FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

VOL. 24 NO. 4
October 1963

Forest Service
UNITED STATES 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 techniques may be communicated to and from every worker in the field of forest fire control.

Volume 24 Number 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

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, training, firefighting, 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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Forest Service, Washington, D. C.

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FIRE BEHAVIOUR STUDIES IN AUSTRALIA

A. G. McArthur and R. H. Luke[1]

[*Editor's note.*—At this time, when we in the United States are about to embark on a national system of fire danger rating, a report of accomplishments to that end in Australia is gratifying. Admittedly, the problem there is different because the range in climate, topography, and vegetation is not great and because comparatively few organizations are involved. Thus, uniform guidelines for application have developed to a degree far greater than would be possible among the diverse geographic regions in the United States.]

Hazard-wise, Australia can be classified into three main types of area:

Insufficient fuel	60 percent
Subject to grass fires	36 "
Subject to forest and scrub fires	4 "

Broadly speaking, the protection of grasslands and some scrub areas is the responsibility of farmers and graziers organised as unpaid volunteers into legally recognised bush fire brigades. The forest services of the States and Territories are responsible for the protection of about 50 million acres of commercial forest.

The acceptance of national fire danger tables does not present great difficulties in Australia. Because of the small number of States there are only a dozen or so organisations to be consulted, and the range in climate, topography, and vegetation is not great. The work of preparing national tables has been entrusted to the Commonwealth Forestry and Timber Bureau, Canberra, in consultation with State and other authorities.

Since 1953 some 5,000 individual fire reports have been analysed, and 500 large-scale experimental fires studied, under a wide range of fuel and weather conditions. The detailed analysis of major "blow-up" fires has also contributed to our knowledge of fire behaviour.

As a result of this work national fire behaviour tables have now been produced for both grassland and forest conditions. The majority of fire protection agencies are now using them, but it is too soon to say that they have been universally adopted. The Commonwealth Bureau of Meteorology is using the tables in providing fire danger forecasts to the general public through press and radio.

The tables adequately represent the present state of our fire behaviour knowledge. For convenience only 6 variables out of a possible 12 or 14 have been used. As our knowledge increases through a careful programme of experimental burning in a wide range of fuel types, the tables will be improved. A reappraisal would be desirable at least every 5 years.

In preparing the tables the use of hazard sticks for the assess-

[1] Respectively, Senior Forestry Officer, Forestry and Timber Bureau, Canberra, and Fire Protection Officer, New South Wales Forestry Commission.

ment of fuel moisture has been dropped in favor of "straight out" meteorological elements.

In the forest fire danger tables a basic fire danger index is first derived. This assumes that (1) the lesser vegetation is 100 percent cured and (2) no residual wetting from recent rain is present in the heavier fuel components. Shade temperature, relative humidity, and wind velocity are the variables used to derive a range of basic fire danger from 0 to 100. The index of 100 represents "worst possible" conditions in a surface fuel concentration of 5 tons per acre. This is a representative figure applicable to eucalypt forests which have been unburnt for 10–15 years. A 5-point classification of low, moderate, high, very high, and extreme is used and is directly related to rate of spread and difficulty of suppression in the 5-ton-per-acre fuel type.

The effect of recent rainfall is taken into consideration in arriving at a drought factor based on the amount of rain, elapsed time, and the degree of curing of the grass component of the surface fuel. At a drought factor of 1 the full basic index is effective. At values less than 1 the basic index is reduced proportionally.

Tables tend to be somewhat inflexible due to the necessary grouping of classes. To overcome this, the national system has been converted to slide rule form. Mark I of this system was in a square form with three slides. This has been recently converted into a circular slide rule similar in format to the U.S. Forest Service Type 8-100-0 meter. Additional variables can be built in as their relative influence on burning conditions is defined.

Rate of spread for a given fuel quantity is related directly to the fire danger index (table 1).

TABLE 1.—*Rate of headfire progress over an extended period in high forest*[1]

Fire danger classification index	Quantity of surface fuel		
	10 tons/acre	5 tons/acre	2 tons/acre
	Chains per hour	*Chains per hour*	*Chains per hour*
Low 1–5	1–8	½–4	0–2
Moderate ... 6–12	9–18	5–9	2–4
High 13–24	19–37	10–18	4–9
Very High .. 25–50	38–75	19–37	9–12
Extreme 51–100	76–150	38–75	12–30+

[1] Tables for grasslands are organised on similar lines. See McArthur, A. G. Fire danger rating tables for annual grasslands. Forestry and Timber Bureau, Canberra. 1960.

The fire intensity in a specific fuel type is related directly to the fire danger index and is thus proportional to the rate of forward progress. Similarly fire damage per acre is directly proportional to the fire danger index in a constant fuel type. The potential size of a fire is the product of the rate of spread and suppression difficulty as represented by control time. It is a power function of the danger index.

(In Australian forests, because of the oil content of eucalypt leaves and of the flash fuels common on the forest floor, fire behaviour, during periods of very high to extreme danger, often

FIGURE 1.—Experimental fire No. 556 south of Dwellingup, Western Australia, 21.3.62. This fire is burning in a 20-year-old fuel type averaging 7 tons per acre and represents behaviour 1 hour from origin. Flame height is around 20 feet, and the headfire is throwing spotfires 15–20 chains in advance. This is a three-dimensional, high intensity fire and provides much necessary information on erratic fire behaviour.

involves crowning, long distance spotting, and high rates of spread. In some forest zones containing scattered grassland areas, long distance spotting and virtual mass ignition have produced forward rates of spread of 6–8 miles per hour for several hours. Effective suppression under conditions of very high to extreme fire danger is therefore difficult and sometimes impossible while a fire is making its run.

