1) timber, (2) site, (3) reestablishment process, and (4) future fire danger, as the four main features of damage. Forage, recreation, and game are ignored, as well as that feature which Show and Kotok were to inject later; i. e., "downstream financial interests."

It is evident that although the objectives were incompletely stated, still there was no doubt that damage was the sound basis. Every milepost in objectives from 1906 up to, but not including, 1935 will be found to be in agreement on that point.

1933. The advent of the CCC's in 1933 appears to me to have been a milepost first in finance and second in methods. Money and labor were here made available to carry out Norcross' transportation plans, Show and Kotok's standards of speed and attack, and build more airplane landing fields for Howard Flint. Cooperation between Federal, State, and private agencies also was pushed ahead in a significant surge. Coincident were funds for greatly expanded research of certain types and better facilities.

But the CCC's brought a surge in methods too, for with that volume and type of labor came both the opportunity and the absolute need of training fire-fighting crews. The man-passing-man, the sector method, the one-lick, and the 40-man shock crew methods of large fire suppression all seem to have been accelerated by the advent of the CCC's.

New ideas not only grow best and can be tested best when you have money and men, but sometimes they are then forced on you. A similar period seems highly probable after the end of the present war. If Hornby's experience is any index of what that means to fire-research men, I hope that we can have our research well under way and not be forced into the 12-hour day and the 8-day week which he worked for 3 years while pressed by availability of CCC money and men.

1934. I have been advised by some of the consultants who helped me prepare this list of mileposts, that fire danger meters should be included. Because of my personal interest in those particular devices, I am automatically disqualified from judging that point. I therefore leave them out.

1935. The so-called "Forester's policy of control by 10 a. m." undoubtedly rates either a milepost or a tombstone on our 35-year road of progress. If and when that policy becomes clearly recognized as a temporary expedient, I believe that it will rate a milepost. If, however, it has become or ever does become the death knell of all previous objectives based on damage, then it rates a tombstone executed in the blackest of black granite. It has already cost us 6 years of attention to variable damage as an objective, but it seems to have

achieved something else which may have been, at the time, worth more than the little thought which might have been given to damage.

It is futile to open a discussion of that policy here and now. It has such a direct bearing, however, on any fire-research program which we may recommend that the import of its impact deserves serious thought.

First, the 10 a. m. policy, if fully enforced, actually sweeps into the discard all previous standards and objectives of fire control. It specifies the same standard of protection for commercial timber, reproduction, forage, water control, recreation, and wildlife. It demands the same speed of control for timber and sagebrush, goat rocks, and valley bottom site I, white pine plantation and decadent hemlock or hair-on-a-dog-back lodgepole. The letter of May 25, 1935, says: "In these respects it treats all areas on an equal basis."

Second, actually the 10 a. m. policy is not fully enforced. The framers themselves never intended that it should be. It therefore says one thing but means another. It is a monumental piece (not masterpiece) of self-deception. Instead of facing facts, it confuses them. It renders systematic fire-control planning impossible because it says that IF you cannot control the fire by 10 a. m. tomorrow by use of all available resources, you can plan on control by 10 a. m. the next day. If that fails, then you may plan for 10 a. m. the third day. Et cetera, until the rain falls! Which 10 a. m. is the fire-control planner to use? The first for commercial timber and forage, the second for old burn and goat rocks, the third, fourth, or fifth for wildlife forage? Only the first, because "In these respects it treats all areas on an equal basis."

Third, to this amateur historian it appears that the 10 a. m. policy actually had the same objective as the Show and Kotok minimum damage theory of 1923; to wit: Stronger prevention and presuppression action so as to catch fires small rather than stronger suppression action aimed primarily at keeping 10,000-acre fires from becoming 20,000—or 30,000-acre burns. There is a vital and basic difference here which will come out in our discussion of the economics of fire control. But if the main idea of the 10 a. m. policy was to catch fires while small, the use of a time criterion—the 10 a. m. tomorrow—would seem to be open to further investigation. For fires can be caught small and cheaply WITHOUT controlling them by 10 a. m. tomorrow. If one function of research is to assemble and array all the significant facts, it seems more than possible that research might contribute something here.

1936. Hornby's methodical treatment of all the significant features of fire control, especially his weighting of each factor and final integration of all of them, has been approved as a milepost by all of the consultants who have aided me in selecting the events that marked progress. While not new, in that fire-control men have always planned, Hornby systematized that planning, made it so methodical, and incorporated so many new features that all future fire-control planners were greatly aided. That is a milepost of progress.

There is one feature of Hornby's work to which I should like to call your attention. I do not believe that his work has very often been viewed from this angle. When Sparhawk set out to "provide

a basis for the proper distribution of protection funds between the different units of the organization"; when he named presence or absence of the causative agencies, cover type, climate and weather, topography, and five factors of controllability as the significant items to measure and integrate, what was he doing that Hornby did not do? Nothing! They were both aiming at the same target. Actually, Sparhawk did little more than set up the target. The records he had to use were so poor that he really had no ammunition. Hornby had far better records and he shot with those as well as with the keen eye of an experienced forest administrator. But he was actually shooting at Sparhawk's target: The proper distribution of protection facilities, hence funds, between different units of the organization.

Both Sparhawk and Hornby likewise turned to the physical conditions on the ground and said to the writers of the Use Book of 1906: "These are the factors that should be considered by each supervisor and by the forester before fixing 'the number for the full summer force of each reserve' and before deciding that 'this allotment will be final.'" They both approached the problem by beginning with the physical conditions on the ground: Sparkhawk said "causative agencies," Hornby said "occurrence rate"; Sparhawk said "cover type, topography, and controllability;" Hornby said "fuel types"; Sparhawk said "climate and weather," Hornby said "measured fire danger," etc., etc. In other words, they both approached their problem from the standpoint of the physical conditions on the ground. They both had the same objective: The proper distribution of protection facilities, but no one gave either man a satisfactory definition of "proper."

The results of many a research project have been determined, and still are determined, before the detailed research begins. The all-powerful determinant is the "approach." Start the problem of distributing facilities or funds on the basis of results attained with past facilities and funds, and you will very probably end up altogether differently than if you approach the same problem from its true beginning—the physical conditions on the ground. Graves named them in 1910, DuBois repeated them in 1914, Sparhawk reasserted them in 1925, Hornby refined them in 1936. Who will be next? And when?

1938. From Hornby's milepost in 1936 to date I cannot find a single event in objectives, methods, or finance that has proved to be of national significance in fire control. I believe that there are three reasons for this. First, in any field of human endeavor, whether it be forest-fire control or the effort to produce a temperature of absolute zero, the nearer you approach your goal the harder it is to take the next step ahead. Second, progress requires men and time to work, and these require funds. Since 1936 funds for all kinds of Forest Service work have been steadily reduced. While we have had additional "relief labor," intellectual progress in objectives and methods of fire control have not been and never will be assisted by ERA and WPA labor. Third, it is difficult to judge the most recent past. Perhaps there have been some steps proposed or taken during the last 5 years which will show up later as milestones of progress.

One recent step, which I believe will be recognized later as a milepost, was taken in Region 1 in 1938 when Sutliff proposed, and Shoemaker and Kelley approved, a uniform, standard relation between current fire danger and the percentage of manpower on duty. Before that, in 1936, for example, when class 4 fire danger prevailed on the Kaniksu Forest that supervisor would have only 23 percent of his total fire force on duty, while under the same class 4 danger the Bitterroot would have 44 percent of its men in place. The spread was even greater when danger became worse and class 5 was reported. Then the Cabinet Forest would have only 41 percent of its force on duty while the Coeur d'Alene would have 81 percent. These are extreme cases. The point is that manpower had not yet been tied to measured fire danger consistently on all forests.[3]

By 1938, however, Sutliff, Crocker, and Hand had 3 or 4 years of records to scrutinize and they did that and more, too. They analyzed. They concluded that if Hornby's principles of planning had been properly applied so that the total manpower on each forest had been properly adjusted to all the significant factors—area protected, causative agencies, fuel types, detection coverage, smoke-chaser coverage, crew attack, etc.—then when class 4 danger occurred on a forest that supervisor should put on the same *percentage* of his total manpower as any other forest experiencing the same danger.

