3.11

ORGANIZED FIRE-FIGHTING CREWS AND THE EFFECT THEY WILL HAVE ON HOUR CONTROL

A SENIOR THESIS

PREPARED AND PRESENTED

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--Forward--

In this, my senior thesis, I have attempted to sum up in a brief, concise form the results of studies by various authorities on fire prevention and suppression, whose object it has been to bring out simple facts that everyone knows, but whose importance, few have realized. To these studies I have added my own experience and observations obtained during four seasons with the Fire Protection organization of the Shasta National Forest, California. My observations have to do with a new and particular phase of fire suppression work that was experimented with the season just past with high success. That this new phase will have a marked effect upon the yearly damage and cost of fires, is what I will endeavor to bring out.

To those men who have offered me every assistance possible and who have placed me in such a position that my observations and studies were possible, I am very grateful and deeply indebted. Supervisor T. J. Jones, Ranger L. T. Solaro, and George A. Gowan, of the Shasta National Forest and Forest Experiment Station respectively, deserve special mention.

--Hypothesis--

It is my belief that the present much feared fire menace of the forest is rapidly becoming controllable, and that it will not be many years before the now, primary concern in forestry, will be checked to a very secondary consideration. I believe that the extensive and continued use of organized crews, whose value I am to bring out, will be a potent and dominating force in bringing about the desired objective.

I base my belief on the rapid progress made by experimentors in new lines of fire suppression. The slowness of adoption of the fruits of these experimentors is all that has slowed up a rapid decrease in fire damage and costs.

Introduction

*(2) 1. Ancient fires

It is probable that forest fires have occurred ever since there were forests. When wood is reduced to charcoal, its structure may be perserved indefinitely. It is in the coal formations that some of the earliest evidence of fire may be found. The charcoal of peat bogs in North America, some of which are estimated to be from 2,000 to 3,000 years old, are indications of the occurrence of fires in the far distant past.

Fire-scarred California bigtrees indicate that great fires occurred there in the years 245, 1441, 1580, and 1797. Evidence has been found of forest fires that occurred in Colorado during 1676, 1707, 1722, 1753, and 1781. And also of numerous ancient fires in the Black Hills of South Dakota, the earliest of which is estimated to have occurred in 1720.

It seems reasonable to assume, and the assumption is supported by evidence, that fires destroyed the forests that probably once covered the great prairie region of the Middle States. This belief is held because trees will grow in these areas if given encouragement and protection.

2. Growth of fires.

Since those ancient times it is everywhere evident that the area over which fires have burned has increased steadily. There seems to be a direct

*(2) Refers to reference in Literature Cited.

Literature Cited

correlation to the number of fires and the area burned with the advance of civilization and the growing of populations.

Not only have the fires increased greatly in number and size, but the damage that they have caused has also steadily increased. The damage is measured in loss of human life and personal property because with the steady increase in populations homes and people have been forced farther and farther back into the forest, hence to be destroyed. The damage is also measured in greater values destroyed because with the growing populations the forests have continued to grow in value.

3. Cause of fires.

(2) At least two causes of fires operated in ancient times, lightning and Indians. The practice of Indians in firing forests, prairies, or swamps was to permit the growth of berries, to drive out game, and occasionally to impede an enemy. That this practice was continued long after the advent of the white man is shown by many accounts of such fires in the early history of America.

The fires of modern times are caused by much the same agents, lightning and man, however, the man caused fires are now with an entirely different object in view from those set by Indians.

The man-caused fires of today in the forests may be classified as follows:

1. Railroads
2. Campers
3. Brush burning
4. Incendiary
5. Sawmills
6. ~~Lightning~~

(2) Lightning is responsible for about 17.5% of the present fires.

4. Damage

Some idea of the present great damage of forest fires can be summed up in the figures put out by the

(3) Forest Service the past year.

1. Direct cost of fire suppression $4,049,466.00
2. Measurable damage(other than cost)3,652,248.00

Besides these direct costs and damages there were very great unmeasurable damages to watersheds and recreational playgrounds.

Body

Organized Fire-fighting Crews as used in this paper pertain to a body of men employed on monthly pay and held in a camp, prepared for that purpose, and who are in a state of readiness at all times.