FIGURE 2.—Experimental fire No. 563 near Dwellingup, Western Australia, 23.3.62. The fire is burning in 2-year-old leaf litter averaging 1.5 tons per acre and represents behaviour at 120 minutes from the time of origin. Flame height on the headfire is 2 feet down to 1 foot on the sides. This is a two-dimensional, low intensity fire and represents ideal control burning conditions in this fuel.

A glance at table 1 will emphasise why there is widespread interest in hazard reduction as a means of restricting fire spread under severe conditions. Naturally the studies made first for the preparation of fire danger tables soon led to the examination of means to carry out control burning safely and economically (see Forestry and Timber Bureau Leaflet No. 80, "Control Burning in Eucalypt Forests" by A. G. McArthur). The factors to be considered are total quantity of surface fuel; quantity of surface fuel available for burning, determined by the pattern of recent rainfall; ambient temperature and relative humidity relationship which affects surface fuel moisture content; time of day in relation to safety and fuel sorption; and the effect of wind, slope, and these other factors on rate of spread and flame height. Flame height is related to scorch level. The height to the base of the crowns of the eucalypts determines permissible scorch level and therefore the permissible flame height. The control burner must then study weather and fuel conditions to enable him to restrict flame height.

The burner must also study the spacing of the spotfires and the pattern of burning in order to avoid undue increases in fire intensity when adjoining fires draw together.

When reading an account of any research programme, there is a tendency to ponder the extent of its application in the field. In this case the relationship is a very close one. Western Australia has recently felt the need to overhaul its hazard reduction programme, and a large proportion of the control burning studies

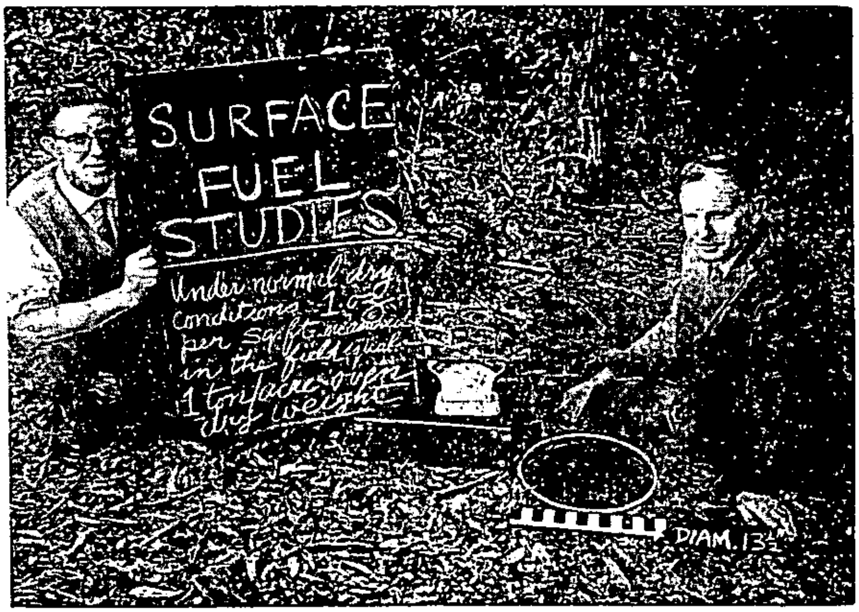

FIGURE 3.—Illustrating a simple means of estimating the oven-dry weight per acre of cured surface fuels within the range of 10–25 percent fuel moisture content.

were done with early application in view. The desire for a satisfactory system of fire danger rating has been universal in all States. In this article, however, we will confine ourselves to the position in New South Wales.

The first step in that State has been the production by the New South Wales Forestry Commission of fire behaviour tables in an abbreviated form for quick reference in office or field. On a card measuring 12 by 10 inches, folding to 4 by 10 inches, the tables relating to forest fire danger rating and to control burning in eucalypt forests appear in summarised form. There are also some additional graphs and tables which suggest to the forester the means for making local forecasts of temperature, humidity, and wind in relation to the movement of air masses and the location and spacing of isobars.

One thing always leads to another, and in New South Wales two further steps were taken. The first has been the provision of field weather kits, similar to those on issue within the U.S. Forest Service, so that foresters may measure the suitability of local conditions for control burning or prepare local forecasts in the field. The second has been the issue of photographs to illustrate various fuel types and to suggest simple means of making fuel studies in the field.

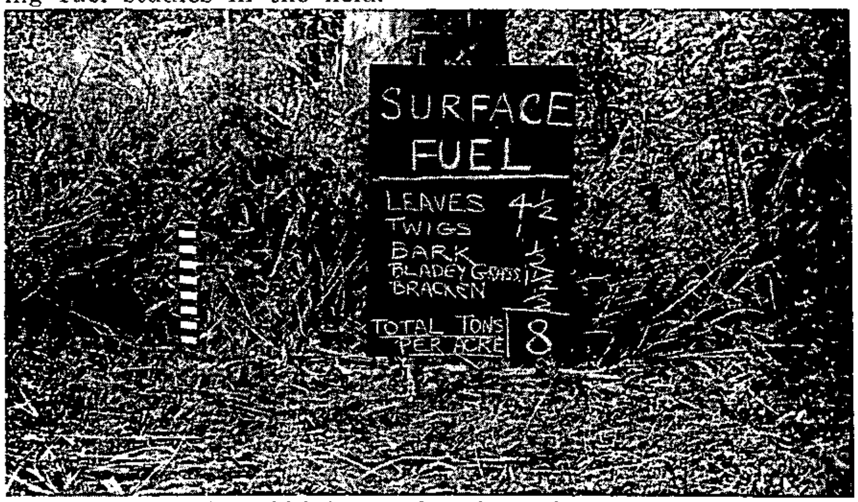

FIGURE 4.—This site, which has not been burnt for 16 years, is in an outer suburb of Sydney. The tree in the foreground is *Eucalyptus saligna*. Bladey grass (*Imperata* sp.) is a dangerous flash fuel when cured.