The chart called table X–1–c in the Region 1 fire plan, which has been used in this region since 1938, is the final result of this analysis. While Sutliff himself admits that efficiency can be improved by certain small changes in the shape of this curve, this standard relation for 10 forests in Region 1 has for 4 years done for current fire danger exactly what Hornby's systematic planning did for average bad danger. Hornby's method says that when the permanent factors of danger are thus and so, the following list of stations and facilities must be *available* for occupancy and use. Sutliff's table X–1–c says that when the variable factors of danger are thus and so, the following percentage of those stations will be occupied. Two, clear-cut, logical steps, both essential to adequate fire control at least possible cost.

To my knowledge this standardization of fire control practices on several national forests was first achieved by Sutliff's table X–1–c in 1938. In 1958, when all forests have planned alike, when all are provided with facilities according to uniform consideration of the same factors, and all are manned alike according to uniformly measured danger, Sutliff's method of correlating manpower and fire danger may be judged as a milepost of progress. The possibility is sufficiently great to justify the shadow or outline of this most recent milepost.

While this concludes the list of definite and datable events which I rate, now, as milestones of progress, there has been one other type of progress which must not be ignored. This type is difficult to name and impossible to date. It is illustrated by Kelley's "Fire Code" for the Eastern Forest Region issued in 1926, and by Head-

[3] The writer has subsequently been informed that H. M. Shank had established a standard relationship and was using it on Region 4 forests previous to 1938. H. T. G.

ley's "Fire Control as an Executive Problem," mimeographed in 1928. It is illustrated by the drive to "calculate the probabilities" contained in the forester's 10 a. m. policy of 1935 (which is the best part of that policy). It is the concept that fire control is a tremendously complicated job, but one which is susceptible to orderly dispatch if the man uses his head, looks at all the factors and facilities, forms correct conclusions, and then takes action. To me it seems that this particular phase of the fire problem began when the forest reserves were created in 1904, has become increasingly important since then, and will never end. Progress has been steady, but I cannot name any particular event that stands out like a national milepost.

I am purposefully not saying anything about "regulation" as a milepost in the progress of fire control, although that idea, and especially the recent action concerning it, are certain to exert a tremendous effect in the future.

Conclusion

If this summary of some of the history of fire control appears to be primarily an attempt to pass judgment on history, then I have failed in my main purpose. My real purpose was to collect, select, and relate enough of the major events of fire control during the past 35 years so that we would have a reasonably dependable background or stage for this Priest River meeting. It may be significant that 19 of the mileposts mark progress in methods, 14 are achievements in understanding our own objectives, while only 10 major steps are evident in finances. One might question whether this shows knowledge ahead of practice, or finance retarding application.

I have tried also to assemble the "framework of ideas" within which we are trying to work out our problem, to see the problem as a whole in the light of past accomplishments. My viewpoint or "position toward this field of facts," as Pitkin calls it, is naturally influenced and perhaps controlled by my own personal experiences to date. I cannot help that, but I admit that mine is not the only viewpoint. Others undoubtedly see this field of fact from a different viewpoint. I know that I would benefit by having them do for me this same job that I have tried to do for them: review the field and tell me how it looks to them. We have done altogether too little of that in the past 20 years, and our failure has consituted a serious weakness in our work. I am convinced that many of our present disagreements would disappear if we could get together and look together at the whole valley from each of the several admittedly different vista points. And I am convinced that we here at Priest River cannot expect to lay out a sound fire research program unless we keep in mind the major events which constitute the history of our particular line of work.

SCIENCE SERVICE FEATURES PREVENTION PROJECTS

In November, Science Service, the "Institution for the Popularization of Science," Washington, D. C., sent to the subscribers of its "THINGS of science" educational service all the material items incorporated in the "fag bag" and "superstition" fire prevention projects, and features these Forest Service undertakings as "the most widespread experiment in applied psychology ever conducted in the interest of all the American people."

"THINGS of science" lists among its 5,500 subscribers mainly educators, students, and laymen with a particular interest in science, and is sponsored and distributed by subscription but without profit by Science Service in much the same way as is the SCIENCE NEWS LETTER with which many readers of Fire Control Notes are familiar.

The purpose of "THINGS of service" is to teach by circularizing disassociated individuals with actual "things" having to do with various scientific subjects—things which can be felt and seen—thereby making the projects more near, real, and understandable.

Packets are made up and distributed as the projects present themselves and the materials become available—on as near a regular monthly schedule as possible. Each packet of "things" is called a "unit" and is accompanied by a popularized letter of explanation. The letter names and gives the necessary background of the particular project involved; names, describes, and explains the use of each "thing" or item included; and usually, but not always, suggests methods of teaching or experiments for testing the effectiveness of the material.

In the case of the "Fire Psychology Unit," as the November fire prevention "THINGS of science" packet was called, the letter itself, which follows, is self-explanatory.

Fire Psychology Unit

This fire psychology unit consists of one cloth bag with tag and enclosed note, a button badge, three posters, two museum-type display cards and these sheets of information.

These are the materials for the most widespread experiment in applied psychology ever conducted in the interest of all the American people.

Pin the button badge on your coat lapel and you immediately take an active part in this Nation-wide experiment designed to save the Nation from the annual tragedy of more than 50,000 man-set forest fires on protected lands which destroy acre upon acre of valuable timber and millions of living creatures.

Forest fire fighters have an old saying that you must "Fight fire with fire." They set a back-fire, using the "scorched earth" defense against the spreading invasion of this universal foe.

Psychologists are following just about the same technique when they circulate buttons with the slogan "It's BAD LUCK to start a forest fire."

For superstition, folkways, and something deep-rooted in the customs of the people that is almost akin to fire-worship are believed to have their part in causing men to burn the woods each year.

Nine out of ten of the great forest fires of the Southland, which run free over miles of woods, are set by human hands—most of them deliberately.

The people in that region will tell you that the woods are burned to kill snakes, to keep down the ticks, to destroy boll weevils. But the answer lies much deeper.

The Button

With the button which you have in this unit of THINGS, the hope is to deliberately start a superstition to fight the superstitions of fire setters.

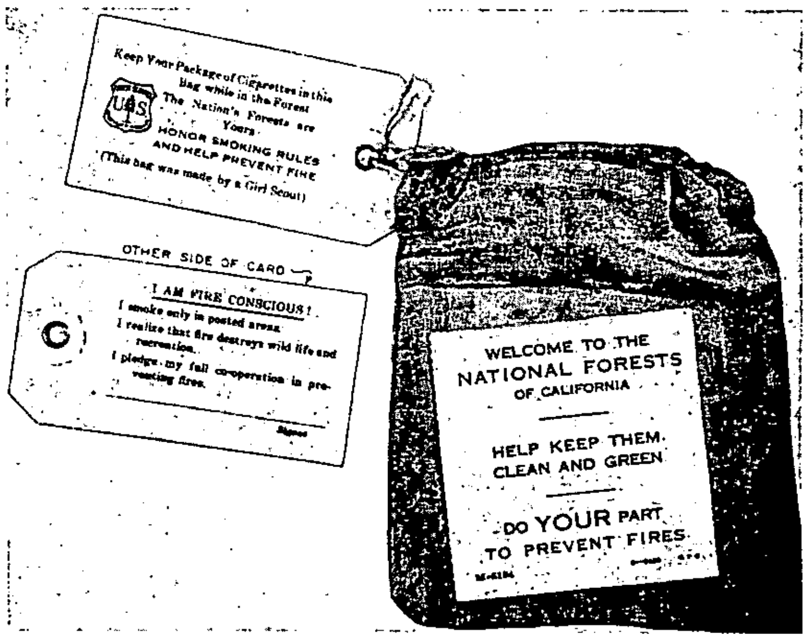
Such a plan has a precedent in the very well known three-on-a-match superstition. Many people who pass along the saying that it is "bad luck to light three cigarettes on one match" do not realize that this bit of folklore is comparatively modern. A credible story of its origin is that it dates back no further than the trench warfare of the first world war. At night up in the front lines, if you held a lighted match long enough to light three cigarettes, it was also long enough for the enemy to take his aim and fire. It was very bad luck indeed.

Whether the superstition was started deliberately for the protection of the doughboys, or whether it spread naturally, based on observation of what happened to the holder of a match kept flaming, it served effectively the same sort of purpose that Uncle Sam's forest fire-fighting forces hope to achieve in their fire-fighting psychological experiment.