(1) Hour control is defined as a classification of area according to the number of hours of time required for travel to fires from points at which employees and cooperators are stationed. It takes into account:

(4) 1. Discovery, or the time from start to discovery; 2. Report time, or the time from discovery until the individual responsible for first attack is notified of the fire; 3. Get away time, or the time spent by the control force after the report is received before actually starting for the fire; and 4. Travel time, or the time consumed in getting to the fire.

In this paper I will deal mostly with the third part of hour control, or that which has to do with get away.

In order to tie in, or, as it were, to show the effect of organized crews on hour control I will go into the present damage caused by fires, the cost of suppression, the factors that effect the spread, the rate of spread, and the months of the year of fire occurrence. From these I intend to point out the value of a quick get away, and the value of having a sufficiently large force of men to attack the fire effectively upon arrival.

(5) 1. Damage

Only a small part of the damage done by fire is immediately evident. Fires run through stands of timber comparatively lightly, usually. Only occasionally and in the younger stands do they flare up into the tops of the trees and become crown fires. For the most part the fires are confined to the underbrush and forest litter, burning fallen dead trees, and killing by heat rather than by actual flame getting into the crowns of live, full grown trees.

A. Fire scarring

From a close study of the virgin forests today, the effects of fire can be determined in detail. As a result of former fires, many trees already bear scars, and these are a common point of attack for even the lighest surface fire. Once this catches on fire it will burn for many hours; the wood is slowly eaten away, and finally the tree will fall. This usually results in the finest trees of the stand being destroyed. Not all fire-scarred trees burn down, but a reckoning of those that persist shows that about 14% of the full volume of the timber is lost.

B. Killing by heat

Another form of loss is the killing of the trees by heat. The amount of damage from this source varies widely, but averages nearly 1,600 board feet
(5) per acre for each fire on lands well stocked. The damage from this source seems to vary with the density of the stand. Heat killing is generally unimportant in very dense stands while in open stands the forest may be entirely wiped out. The reason for this is that the crowns of the trees in the open reach nearer the ground and are more exposed to the intense heat.

C. Injury to crowns

The trees in the open may not be entirely killed but their crowns are so damaged as to seriously impare the future growth. In some cases as much as 25 to 30%, this has been found by measuring the rings before and after the injury.

D. Aid to insects.

The damage to virgin forests due to fire is serious enough, but it by no means represents all the damage caused by burning. Indirect injuries that follow in the wake of the fire contribute also to the gradual wearing down of the forest. Insect attacks is one of these.

On some burns the annual rate of loss on each acre has reached a figure of 500 to 800 board feet as compared with a loss of 35 to 75 board feet on adjacent unburned areas.

(5) E. Aid to fungal attacks

In a detailed study of white fir, nearly half of all serious infestations were tracable to fire scars, through which the spores of the fungus gained entrance to the heart of the wood. With incense cedar 85% of the cases where culls resulted were due to fire.

F. Destroys young growth

The above are some of the ways in which fire, even light surface fires, reduce or injure the merchantable portions of the virgin forest. But another, and highly important part of the forest, is made up of young growth. These young trees are the hope of the forests of the future. They are particularly subject to destruction by fire, because the bark is thinner, the foliage closer to the ground, and the buds not so well protected from heat as are those of the mature trees. Without young trees no forest can continue indefinitely.

G. Progressive forest deterioration

The role of fire in the forest is thus a long and complicated process, which has operated on an enormous scale for centuries, as the evidence in the remaining understocked forest and brush fields show.

How seriously the fires of the past centuries have reduced the density of our forests is well shown by the fact that in one national forest, on good soil, second-growth stands have in the past 50 years
(5) attained a yield of 74,000 board feet per acre, whereas the virgin forest, from 200 to 300 years old, yields but 34,000 feet, or 46% as much. In another forest in the rare patches of fully stocked virgin timber the yield is 110,000 board feet compared with 42,000 to the acre for the average best. The virgin forest is certainly less than half stocked, chiefly as one result of centuries of repeated fires. When man becomes accomplice, as a cause of more frequent fires, he does not alter the process at all, but simply accelerates its action and increases the odds against the forest.

(6) H. Injury to the soil

In every forest there is a certain amount of humus mixed with the mineral soil. This is of value, both physically and chemically. If a forest is burned over repeatedly, however, the humus in mixture gradually disappears, and since the leaves which fall are destroyed, and no humus is formed, the soil is injured.