There are few specialists in the Australian forest services. Most field officers are accustomed to carrying out a wide variety of marketing, budget accounting, silvicultural, construction, and protection tasks. One of the jobs of the specialist is to digest his specialty into a few simple suggestions so that the field practitioner is not inundated with paper. Part of our purpose in preparing this article was to indicate our own attempts to get down to earth.

THE INTERREGIONAL SUPPRESSION CREW

DIVISION OF FIRE CONTROL, U.S. FOREST SERVICE

The recruitment, training, development, and organization of men into well-conditioned, highly skilled, versatile firefighting crews has always been an objective of the Forest Service. The "40-man," "Hotshot," and similar crews have been examples. A crew with high mobility along with the other criteria mentioned that can reach a large fire and do effective work during the first burning period has long been a dream of Fire Control people. The ability to move a crack firefighting crew to a critical fire situation on short notice adds a new dimension to a local unit's plan for control of a wildfire. The Forest Service had five commando-type interregional fire crews for the 1961 fire season and increased these to nine for the 1963 season.

Men for these crews have been recruited and trained in the western United States and are used primarily as reinforcement to initial attack forces. Crew headquarters have been carefully selected. Ideally, they are located near large airports and available to high priority fire work. This enables rapid transport by large aircraft to critical situations. When not actively engaged in training or suppression, they perform hazard reduction, maintenance, or construction duties.

Movement and use of interregional fire crews among the Regions has been coordinated by the National Fire Control Coordination Center in Washington, D.C. This permits a central office, which has the national fire control picture, to analyze and estimate potential situations and assign priorities when the demand for crews is greater than the supply.

A crew is normally composed of a foreman and 1 alternate, 3 squad bosses with 1 alternate, and 24 crew members. Men must be from age 18 to 45 and pass a yearly physical examination. They must be willing to fly and be away from home base for extended periods. Some crew members are required to have had previous firefighting experience. A few are trained in special skills such as operating power saws, trenchers, pumpers, and radios. Emphasis is placed on handline construction, mopup technique, use and care of hand tools and specialized equipment, organization, fire behavior, and safety. Each crew member is equipped with a fireman's pack and can be self-sufficient for 48 hours. Crews can be broken into several smaller units if conditions warrant, or can be combined with another crew if the going is slow and a larger crew is needed.

Experience has already shown that assignments to the interregional crews are highly prized. In some cases, the experience is used as a steppingstone to selection for smokejumping. It is customary for these "high-production" crews to be assigned control of the most difficult sectors of project fires. Outstanding performance under difficult conditions is expected and obtained. High morale and a certain esprit de corps are present in these groups, which consider themselves "the best." Performance to date indicates that they are meeting their objectives and giving the Forest Service a crack reinforcement force not previously available. Experience and training on these crews should also encourage students and other young men entering the Forest Service to consider careers as fire control professionals.

FIREFIGHTERS' WORK SHIRT

MISSOULA EQUIPMENT DEVELOPMENT CENTER
U.S. Forest Service

Several firefighters have died in the past few years from burns resulting from the ignition of clothing by flames and sparks. Evaluation of fire-resistant, orange workshirts during the 1961 fire season by smokejumpers and other special crews was extremely favorable. These personnel, in completing questionnaires, indicated the following assets of these shirts:

Color.—The bright orange color permits the quick location of men on fires by personnel in aircraft. Fireline overhead can maintain better contact with personnel when smoke and dust cause poor visibility.

Durability.—The shirts were equal to or better than ordinary work shirts.

Protection.—The shirt material is treated with a permanent, fire-retardent chemical. The shirts can be laundered or drycleaned many times without losing this protection. The material will char when in direct contact with flames or burning embers but does not support flame.

Use of these shirts averted a disaster on one large fire. During a blowup, a 20-man smokejumper crew was cut off from the escape route and took refuge in a helicopter spot. Intense heat and dense falling embers ignited several crew members' trousers and canteen covers. Later examination of their shirts showed only minute spark holes. The helicopter pilot who evacuated the crew stated that the orange shirts enabled him to locate them.

Because of the successful use of this shirt,[1] the Forest Service has adopted a Service-wide policy regarding issuance and use of flame-resistant clothing. Distribution of this clothing depends on the employee's estimated probable exposure to hazardous fireline conditions.

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[1] An interim specification has been prepared for the orange fire-resistant shirts. The specification includes small, medium, and large sizes. The neck sizes and sleeve lengths of the shirts are 14½–15 and 32 (small), 15½–16 and 33 (medium), and 16½–17 and 34 (large). The cost of each shirt is approximately $5.

MICHIGAN SAND CASTER—MODEL III

STEVEN SUCH
Supervisor, Forest Fire Experiment Station, Roscommon, Mich.

The Model III Michigan Sand Caster is a machine created to retard and suppress forest fires. It was designed and manufactured by the staff of the Forest Fire Experiment Station, Michigan Department of Conservation, Roscommon, under a project which began in 1957 in cooperation with the Forest Service, U.S. Department of Agriculture.

This machine is the third in a series of sandcasters, all of which were developed to test the effectiveness of sand in large volumes on forest fires. This model is intended to come as close as possible to a final design. The Model III is a self-contained unit having two engines—one to propel the crawler-tractorlike machine, and the other to provide power to the caster head. The caster, or rotor, is mounted in front and is hydraulically controlled to provide swiveling action through a 90-degree arc. It also has a hydraulically actuated deflector, permitting control of the trajectory of the discharge. Operation of the sandcaster is a two-man job; one man being in charge of the tractor movements, and the other controlling the sandcasting.