Drawback to the experiment is that superstitions—whether they serve a useful purpose or not—are evil things. They can never serve as an adequate substitute for sound knowledge and enlightenment. Psychologists would be the first to assure you of that. But these men who know the workings of the human mind realize that superstitions do have an appeal that is almost universal. They are easily remembered. They work.

The Fag Bag

The cloth bag in this unit of THINGS is also being used in the great fire-fighting experiment in applied psychology. But this psychological tool is intended to make people think. Its purpose is to break up the mechanical, automatic behavior of long habit.



Fag bag F-416478

When a smoker enters a national forest, he will receive one of the fag bags with a pledge card attached. Not only does the smoker sign the pledge to be "fire conscious," but he puts his package of cigarettes into the bag and pulls up the drawstring.

Then when he reaches for a smoke, he cannot light up thoughtlessly. The flame-red bag and its drawstring are reminders of the hazard of a careless smoke, a dropped match, a discarded glowing stub.

Psychological value of the reminder is in the timing. It comes at exactly the right moment to be most effective.

The fag bag also serves indirectly to educate the public in regard to fire dangers, through the children. The bag you have in this unit of THINGS was made by a Girl Scout. Girl Scouts made all the other fag bags used in this great fire-fighting experiment. The material for your fag bag was collected by California school children who held a "Fag Bag Day." On that day they gathered in all the sugar, salt, and flour sacks they could collect for this purpose.

You, too, can contribute by sending any such cloth sacks you may have to the nearest United States Forest Service office. It tells how on the letter to you from William V. Mendenhall, forest supervisor of the Angeles National Forest, that you will find tucked into your fag bag.

The school children who gathered the sugar sacks, the Girl Scouts who made them into fag bags, and the smokers who use them to keep cigarettes in are all made fire conscious by this experiment.

The Posters

In making use of very modern psychological devices for changing the habits of careless smokers in the forests and of men and women who have learned to follow ignorantly the generations-old tradition of burning the woods, Uncle Sam's forest fire fighters are not neglecting the older psychology of advertising.

Effective teaching through "eye appeal" is demonstrated by the posters in this unit of THINGS. Notice that each contains a dramatic painting by the well-loved illustrator, James Montgomery Flagg. Each contains a brief, compelling slogan—"Forest Defense Is National Defense," "Yours in Trust," "Your Forest—Your Fault—Your Loss." Each carries the same easily learned lesson on fire prevention in the form of nine short rules.

The Forest Service welcomes the cooperation of many organizations, companies, and agencies in their campaign of fire prevention. Psychologists know that the most effective way to learn a lesson is to take part in teaching it. One of these posters you have was carried as a full-page illustration in the American Weekly. Another poster, not in your collection, was carried in the advertising of the Texas Oil Co.

The National Fire Protection Association, various religious and fraternal organizations, the American Legion, the Boy Scouts, the Post Office Department, and the Western Union and Postal Telegraph companies are among the organizations that have joined in distributing and posting these educational posters. They are placed in post offices, schools, hotel lobbies, meeting places, and show windows.

Experiments

1. You can try this experiment on one person—perhaps yourself—but it will be more fun and more interesting scientifically if you use a group as your subjects. Have each individual follow this procedure: First, he should read the button and wear it for, say, 10 minutes. Then he should copy and sign the pledge card on the fag bag. Then he should read and study the slogan and fire-prevention rules on one of the posters. Allow about 5 minutes for this. Now take away all the materials and have him write: (1) The pledge, (2) the slogan on the button, (3) the slogan on the poster, (4) a description of the picture on the poster, and (5) as many of the fire-prevention rules on the poster as he can remember. Vary the order of the material studied and the recall for the different persons you test. This is to avoid "loading" the experiment in favor of the material studied first or last or that which it is attempted to recall first.

(Continued on page 69)

RANDOM NEWS NOTES FROM THE FOREST SERVICE RADIO LABORATORY

H. K. Lawson

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The Radio Laboratory has a variety of new equipment and improvements to report which should be of interest to those associated with protection and suppression communication.

The type SX radiophone, superseding the type S, has been completed and 290 sets have been produced and are being distributed to the field. The type SX transmitter, being crystal-controlled, opens the way to improved reliability in ultra-high frequency communication networks and makes possible the successful inclusion of automatic relay equipment in such networks. The type SX can be operated on any one of three crystal-controlled frequencies merely by turning a switch on the panel of the set. The inclusion of three transmitting frequencies permits setting up one channel for local district communication, one for adjacent district or forest or regional fire communication, and one for automatic relay contact, or in any other combination desired.

An attachment, which has been designated as type SXA, provides loudspeaker stand-by service. Where it is desired to use the SX as a station or lookout-communication unit, the attachment can be plugged into the SX and a loudspeaker is then available for stand-by or for off-schedule calls.

This combination of SX and SXA provides the same service facilities as the type SV radiophone which has been discontinued. No tools are required to separate the two units and the SX can be prepared for strictly portable service in less than a half minute. In portable form the SX weighs 10 pounds.

When an SX is ordered with SXA attachment the two units are supplied in a wood kitbox. The box has storage space for heavy-duty batteries necessary for stand-by service and is equipped with heavy-duty battery cable and semipermanent type antenna.

The subject of automatic radio relaying and the purpose and possibilities of such systems was discussed under Random News Notes from the Forest Service Radio Laboratory in the October 1939 and January 1940 issues of Fire Control Notes. Two field installations were put in service in Region 5 during the past season. One relay, an A. C. operated unit, was installed on Mount Diablo, Calif., and was commissioned to provide direct communication between the fire weather office at Mills Field, San Francisco, and reporting stations on 7 different forests. The shortest path between relay and field station was approximately 75 miles and the longest about 210 miles. Aside from an hourly shifting in signal level ranging from weak to

moderately strong on the 210-mile path and on one circuit of about 165 miles the performance of this installation has been extremely gratifying.

A dry-battery operated relay installed on Grey Butte, Shasta National Forest, has further proved the possibilities of the general application of radio relaying. Tests just concluded indicate that a new circuit and system of control, devised since the Grey Butte installation, has completely eliminated the problem of normal battery voltage drop during use. It is hoped that a representative number of these relays will be put into service during 1942 to acquaint the field with the enlarged communication possibilities resulting from inclusion of this new equipment.

A new ultra-high frequency antenna for tower and other permanent antenna installations has been designed and tested. The new antenna to be known as the type PD will produce almost a 2-to-1 increase in equipment performance as compared to the type J described in the Radio Handbook. Detailed drawings of this antenna have been processed and distributed to holders of the Radio Handbook.

A development of which the laboratory group is justly proud is the new type KU–R ultra high frequency mobile radio receiver. Intensive use of 2-way ultra-high frequency communication in cars and trucks has awaited development of a receiver that would discriminate against traffic-ignition interference while providing high sensitivity for weak signals.

The much-publicized system of Frequency modulation (FM) provides this noise-free service, but there are two very important facts that rule out its application to Forest Service problems. First, the Forest Service already has approximately 2,000 ultra-high frequency radiophones, all amplitude modulated (AM) and all serving a useful purpose in communication. It would be impossible to justify a complete change-over to the new system merely to provide a more ideal mobile communication system where, incidentally, the only major improvement in service would result. Second, frequency modulation technique has not advanced sufficiently far to date to permit the production of portable units that can compete with equipment such as the SX in size, weight, and over-all low power consumption.

The new type KU–R receiver so effectively minimizes ignition interference that we can now say that reliable equipment is available for all normal forestry mobile communication problems where ultra-high frequency is desired. Provision is made in the receiver to permit tuning to any frequency in the range of 30.5 to 40 megacycles as well as for crystal-controlled spot-frequency stand-by operation. Crystal-controlled spot-frequency stand-by assures that the receiver will always be on the principal operating channel without necessity of intermittent correction of the tuning dial.

Two types of ultra-high-frequency mobile transmitters are available. One, known as the type KU–T, operates on a single frequency only and has a power output of approximately 8 watts. The other transmitter, known as the type KU–T2, is a two-frequency unit having a power output of approximately 4½ watts. Either of the two frequencies in the KU–T2 are instantly available by manipulation of a single panel control. The two-frequency unit will undoubtedly find wide application in communication systems involving automatic relays

where only frequency can be used for relaying and the other for local network operation.