Besides the direct injury to the soil through change in chemical content, and physical quality, fires do damage through opening the way to soil erosion.

J. Injury to recreational values

Besides the above methods of injury that can be measured quite directly there is the damage to recreational values. These values are becoming more important yearly, as shown by the ever increasing inroads of the tourist into the forest. In some sections of the country the recreational values are considered primary to all others.

2. Cost of fires.

(3) Some idea of the immense cost of fighting fires can be gotten from the last annual report of the Forester to the Secretary of Agriculture. In this report the Forester estimated that during the last five years an average of $2,056,892, was spent for fire suppression alone. This figure did not include the time of forest officers.

Damage is, of course, by far the greatest factor in the total cost of fires, but it is a rather intangible subject, so in this paper I will use cost of suppression. This, besides being fairly tangible, is of great interest and importance and will serve to bring out the point for which I am striving.

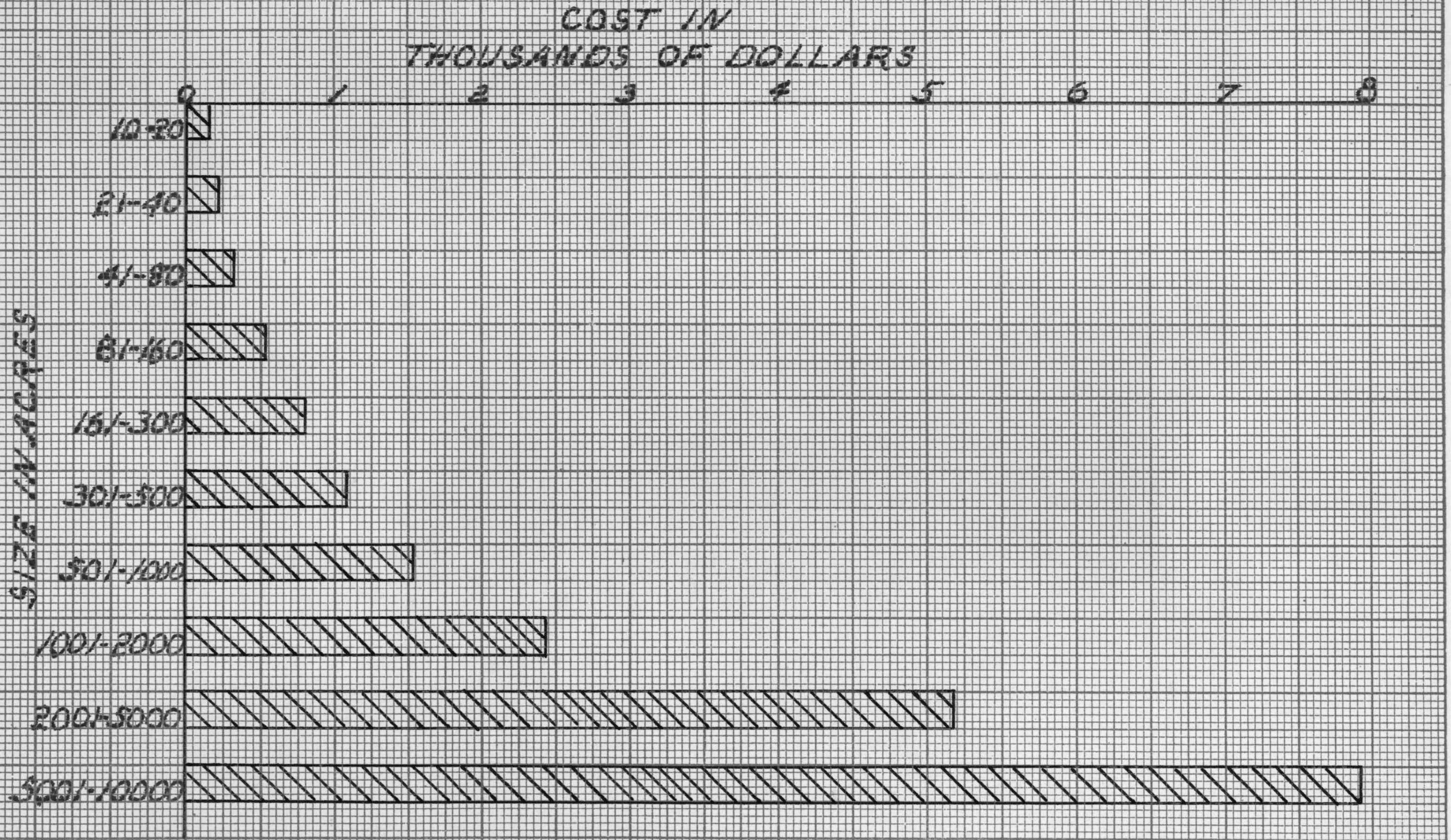
A. Relation of cost of fires to size.