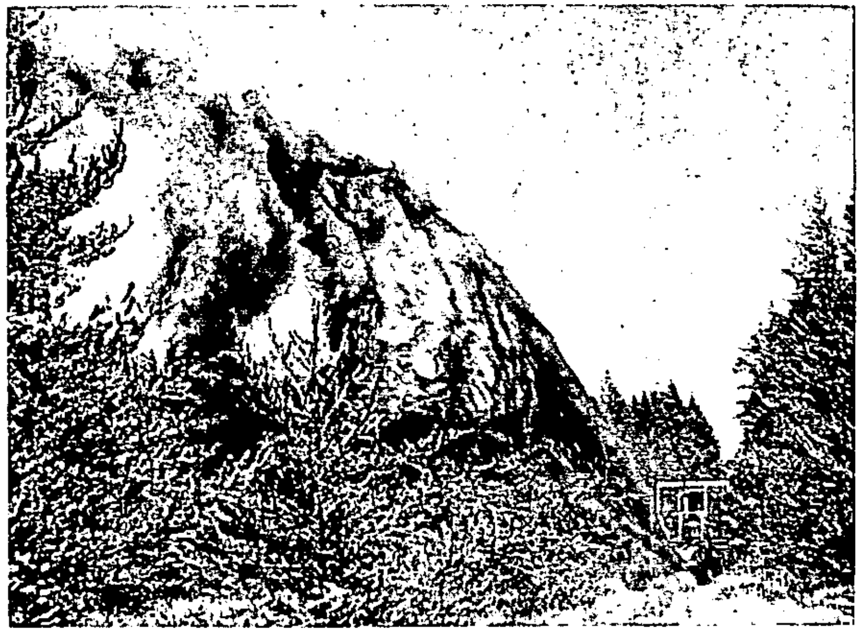
The physical dimensions of the sandcaster are:

Height	8 feet
Width	6 feet
Length	14 feet
Weight	15,000 pounds

Performance characteristics indicate a consistent discharge of 4 cubic yards of sand at velocities of about 6,000 feet per minute (70 m.p.h.), reaching elevations of 25–30 feet and distances of 50–75 feet. Fire conditions determine the pattern of sand discharge.

In practical use the sandcaster may have several functions. It is capable of building line similar to that produced by a fireline plow; it can extinguish flame by the direct application of the sand; it can pretreat areas ahead of the fire by placing sand on the ground or in aerial fuels—the sand acting as a retardant. The capability of pretreating makes this machine unique among other methods of forest firefighting. Sand is an excellent retarding agent, besides being a fine suppressor.

The Model III Sandcaster moves at 1 to 3 m.p.h., depending on the terrain and the density of growth. It operates in various cover and soil types, but discharges smaller volumes in the heavy sods and clays because such soils are more demanding of power. Buried obstacles such as rocks, roots, and stumps either stall the machine



or are discharged by the rotor or pushed aside. If the machine is stalled, a shear pin device protects the power train; also, the spring-mounted rotor head allows for some vertical movement to compensate for such occurrences.

Transportation to and from fires is accomplished by the use of a lowboy type semi-truck, such as those used for hauling tractors. Therefore, the speed of delivery to a fire is governed by road conditions and the speed of the truck itself.

The potential of forest fire sandcasters has not yet been established because of the lack of machines and experience. Because of their impressive performances, however, there is a growing conviction that they will eventually find their way into regular usage.

IMPROVED FIELD DESK

MISSOULA EQUIPMENT DEVELOPMENT CENTER
U.S. Forest Service

Fire bosses, timekeepers, blister rust control camp bosses, and others who must keep many records in the field will find their work greatly simplified by a portable desk designed by the Missoula Equipment Development Center (figs. 1 and 2). Constructed of light sturdy plywood, the desk folds into a compact unit which may be airdropped or trucked to remote areas. The cost of constructing the desk is approximately $160. Plans and materials lists are available from the Regional Forester, Missoula, Mont.