Since we have mentioned two transmitters, one having a power output 1.77 times that of the other, it seems that this is an excellent opportunity to correct a general misunderstanding as to the effect of doubling the power of a transmitter. For the case at hand, if we assume that a certain arbitrary strength of signal is received at a distance of 31 miles from the 4½-watt transmitter then the 8-watt transmitter will deliver the same strength of signal at only 34 miles—not 55 miles as is often assumed on the basis of a multiplying factor of 1.77 times. This comparison assumes only that the antenna heights remain the same and that there is no radical change in topography in the two cases. The distances indicated in the example are not the maximum working range of the KZ series of transmitters, but serve merely to indicate the comparative coverage to be expected from the 4½- and 8-watt units.

SCIENCE SERVICE FEATURES PREVENTION PROJECTS

(Continued from page 66)

Notice which sort of material is remembered correctly by the greatest number. Can you tell why?

2. Invent a psychological device using the same principle as that of the fag bag to break a bad habit in your own home or community. Remember that timeliness is a key to the effectiveness of this habit-breaker. Here are some suggestions to start your thinking: Want to stop leaving lights burning when you go out of a room?—A light-weight card without sharp corners suspended in the doorway where it must bump your face as you leave the room might be effective reminder until you form the habit of reaching for the switch. Want to form the habit of studying?—Arrange the lighting in your room so that when you push your light switch only your desk and an open book on it is illuminated. (This is not recommended illumination for reading, only as a forceful reminder of your work.) Is scattering of litter on the streets a problem in your town?—Where would you place trash receptacles?—How would you mark them?—Is jay-walking a menace to traffic?—How and where would you warn pedestrians of this danger?

3. If you like a quiz, here is a question to try on your friends: Which of the following are superstitions?—(1) when you see smoke from a woods, you should make a wish, (2) you should break a burnt match twice before you throw it away, (3) a campfire should be built in a hole, (4) woods should always be burned in the autumn to clear the ground—Answer: (1) and (4). Which are useful rules?—Answer: (2) and (3).

A NEW TYPE OF FIRE EQUIPMENT IN MICHIGAN

GILBERT STEWART

Roscommon Experiment Station,
Michigan Department of Conservation

When using water in fire suppression, hand-operated pack-sack water pumps carried by individual men permit extreme mobility, quick attack, and ease of operation, but necessary refiles involve delay. Tank equipment with guaranteed delivery of larger volumes of water is less mobile and slower in attack. The author describes a new water tank-pump-trailer assembly used in Michigan which was designed to include the favorable qualities of both hand pumps and tank equipment.

For the past decade, specialized classes of mechanical equipment have been adapted to every possible phase of forest-fire suppression. In order to increase combat power of fire organizations, manual methods of attack have been supplemented by mechanical means wherever they have been applicable. There are very definite reasons for this. After fire starts, the amount of physical work which must be done, within a short time, is tremenduous. It becomes necessary to stop running fronts, and the entire fire area must be confined as quickly as possible. To do this, barriers must be constructed, immense quantities of fuel may have to be moved, and backfires may have to be set and held at correct places and at proper times. After these tasks are accomplished, there still remains the important work of mop-up and patrol.

All forest-fire agencies have to be organized and equipped to meet these hazardous conditions which constitute the extreme. Under such circumstances, the usefulness of proper machines is very great. Man-power can be conserved, organization simplified, greater flexibility in the assignment of forces realized, and the power of each individual increased, simply because much of the arduous work can be assigned to mechanical equipment.

Disastrous results may develop, however, if mechanical equipment is improperly assigned or if incorrect types are employed. It therefore becomes necessary to provide organizations with a variety of equipment. In Michigan, the assignment of mechanical equipment has become extensive, and within the past year, specialized types of tank units have been perfected for issue to the field personnel of the Department of Conservation. Up to the present time, tank equipment has not been widely used, because correct types have not been developed to meet the requirements of Michigon forest conditions.

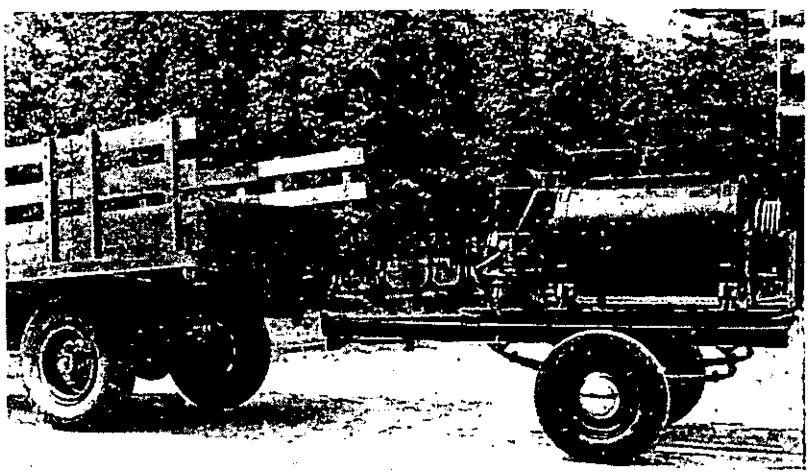
The New Equipment

The term "booster unit" has been applied to tank equipment for a long time. Such machines have been used in forest regions for a number of years, especially in certain portions of the West where no

other type of power equipment found ready acceptance. In most cases, these have been special tank units transported by trucks completely equipped for that particular purpose. Sole dependence could not be placed on machines of this kind for average duty in Michigan because great areas of hazardous character cannot be reached by truck. Additional means of transportation must be provided, which implies trailer mounting suitable for attachment to any truck, pick-up truck, car, or tractor.

A type of tank equipment has been developed at the Michigan Forest Fire Experiment Station which fulfills the requirements of field assignment in this region. Experience had proved that water-pumping equipment could be used with great success in Michigan, where water normally is readily accessible. However, pumping units were restricted to hand-operated pack-sack pumps to do heavy-duty stationary machines. The pack-sack pumps, carried readily by one man, permitted extreme mobility, rapidity of attack, and ease of operation. The working time is relatively short, however, and frequent refills are absolutely necessary to maintain high efficiency on running fire. Power-pumping equipment guarantees the delivery of large volumes of water at any desired point; but fast attack is not usually possible, and there is absolutely no mobility while in use, except as hose line can be shifted.

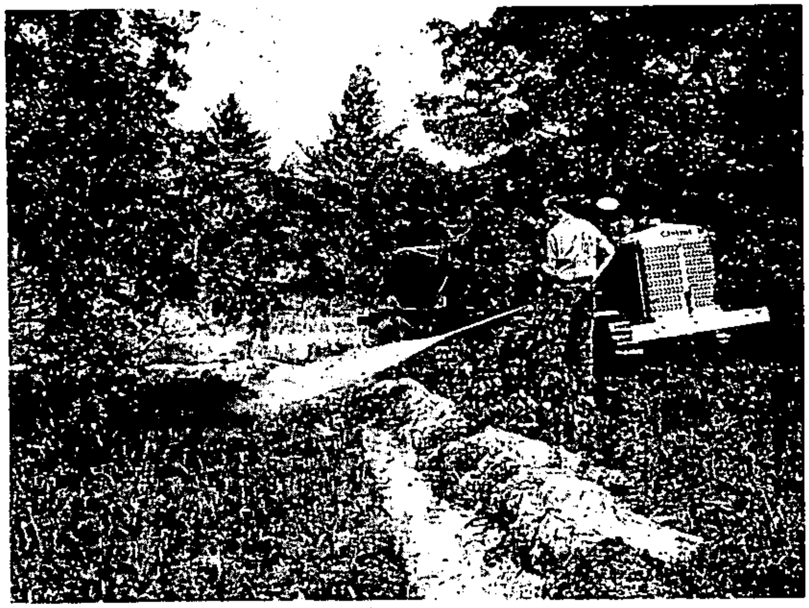
Analysis of field requirements indicated that a third class of machine was greatly needed. The chief requirements were extreme mobility, long working time, moderate capacity, and the reliability of power delivery of water under high pressure. A unit of this kind would incorporate all the advantages of back pumps in terms of mobility and greatly increase the quantity of water carried in one mobile outfit. The weight and bulk involved, however, would take the machine completely out of the class of manually operated equipments consist of a tank assembly, complete with self-contained power pump would guarantee all the advantages of mechanical pumping without robbing the unit of mobility or restricting it to stationary duty.