To bring out how the cost increases, and in just what proportion it increases, with the increase in the size of fires, I have obtained the cost figures from the northern forests of California for fires that occurred there during the past ten years (from 1920 to 1931). A chart of about how these figures run, has been prepared. This will serve to show the significance a little more clearly.

The cost of class C fires were taken separate from the As and Bs because the suppression costs vary much more evenly with C fires and will bring out the relationship of cost to size much better.

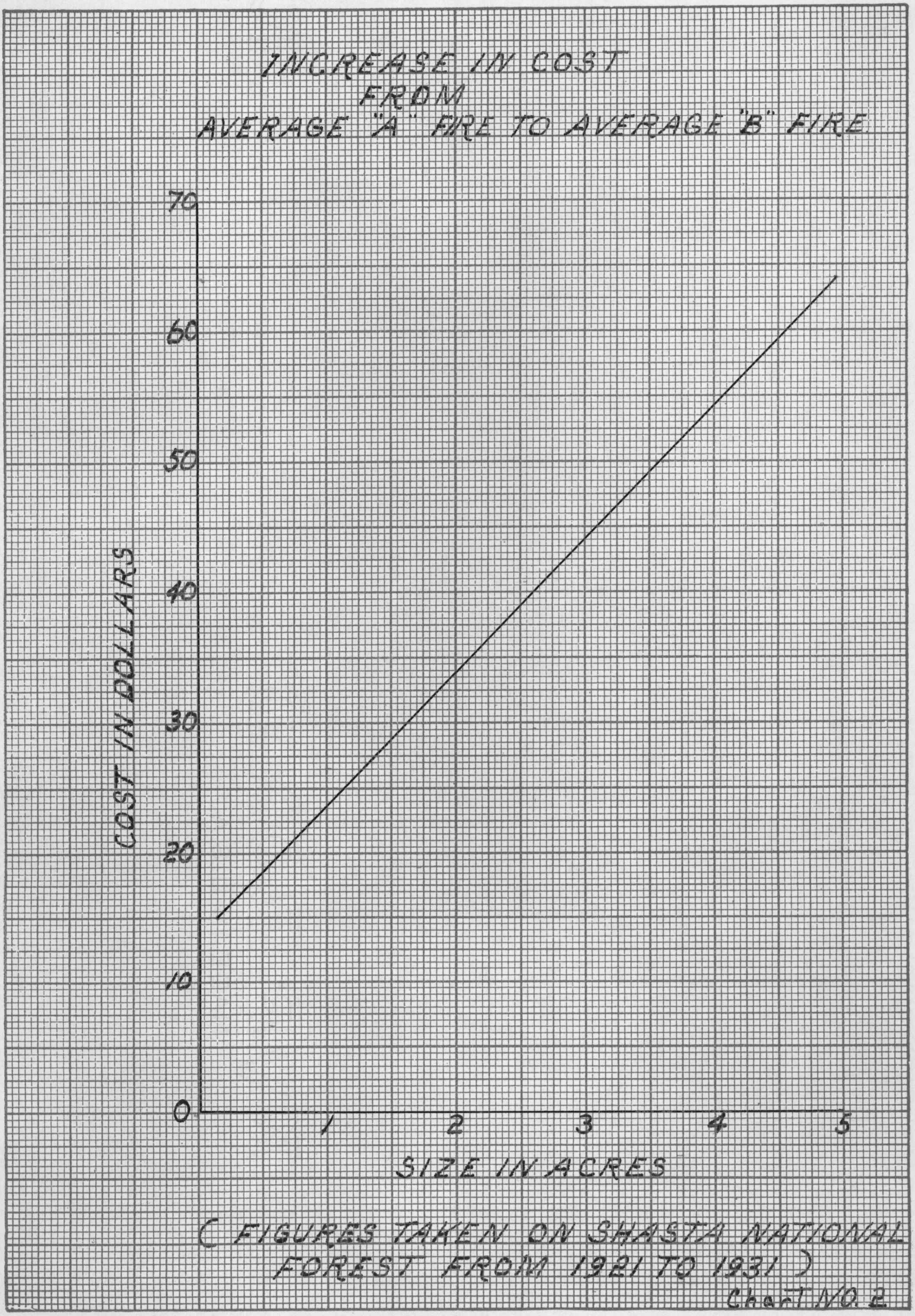
In making the curve it was necessary to subdivide the C fires into size groups. A "C" fire is one over ten acres.