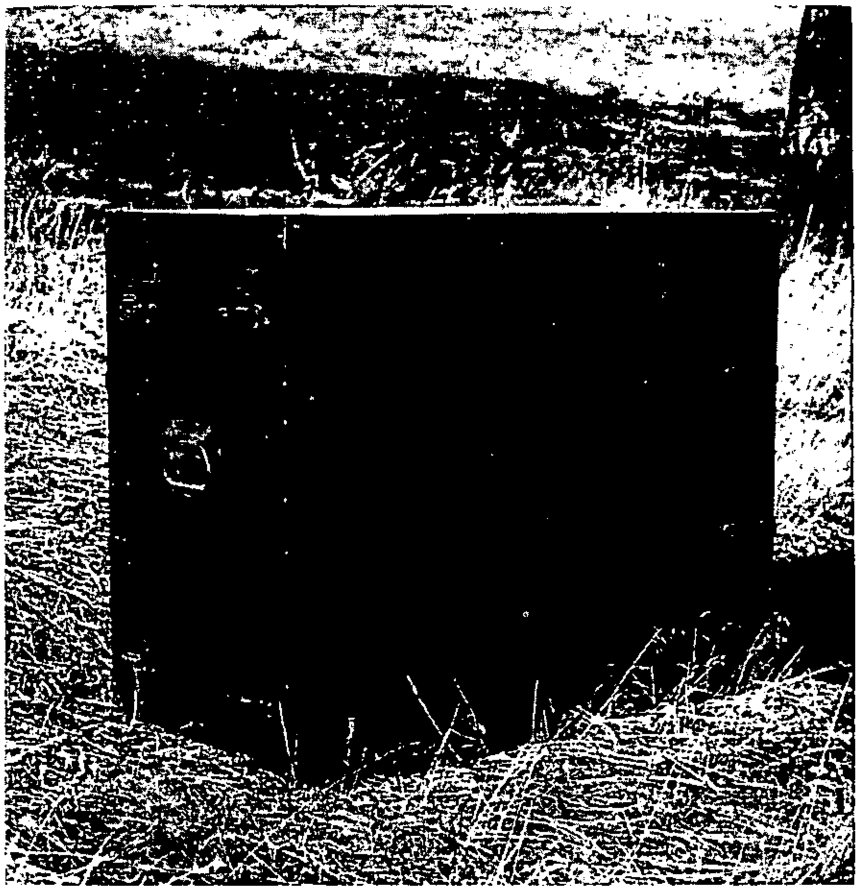


FIGURE 1.—When folded, the desk contains chairs, records, forms, writing supplies, and a gasoline lantern. The desk is 33½ by 28 inches. When empty, it weighs 106 pounds.

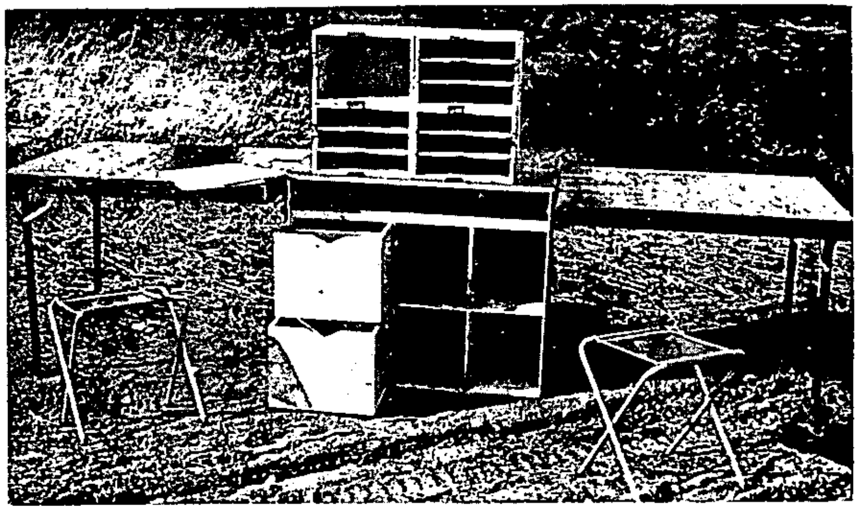
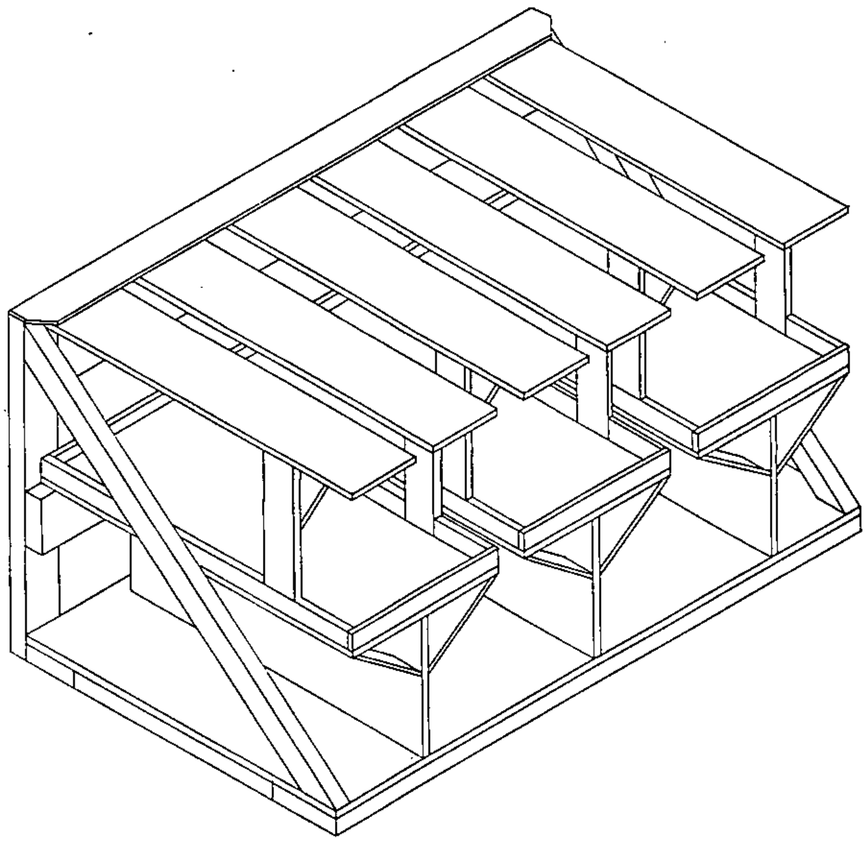


FIGURE 2.—When unfolded, the desk's covers convert to tables. Drawer partitions are adjustable.