MICHIGAN DEPARTMENT OF CONSERVATION

Water tank and pump assembly mounting on special trailer pulled by truck.

The machine which has been built in accordance with the requirements consist of a tank assembly, complete with self-contained power pump, tool box, and hose reel. The entire outfit is attached to a sled-like base, and the assembly is one complete unit; all pipe lines and hose lines are permanent and ready for instant use. Inasmuch as the unit is completely self-contained, it may be transported by any truck, pick-up truck, or trailer, which eliminates the necessity for a special truck.



MICHIGAN DEPARTMENT OF CONSERVATION

Water-tank machine, pulled by tractor, in operation on fire line.

A special trailer is a standard part of the outfit, but its use is optional. Trailer transportation, however, permits extreme flexibility in field assignment, and tractors may transport the outfit over rugged terrain and into isolated places where truck transportation would be impossible. Practically all portions of fire fronts may be reached with tractor-trailer transportation.

Actually, the assembly of self-contained tank units is not particularly new. The specialized design and the features which have been incorporated in the new equipment, however, make it particularly adaptable for woods work. The entire unit is 6½ feet long, 30 inches wide, and 40 inches high. The tank capacity is 110 gallons. The complete pumping unit is manufactured by the Novo Engine Co., and its capacity is 5 gallons per minute with a pressure range up to 300 pounds. Power is provided by a 2-horsepower motor, and 2 pumps are driven by it. In addition to the reciprocating pressure pump, an auxiliary centrifugal pump is used for purposes of filling the tank only. These 2 pumps are used at different times: the pressure pump is employed for fire fighting only, and the centrifugal pump for refilling the tank. A selective clutch permits disengagement of the aux-

iliary pump—but the latter is primed by the pressure pump by a special arrangement of hose lines and valves connecting them.

Starting with a full tank, the average working time is about 1 hour 20 minutes. In actual service, water is seldom discharged continuously. This necessitates the installation of a bypass on the pressure pump, which permits water to pass from the pump back into the tank or intake line when the nozzle is closed and eliminates the necessity of stopping both pump and motor when water is not to be discharged.

Ordinary high-pressure hose may be used, size ½ inch and 75 feet long. A special nozzle gun completes the hose assembly. This is a spray gun with a shut-off valve in the handle, by means of which the discharge or stoppage of water is under the immediate control of the operator. The bypass and nozzle gun are features which greatly increase the convenience, usefulness, and efficiency of the entire outfit. Without them, water would be continuously discharged with great waste, unless the pumping unit were stopped very frequently. As it is, the unit can be transported along a fire front with the motor and pump in operation and water discharged only when necessary.

Convenience in operation is provided by a fully equipped tool and accessory box mounted permanently over the tank, so arranged that every spare part and tool has one particular space. A full kit of necessary tools is included, together with a variety of spare nozzles, spray head with a selection of disks, gaskets, foot valve, spare fuel, and oil. Full instructions for operation and care are framed in the lid.

All tractors, trucks, and cars used by the department are equipped with standard interchangeable trailer hitches so that transportation is guaranteed by all of these classes of equipment.

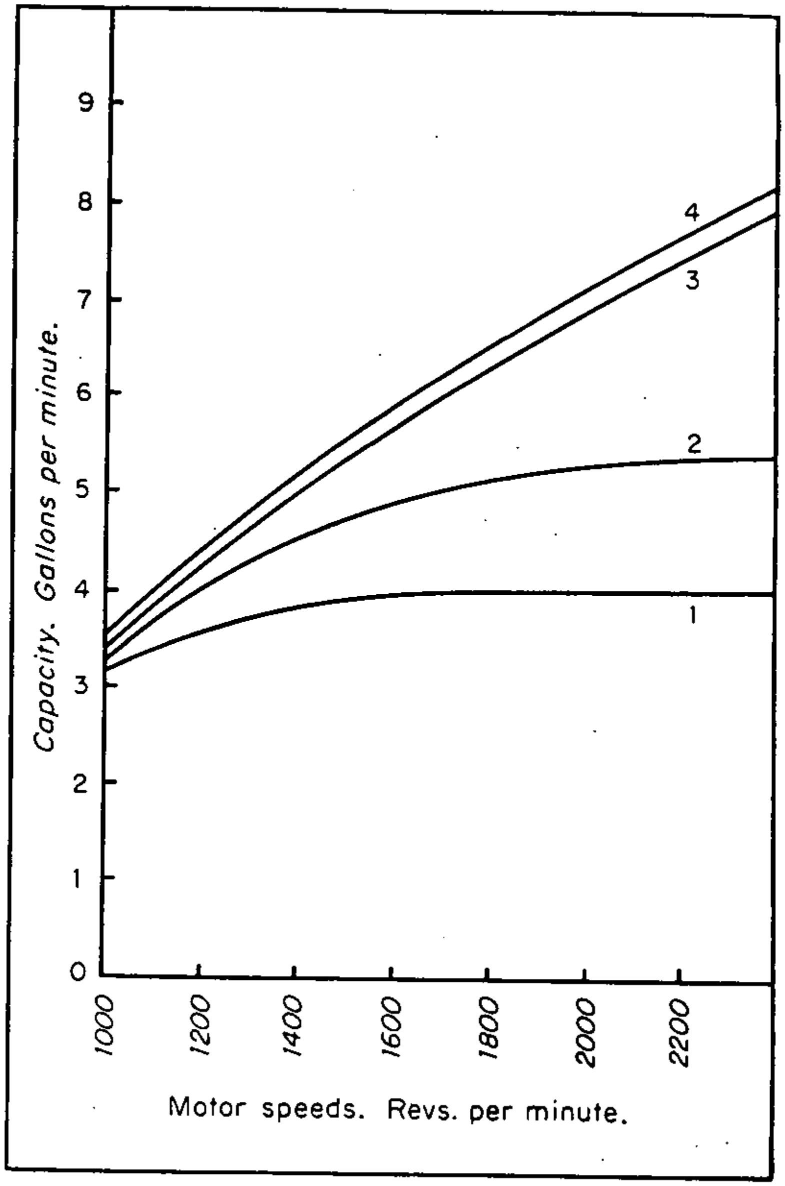
Performance Ratings

Carefully controlled tests conducted at the Experiment Station have determined the capabilities of the pumping unit with which these machines are outfitted. Tables 1 to 4 contain the data assembled from these rating tests.

TABLE 1.—*Performance rating of the Novo pressure pump. Model AU—Capacities developed when operated over a full range of speeds, and when using different sizes of nozzle equipment*

Motor speed (revolutions per minute)	Size of nozzles				Motor speed (revolutions per minute)	Size of nozzles			
	3/32 inch	1/8 inch	3/16 inch	1/4 inch		3/32 inch	1/8 inch	3/16 inch	1/4 inch
	Gallons per minute	*Gallons per minute*	*Gallons per minute*	*Gallons per minute*		*Gallons per minute*	*Gallons per minute*	*Gallons per minute*	*Gallons per minute*
1,000	3.2	3.3	3.43	3.5	1,800	4.0	5.2	6.4	6.58
1,100	3.4	3.75	3.86	3.95	1,900	4.0	5.25	6.7	6.88
1,200	3.6	4.1	4.3	4.38	2,000	4.0	5.3	6.95	7.15
1,300	3.75	4.4	4.7	4.8	2,100	4.0	5.33	7.25	7.42
1,400	3.85	4.65	5.05	5.18	2,200	4.0	5.35	7.5	7.68
1,500	3.9	4.83	5.42	5.58	2,300	4.0	5.38	7.75	7.9
1,600	3.96	5.0	5.75	5.92	2,400	4.0	5.4	7.95	8.1
1,700	4.0	5.1	6.1	6.28					

Governed motor speed is 1,200 revolutions per minute. The pump operates at one-tenth of the speed of the motor.



Capacities obtainable with the Novo pressure pump, Model AU, when equipped for booster duty. Curve 1, 3/32-inch nozzle; curve 2, 1/8-inch nozzle; curve 3, 3/16-inch nozzle; curve 4, 1/4-inch nozzle.