CARE AND STORAGE OF HANDTOOLS

INTERMOUNTAIN REGION
U.S. Forest Service

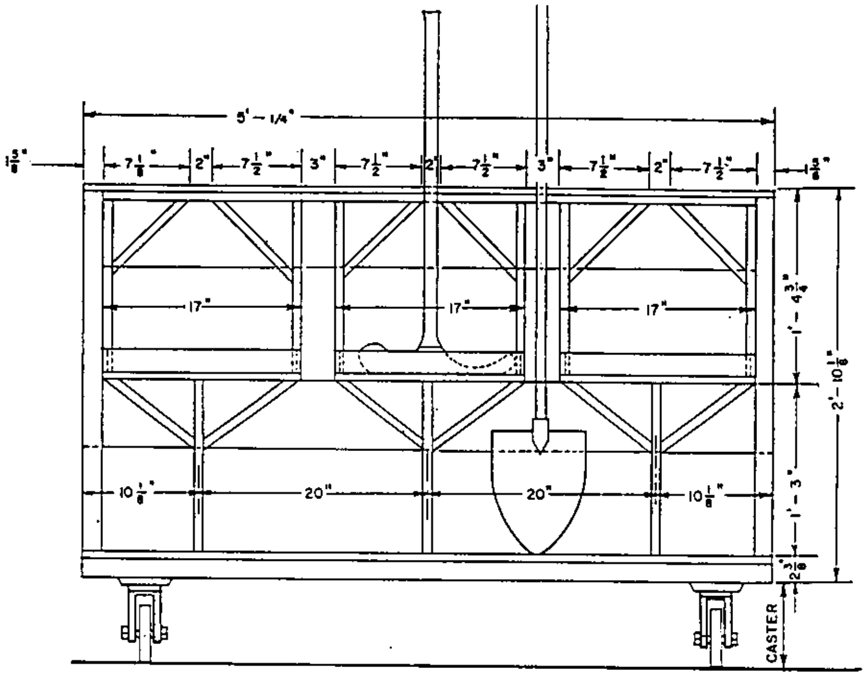
One method of storing fire control handtools such as shovels, pulaskis, and axes is by use of the rack shown in figure 1. The rack can be constructed easily from the specifications (fig. 2), using the material listed. Attaching castors to the rack facilitates loading, since it can be easily rolled to a doorway or ramp close to the truck. In some National Forests similar portable racks have been constructed for use in fire camps. Such racks help reduce damage to fire tools which often results when the tools are piled.



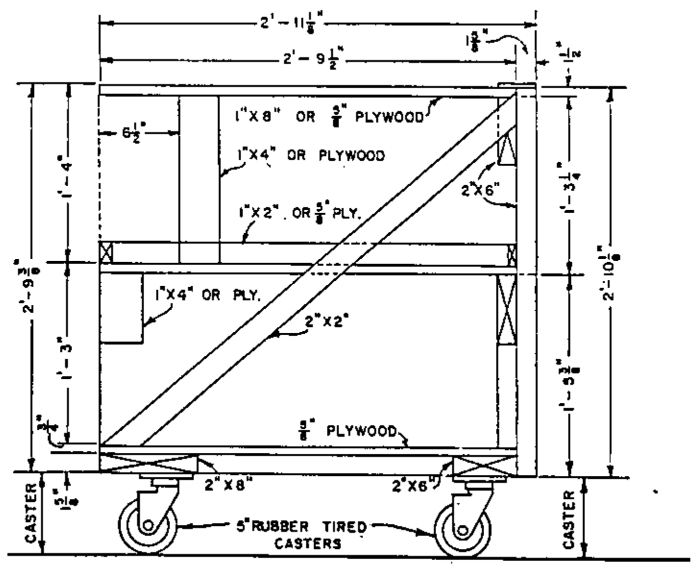
	MATERIAL LIST
QUANTITY	ITEM
2 Sheets	5/8" X 4' X 8' PLYWOOD
1	2" X 8" X 6'
2	2" X 6" X 12'
1	2" X 4" X 6'
1	2" X 2" X 6'
3	1" X 2" X 10'
4	DARNELL NO. 1-75K CASTERS

NOTE: NAILS NOT INCLUDED IN MATERIAL LIST

FIGURE 1.



FRONT ELEVATION



SIDE ELEVATION

FIGURE 2.

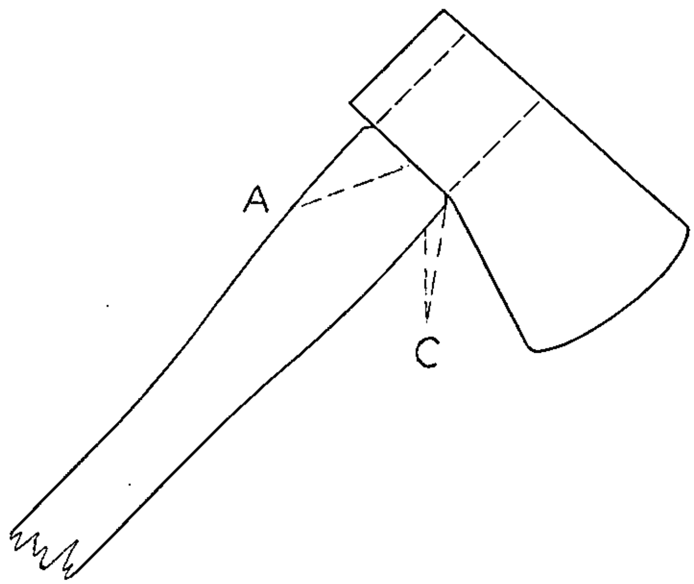
HANDLE BREAKAGE PREVENTION

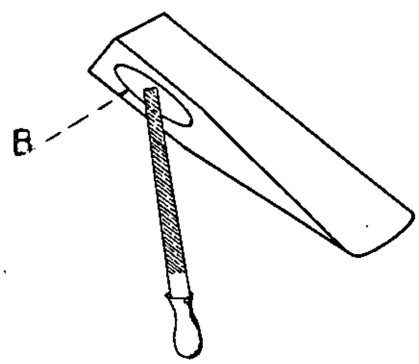
LACY JOHNSON
Forester, Superior National Forest

Ax, pulaski, and hammer handles break most frequently just below the head (*A* in the figure). Much of this breakage can be prevented. Two factors, singly or combined, cause most handle breakage.

The first factor is the sharp metal corner at the inside edge of the handle hole (*B*). This corner forms a sharp apex from which handle breaks may start when a glancing blow is struck. This damage can easily be eliminated. When fitting a handle, file the inside of the hole to a rounded or beveled edge. This type of edge permits compression of wood fibers at the critical point.

The second factor is the presence of a heavy handle cross section close to the sharp corners of the haft hole (*C*). The heavy handle allows little spring or bending during the shock of a blow and in twisting of the blade. The heavy handle should be trimmed with a rasp, drawshave, or power sander before installation.





PLASTIC TENT FLY

MISSOULA EQUIPMENT DEVELOPMENT CENTER
U.S. Forest Service

Laboratory and outdoor tests of a 16- by 20-foot, reinforced plastic tent fly have been completed. This model has the following advantages over the standard cotton duck fly:

1. Unit cost is about $15, compared with $46 for the cotton duck fly.
2. It weighs 8.5 pounds, versus 46 pounds.
3. The plastic fly will not mildew and is a better reflector of heat and light.

Nylon reinforcing scrim, 22 threads each way, is sandwiched between two layers of plastic film. The material is cut and fabricated on the bias. Seams and grommet reinforcing patches are heat sealed. Tiedown grommets are at 3-foot intervals along the edges.

The plastic fly was exposed to outdoor weathering conditions for a 30-day period. Weather conditions during this testing period varied from mild temperatures with light rain to subzero temperatures, heavy snow, and wind velocities up to 30 m.p.h. Inspection of the fly after testing revealed no appreciable damage. All grommets held, and there was no seam separation.

LITTER FUELS IN RED PINE PLANTATIONS

J. H. DIETERICH

Research Forester, Lake States Forest Experiment Station

The weight and composition of forest fuels in red pine plantations are being studied over a large area in central Lower Michigan. These studies are designed to obtain basic information on total volume, moisture content, composition, and distribution of combustible material available in specific forested areas. To date, only red pine plantations have been studied. Fuel weight—especially available fuel weight—is an important factor in predicting fire behavior and intensity. Other factors that may be equally important are fuel moisture content, fuel size and arrangement, and chemical composition.

As a part of the Lake States Station's fuels study, some detailed measurements have been made on ground fuels under plantation stands (fig. 1). This work is a continuation and expansion of the red pine plantation fuel work done by LaMois[1] in 1958. In 1961, 16 separate stand conditions were sampled. Two 1/10-acre plots were randomly located in each stand. Age, site, and stand density were determined, and 10 subsamples of forest floor material were collected from each plot. The subsamples consisted of all dead organic material on the forest floor that could be readily separated from the mineral soil. In young red pine plantations, a sharp line apparently separates combustible material from the layer that is predominantly mineral soil.

As each subsample was collected, it was divided into two parts: The L layer (litter) and the F layer (all material below the L layer to mineral soil). The layers were relatively easy to separate by carefully removing the surface needles down to where the darkened needles were matted and lightly bound together by fungus mycelium. These two layers of material make up that portion of the forest floor that would be consumed by fire if the fuel moisture content was sufficiently low. The L layer is the surface fuel component that changes rapidly in moisture content and affects rate of fire spread.

Individual samples were analyzed in the laboratory by determining the oven-dry weight of the needles in the L layer, branchwood in the L layer, all material in the F layer, and miscellaneous material such as bark and cones. After these results were obtained, a total dry-weight value was determined and applied on a per-acre basis.

Depth measurements were also made of both L and F layers. Four depth measurements were averaged for each subsample. Knowing the depth and weight per acre of both layers, a total weight per acre of forest floor material was determined.

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[1] LaMois, Loyd. Fire fuels in red pine plantations. U. S. Forest Serv., Lake States Forest Expt. Sta., Sta. Paper 68, 19 pp., illus. 1958.

FIGURE 1.—A typical plantation of good site, 33-year-old red pine showing surface fuel conditions. This stand contains approximately 150 square feet of basal area and nearly 10 tons of combustible surface fuels per acre.

By separating the two layers and obtaining both depth and weight for each layer, density values were computed that indicate rather clearly why the less dense litter layer changes moisture content rapidly and may burn more readily. They also show why the F layer, with higher density, may retain more moisture and burn as a smoldering fire. These density values are:

L layer	7,000 pounds per acre-inch
F layer	11,600 pounds per acre-inch
Average forest floor	9,300 pounds per acre-inch

The *total weight* of forest floor fuels correlates well with basal area in the stands that were sampled. Figure 2 shows a weight prediction curve based on stand density or basal area per acre. Stand age may also be used to strengthen the prediction equation