TABLE 2.—*Performance rating of the Novo pressure pump, Model AU—Pump pressures developed when the unit is operated over a full range of speeds, and when using different sizes of nozzle equipment*

Motor speeds (revolutions per minute)	Sizes of nozzles: 3/32 inch	1/8 inch	3/16 inch	1/4 inch	Motor speeds (revolutions per minute)	Sizes of nozzles: 3/32 inch	1/8 inch	3/16 inch	1/4 inch
	Pump pressure—Pounds per square inch					Pump pressure—Pounds per square inch			
1,000	250	175	60	50	1,800	300	300	195	150
1,100	275	217	78	62	1,900	300	399	211	163
1,200	300	246	96	75	2,000	300	300	226	175
1,300	300	275	113	87	2,100	300	300	241	187
1,400	300	300	131	100	2,200	300	300	256	200
1,500	300	300	147	112	2,300	300	300	271	212
1,600	300	300	163	125	2,400	300	300	285	224
1,700	300	300	180	138					

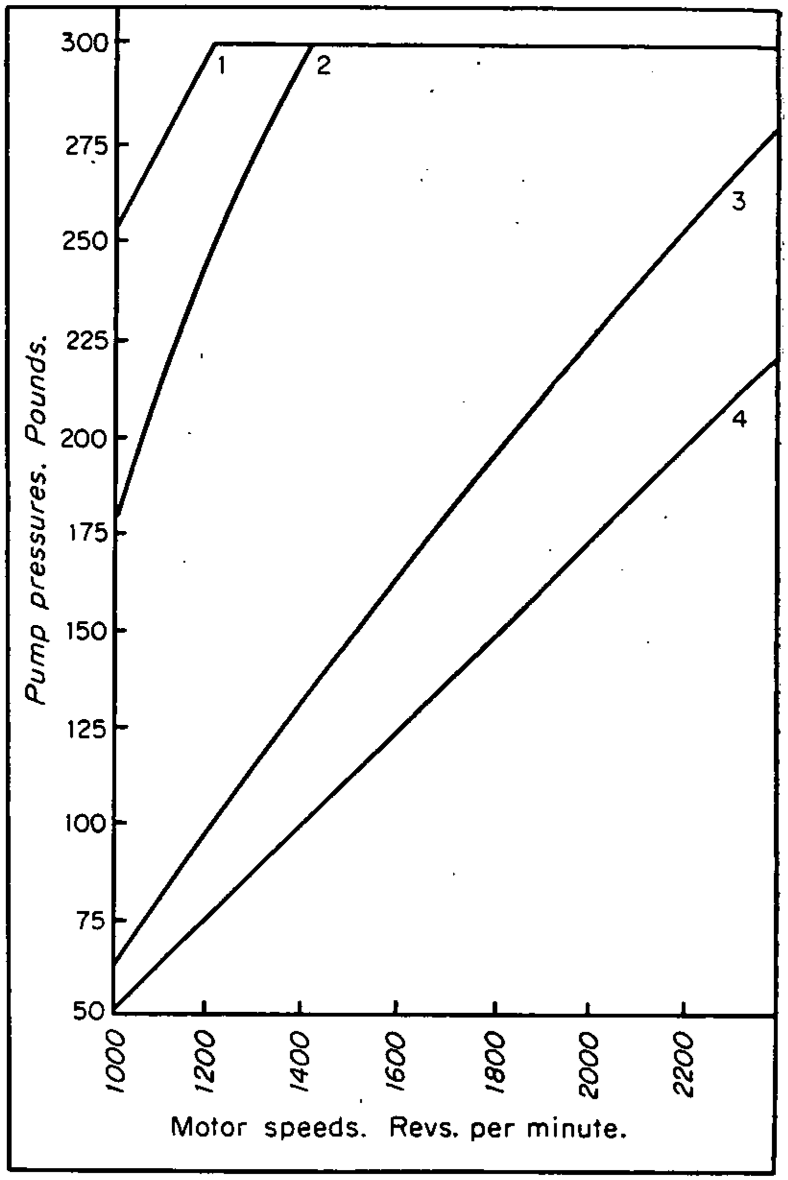
The bypass valve on this particular unit was set at 300 pounds. Normal setting is 275 pounds. Pressures higher than the valve setting are impossible to develop. Water passing through the bypass valve returns to the intake line. Governed motor speed is 1,200 revolutions per minute.

TABLE 3.—*Performance rating of the Novo pressure pump, Model AU—Remaining nozzle pressure available for fire suppression, when the pump is operated over a full range of speeds, and when using different sizes of nozzle equipment*

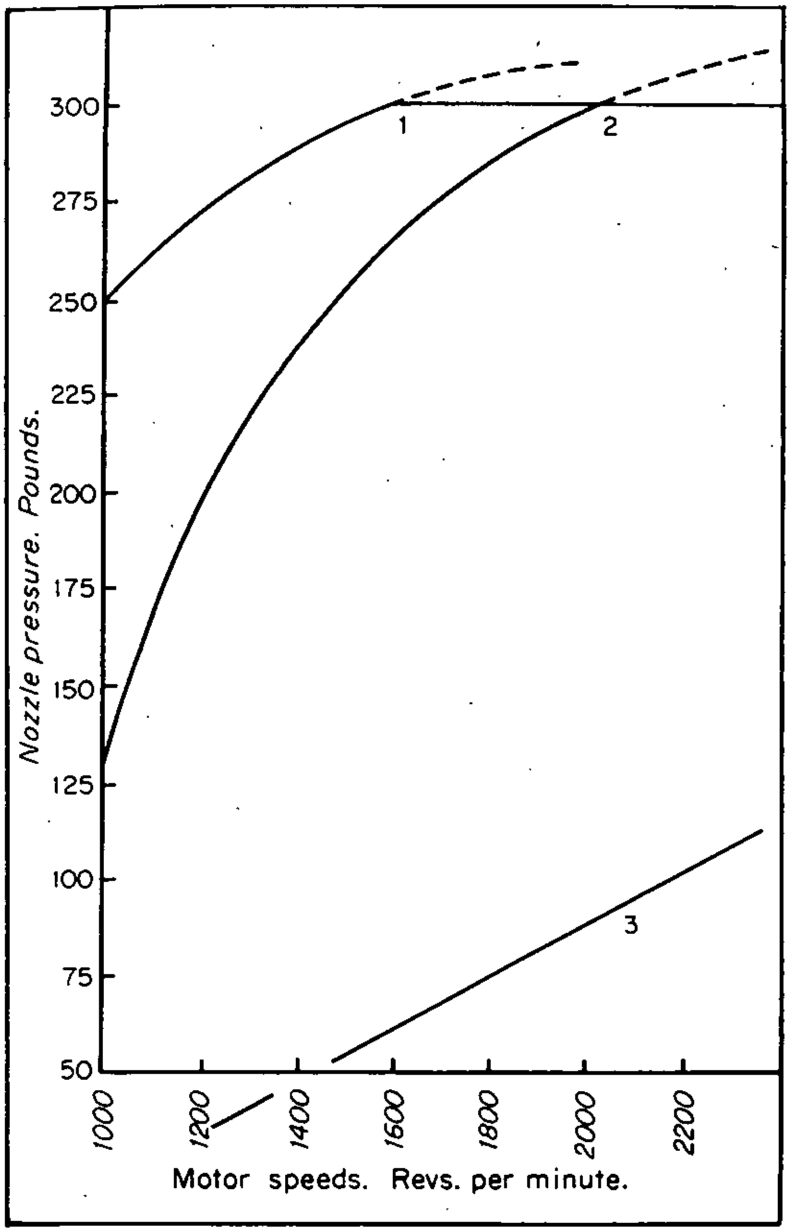
Motor speeds (revolutions per minute)	Size of nozzles: 3/32 inch	1/8 inch	3/16 inch	1/4 inch	Motor speeds (revolutions per minute)	Sizes of nozzles: 3/32 inch	1/8 inch	3/16 inch	1/4 inch
	Nozzle pressure—Pounds per square inch					Nozzle pressure—Pounds per square inch			
1,000	250	130	21	1	1,800	300	287	75	7
1,100	265	165	28	1	1,900	300	294	83	8
1,200	274	195	35	2	2,000	300	300	90	9
1,300	283	217	41	3	2,100	300	300	96	10
1,400	290	237	48	4	2,200	300	300	103	11
1,500	295	255	55	4	2,300	300	300	110	12
1,600	300	268	63	5	2,400	300	300	116	13
1,700	300	280	69	6					

TABLE 4.—*Road test under actual field conditions, showing the performance of the machine in terms of road mileage with constant water delivery; working time; capacities and pressures developed with standard types of hose equipment and when the motor is operated at the proper governed speed of 1,200 revolutions per minute*

Nozzle type	Size of orifice	Capacity	Pump pressure	Road mileage	Working time	Car speed	Remarks
	Inch	*Gallons per minute*	*Pounds*	*Miles*	*Minutes*	*Miles per hour*	
Spray disk	3 1/32	1.42	300	4.6	69½	3–4	3-way spray head.
Do	7/64	3.75	300	1.8	27½	3–4	Single spray disk.
Straight	7/64	4.25	275	1.8	26¼	3–4	Good stream; grass, brush.
Do	3/32	3.6	300	1.9	32⅔	3–4	Do.
Do	1/8	4.1	246	1.45	27½	3–4	Fair stream; grass, brush.
Do	5/32	4.3	150	1.8	24½	4–5	Too little pressure.
Do	3/16	4.7	100	1.6	23⅔	3–4	Do.



Pump pressures obtainable with the Novo pressure pump, Model AU, when equipped for booster duty—Curve 1, 3/32-inch nozzle; curve 2, 1/8-inch nozzle; curve 3, 3/16-inch nozzle; curve 4, 1/4-inch nozzle.



Remaining nozzle pressures available for fire suppression with the Novo pressure pump, Model AU—Curve 1, 3/32-inch nozzle; curve 2, 1/8-inch nozzle; curve 3, 3/16-inch nozzle.

It is obvious that a selection of nozzle equipment is available, and a choice can be made depending on the requirements of the work to be done. Those requirements cannot be established by rule; efficient use of the outfit depends largely upon the experience and training of the fire officers using it. However, some generalization is permissible. Spray nozzles can be used very successfully with high pressures; they are effective on grass fires and other light types of fuel where close approach is permissible. Dense, foglike jets are produced, especially by the multiple-head nozzles, which appear to have a deadening effect far out of proportion to the quantity of water discharged. In all probability a smothering effect is produced, in addition to the drowning action of the water itself.

Sharp, cutting streams are produced by the standard straight nozzles. They are effective at distances up to 30 feet and are used with good results on hot types of fuel which do not permit close approach. Because of the high pressures developed, they derive much of their effectiveness from striking force, in addition to the wetting and cooling action of the water itself. In suppressing fire, given quantities of water are always more efficient when delivered at high pressure, which is especially desirable in small-capacity power pumps. Pressures of less than 150 pounds should not be used for booster duty; pressures of 200 to 250 pounds produce really effective results, and nozzle equipment must be selected accordingly.

Organization and Field Assignment

The real value of new developments in mechanical equipment is never measured solely by laboratory rating tests. Success or failure is determined by actual use in fire suppression. Many different classes of machines have proved successful simply because they have eliminated tremendous amounts of physical labor. Devices which simplify and make organization flexible are extremely useful, particularly when manpower is scarce. Small booster units because of their performance, promise to be especially successful in Michigan. Considering the fact that each unit has a tank capacity of 110 gallons, they are equal to 22 men equipped with pack-sack pumps as far as actual quantity of water is concerned. When transported by truck or trailer, they are exceedingly mobile, and guarantee fast attack and considerable combat power while fires are small. Even on large fires which grow beyond their capacity, these small outfits fill important places in the organization. Under present-day conditions, many fires occur by roadsides or are stopped at roadsides, and one booster unit can undertake the fast patrol of miles of such fire front, thereby freeing many men for assignment along other portions where automotive travel is difficult or impossible. Backfires, or burning-out fires, are usually set at some barrier such as roadside or firebreak, and this work proceeds with great rapidity with the aid of booster equipment.

Irrespective of roads, few places are too isolated to be reached by booster equipment hauled on trailers behind tractors. In fact, this type of assignment promises to increase the usefulness of tractors on fire location.

MICHIGAN DEPARTMENT OF CONSERVATION

Water-tank machine pulled by tractor cross-country through forest en route to fire.

It frequently happens that tractors are removed from duty after adequate fire lines have been constructed, because they are one-purpose machines and no additional work can be done with them. If booster equipment is available, however, tractors can be assigned to patrol duty along all fronts, and the tank unit can be trailed to any desired location for holding backfires and mopping-up portions of fire line that have been successfully held. In this particular phase of work, tank units will probably never completely replace well organized foot crews, but their value can hardly be overestimated in increased combat strength and flexibility of organization that may be gained through their use. Their aid in mop-up and patrol is effective on any fire, especially when crews are exhausted from previous work. Present-day assignment of tractor equipment is for the single purpose of fire line construction. As sufficient tank equipment becomes available, its use will be extended; transportation of booster equipment on trailers by tractors will be considered a function of these machines, equally as important as the drawing of plows.

Disadvantages of Tank Equipment

Certain field conditions tend to reduce greatly the usefulness of booster machines. Of necessity, they must possess considerable bulk and weight. Absence of passable roads, thick cover, rough terrain, and scarcity of surface water for refills are factors which place booster machines at a disadvantage. Like all power equipment, they are not adaptable everywhere, and in localities where adverse con-

ditions exist, considerable care must be exercised in their assignment. Fire organizations, therefore, must be familiar with the situation throughout each district and govern the assignment of tank equipment accordingly. This must be done with all other classes of power equipment, however, and entails no redrafting of fire plans.

Probable Use of Tank Equipment

Throughout most of the forested areas of Michigan, many miles of roads and firebreaks have been constructed during the past 5 years. Moreover hundreds of miles of sand trails have been used for years by fire organizations. These conditions favor the extensive use of tank units because large areas of wild land can be reached by them. They may be dispatched speedily with a crew of 2 men in charge, and permit fast attack on roadside fires with the water carrying capacity equivalent to that of 22 men. In view of the progress being made in the use of cheap chemicals, it is probable that booster units will be the means of handling them on fire location. Whether or not full dependence will be placed on small units of 110 to 150 gallons capacity cannot be predicted. Water is so useful on fire location that larger units are almost sure to be employed, in which case tank capacities will range up to 500 gallons, with pump capacities of 10 gallons per minute.

Conclusions

Based on experience with booster units dating from 1932, certain conclusions are permissible.

1. Forest conditions throughout Michigan favor the use of tank units. Many areas, such as the surface rock localties around Alpena, will not permit the use of any other kind of power equipment.
2. Extreme mobility is of great importance; outfits of 110-gallon capacity permit transportation by light truck or trailer, or behind any car or tractor.
3. Trailer mounting is essential; it avoids tying up special truck equipment solely as tank trucks; hence a large number of cars or tractors may provide transportation when equipped with interchangeable trailer couplers.
4. Flexibility of organization is guaranteed through the use of booster units because duties such as patrol and mop-up can be alloted to them, thereby freeing men for assignment at other places.
5. Power of attack is increased. The tank capacity of 110-gallon units equals the quantity of water carried by 22 men with back pumps.
6. Use of booster units increases the usefulness of tractor equipment. After fire lines are constructed, trailer-mounted tank units may be hauled by tractors along all portions of a fire front.
7. Booster units offer the best chance for extensive use of chemicals in the future. Use of chemicals is not yet justified, but if they are ever employed, liquid chemicals will require self-contained tank units to handle them.

REDUCING FIRE SUPPRESSION COSTS WITH RADIO COMMUNICATION

WALDO M. SANDS

Project Superintendent CCC Camp Wellston, F–68, Michigan

Reduction of fire suppression costs has been the goal for many years of all personnel connected with fire-fighting organizations. Increased fire costs generally result from:

1. Poor organization.
2. Lack of proper communication, resulting in:
   - (*a*) Inability of initial attack crew to get into immediate contact with the towerman or dispatcher.
   - (*b*) Overmanning of fires through sending relief crews by dispatcher or towerman, because of lack of immediate contact with first crew on fire.
   - (*c*) Sending crews from camp or other main stations, thus adding to transportation costs and risking increased burned area through loss of time in travel, when crews in immediate vicinity, if they had been equipped with mobile stand-by communication, such as a portable radio set, could have been sent while fire was small.