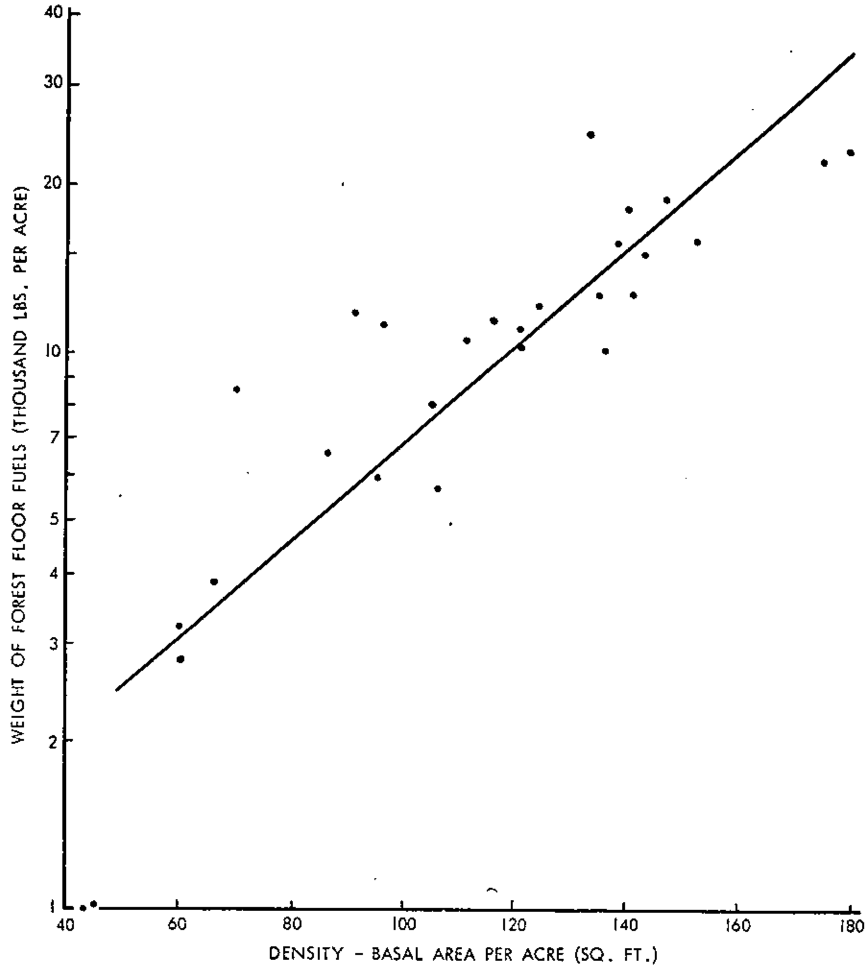


FIGURE 2.—Weight of forest floor fuels, according to stand density in red pine plantations on good sites in Lower Michigan. The prediction equation is: Log (forest floor fuel weight) = 2.9640 + 0.00877× (basal area per acre).

for determining total weight per acre, but it was not included in plotting the data for figure 2.

Litter weight (L layer) also correlates well with stand density in stands 15 to 20 years old (fig. 3). Not enough stands older than 25 years were available for a representative sample in that category. The stands younger than about 10 years still had a mixture of grass and weeds on the grounds that precluded meaningful fuel estimates.

This study has established a procedure for systematically sampling surface fuel conditions in pure plantations of red pine. The work should now be extended to cover other conifer types and stands of mixed conifers, as well. It is generally recognized that surface fuel weights increase with both stand age and stand density. The amount of these increases has not been established for Lake States forest types. Surface materials are an important fuel component in established pine stands or plantations. Fuel volume determinations for these stands may eventually create a better understanding of fuel-fire relationships.

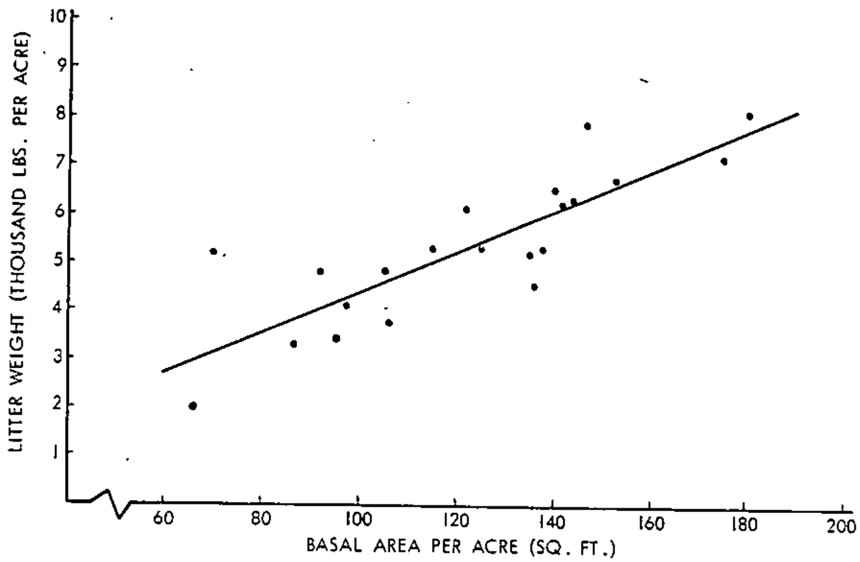


FIGURE 3.—Weight of upper layer needles or litter on good site red pine plantation, 15–25 years old, Lower Michigan. The prediction equation is: Litter weight in thousand lbs. per acre = 355 + 41.18× (basal area per acre).

INDEX, 1963

[Jan., pp. 1–24; Apr., pp. 25–50; July, pp. 51–85; Oct., pp. 87–111]

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.

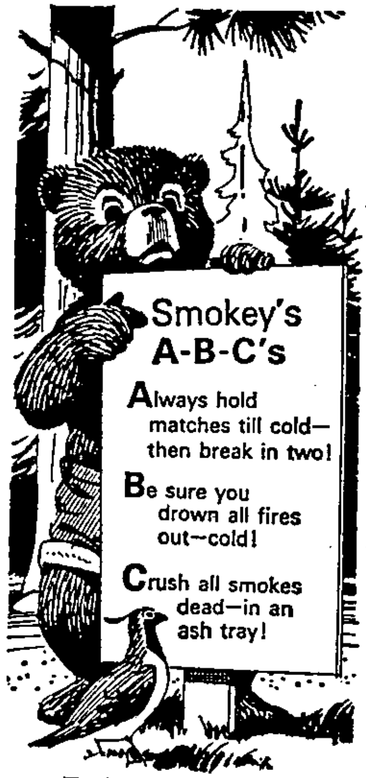
The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

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. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

India ink line drawings will reproduce properly, but no prints (black-line prints or blueprints) will give clear reproductions. Please therefore submit well-drawn tracings instead of prints.


Smokey's
A-B-C's
Always hold matches till cold—then break in two!
Be sure you drown all fires out—cold!
Crush all smokes dead—in an ash tray!