The use of radio both in fire detection and suppression during the summer of 1941 by Camp Wellston fire crews proved it to be the most efficient and economical means of communication used to date for fire suppression. This was demonstrated on two fires, on which the burned area and costs could have reached major proportions had dependence been placed on telephone lines for communication.

Pickerel Lake Fire

The Pickerel Lake Fire in sec. 8, T. 20 N., R. 15 W., on July 29, was one of the fires on which the effectiveness and economy of radio were demonstrated. The fire occurred on a low hazard (2) day when the dispatcher and towerman were not on duty. Starting sometime in the morning, the fire burned slowly until shortly after noon, when, whipped up by a sudden high wind, it was discovered by a local man, who reported it to Camp Wellston at 3:11 p. m. The superintendent immediately sent a small crew to the fire with a competent foreman and instructed the switchboard operator at the Wellston Guard Station to stand-by the radio there, and to mount the Udell Lookout towerman and have him stand-by his radio.

Upon arrival at the fire with a few additional men, the superintendent made a rapid survey of the fire, which had started along an east and west road in an old field furrowed and planted to jack pine in 1939. The area at the point of origin of the fire was covered by a rank growth of sedge and junegrasses. The fire, although checked by the furrows, spread rapidly into a heavy overstory of natural jack pine and oak, saplings and poles. The wind was in the southwest and blowing at the rate of 9 miles per hour. Bordering the burn to the north

was an area of slash from the previous winter's TSI operations, toward which the fire was spreading and which it reached before it was controlled.

It was decided that the crew on the fire could control it, and communication was established immediately with the Udell Lookout towerman, using the radio set mounted on the stand-by fire truck. This radio set, incidentally, is part of the fire equipment of Camp Wellston's stand-by unit during the fire season. Needed crew reinforcements for relief and mop-up work were called out, food and water ordered for the fire fighters, and directions given as to the fastest and shortest route to the fire.

The radios on the truck and in the tower were type T radiophone transmitter-receiver, ultra-high frequency sets, operating in a range of 30,000 to 40,000 kilocycles. Messages were relayed by the towerman to the Wellston dispatcher's radio, which is a type U, ultra-high frequency, transmitter-receiver radiophone. Relaying was necessary because of the range of hills between fire location and dispatcher, which made direct communication difficult.

Lack of the radio would have required traveling 10 miles to a telephone line to establish communication with the tower and camp, using additional truck mileage, and losing valuable time when minutes could have meant the loss of a planted area of 210 acres and other timber. Immediate contact with the towerman also made it unnecessary to dispatch additional reinforcements as is customary when communication is delayed and the volume of smoke indicates the fire is not suppressed, which would have caused a large and unnecessary man-day cost. Direct communication with the towerman forestalled an error in judgment in deciding what was the smallest crew possible for control of the fire, as reinforcements could be called out quickly if an emergency arose.

Because of the direction of the wind, the fire burned itself out partially against a fire lane on the east side of the burned area, but had the wind blown from a southeasterly direction, the fire could not have been controlled with the first crew on the scene of action. Any delay which would have prevented establishing prompt communication with the towerman and camp would have meant disaster and the probable loss of several hundred acres of planted and natural-growth area. The saving effected on this fire, shown below, is representative of the many fires on which radio communication has been used successfully.

Increased costs for this fire, had telephone communication been used, were estimated as follows:

Distance to and from telephone line—24 miles with pick-up, at $0.045 per mile	$1.08
Enrollee and superintendent's time lost (1 hour)	1.30
Crew man-days saved on reinforcements—15, at $1.50	22.50
Two trucks at 35 miles each—70 miles, at $0.065 per mile	4.55
Two foremen (time lost—3 hours)—6 hours, at $0.62 per hour	3.72
Total	33.15
Potential damage, assuming fire had not been controlled by first crew and a ½ hour delay had occurred before communication could be established, would have been 210 acres of planted area and 350 acres of oak and jack pine natural reproduction burned, at an estimated value of	3,270.00
Total damage sustained through fire (actual)	291.00
Difference between actual and potential damage	2,979.00

Maple Street Fire

The Maple Street Fire, sec. 14, T. 20 N., R. 17 W., in the Grant Extension, was another example on which radio communication was an indispensable and cost-reducing factor. This fire was reported at 1:53 p. m., August 5, 1941, to the district ranger at Manistee, who left with 5 men to locate it. On arrival at the reported location, no fire or smoke were visible. Because of the flat terrain and heavy growth of timber on all sides, locating the fire by search would have been extremely difficult. The ranger immediately contacted the towerman at Grant tower with a type A set mounted in the dashboard of the ¾ ton International, pump-type pick-up. By establishing his location with the towerman through description of the ground and landmarks, he determined the cross-shot was in error, and was able to correct himself as to the true direction of the fire and eventually reached the burning area at 2:30 p. m. The fire, ¾ of a mile off the main road and almost in the center of a section, was difficult to find. It had started at the edge of an alder and marsh-grass swamp and was burning its way deeper into the swamp. Wind velocity was 15 miles per hour, danger class 5. Rate of spread was 3 feet per minute, but gaining rapidly, because of wind velocity and additional heat from increasing spread of burned area. Area increased 7 acres from time of attack until controlled.

There was no telephone line closer from Manistee, 9 miles away. The delay caused by returning to Manistee or to the tower to try to relocate the fire, based on fire conditions, fuel, type of fire and rate of speed, would have allowed the fire to triple in area, and a larger number of man-days and more supervision would have been required to control it. In addition, the time lost looking for the smoke would have further increased the number of man-days and tended to give the fire time to burn and perhaps reach major proportions.

Analysis of the probable increased costs of this fire, if radio communication had not been available follows:

Probable time lost in looking for fire and establishing telephone communication—5 men and ranger—2 hours	$3.70
Increased area over total burned, because of time between discovery and attack—27 acres—increase in damage	21.60
Probable increase in reinforcements in excess of needs because of failure to locate fire—25 men and foreman	7.24
Truck mileage in excess of needs—60 miles at $0.065 per mile	3.90
Total increased costs	36.44

It is admitted that in both fires we have set up hypothetical cases based on the burning conditions and fire behavior, but it is believed these figures bring out the fact that regardless of the problematical side of the picture, certain definite costs were reduced because of the quick contact established with the towers. Cost reductions were caused by:

1. Less transportation.
2. Use of minimum number of effective man-days for fire suppression.
3. Less time lost in locating fire.

4. Fewer crew reinforcements.
5. Smaller burned area loss.
6. Added protection in case of emergency (intangible cost); i. e., such as sudden shift in wind direction.

THE PRIEST RIVER MEETING

(Continued from page 46)

and influence the right people. Recent advances in applied psychology and in methods of sampling and studying mass opinion seem to offer effective tools that research could investigate and develop to aid administration in increasing the effectiveness of fire-prevention work.

Emphasis in the fields of effects and behavior was toward getting a more complete basic knowledge. Significant was the recommendation of the committee accepted at the meeting that "* * * fire-danger-rating research be temporarily suspended as soon as current work reaches a reasonable stopping point. It is recognized that existing fire-danger-rating systems only partially satisfy the needs of fire control, but pending the more precise definition of the elements of fire behavior, it is believed that more rapid progress in this field will be made by the study of these elements than by further direct study of danger at this time."

The fire-control organization and management committee was handed a very broad assignment and responded in kind. Their job was to examine research needs in problems of detection planning, communications, transportation, fire-suppression organization, and tactics, all having a direct tie-in with control by the administrative organizations. It is here that the big money is spent and even a relatively small percentage increase in efficiency means a sizeable gain. The committee recognized a definite need for objective study in the general field of fire-control management and outlined a comprehensive program of needed work divided between the research and administrative organizations.

A strong point of the meeting was the closeness with which research and administrative men work together. In all discussions full consideration was given research needs for the protection of State and private forest areas as well as those on the national forests. The fine facilities at the Priest River Experimental Forest and the smooth handling of arrangements by the Northern Rocky Mountain Station contributed much to the success of the meeting. As a wind-up, the Southerners were treated to a good Western snowstorm.

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INFORMATION FOR CONTRIBUTORS

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

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

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

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

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