Up to about 300 acres, the unit cost is fairly regular, but above that it fluctuates widely. This is probably due to the fact that on fires of 300 acres or less the matching of resources to the job is pretty well standardized, whereas above that point the difficulty



INCREASE IN COST WITH INCREASE IN SIZE
OF CLASS "C" FIRES
(FIGURES TAKEN ON NORTHERN FORESTS OF CALIFORNIA)
1921 – 1931

Chart No. 1


INCREASE IN COST
FROM
AVERAGE "A" FIRE TO AVERAGE "B" FIRE
COST IN DOLLARS
0
10
20
30
40
50
60
70
1
2
3
4
5
SIZE IN ACRES
(FIGURES TAKEN ON SHASTA NATIONAL
FOREST FROM 1921 TO 1931)
Chart NO. 2

(7) of handling a more complex organization increases.
Lost line is also a factor.

I also have the figures for the cost of the A and B fires for just the Shasta Forest alone during the ten year period. These are not as important as the C figures, due to the limited range from which they were taken and for the reason given above. However, I have drawn a curve, which, in a way, represents the rapid increase in cost from the average A fire to the average B.

3. Factors that effect spread and consequently the cost of fires.

A. Moisture content of the fuel on the forest floor.

a. Rainfall

Rainfall is, of course, a very important
factor in reducing the inflamability of the duff on
the forest floor. Experiments have shown that it is
possible for the duff to absorb as high as 200 to
(10) 300% of moisture before it becomes saturated. How-
ever, this is only the case when there is heavy and
continued rainfall. Mr. Show carried on experiments
in California in which he proved that when the fuel
has a moisture content of as low as 8% the fire
(10) danger is practically nill. Larsen, in another set
of experiments estimated that about 2 inches of rain-
fall per month was necessary to eliminate fires complete-
ly. But, since this amount of rainfall or, in fact any

amount of rainfall during the fire season is exceedingly rare it is not a point of major importance and the few facts that have been stated will suffice to cover it.

b. Relative Humidity

Relative humidity, even though it can put
(10) only about 50% maximum moisture in fuels compared to the 200 to 300% that rain can put in, it is a very important factor in determining the rate at which fires will spread on the forest floor, because it is ever present.

The moisture in the fuels increase with an increase in the humidity of the atmosphere until the fuels have a content of about 50%, however, the rate of increase varies greatly. For example, from experiments performed in Idaho a humidity increase of from 10 to 60% can be expected to raise the fuel moisture content from 4 to 11%, or a 7% rise in fuel moisture to a 50% rise in humidity. If the humidity then rises from 60 to 90, the fuel may be expected to pick up from 11 to 20, or a 9% rise in fuel moisture for a 30% increase in humidity. Then again if the humidity increases only 10% more, or to 100%, the fuel may be expected to increase its moisture content from 20 to 40%. Therefore, it can be seen that a change of humidity in its higher range has a much greater effect than equal changes in the lower range.

The principal factor seems to be that the rate of change of moisture between the fuels and the atmosphere is the difference between their moisture contents. When the fuel is very wet and the air very dry the change will be most rapid, and when the fuel is very dry and the humidity very high the change will also be rapid, but when the two are nearly in balance the change will be very slow. This later is probably the case during the high fire danger of the year.

c. Wind

Another factor that changes the moisture content of the fuels quite rapidly is the wind. Large volumes of dry air passing over fuel dry it out much more rapidly than when the air is pretty much stationary. The fact that air next to the fuel is continually rising in humidity and tending to equal that of the fuel seems to be the important thing. If the air remains stationary it will gradually take less and less water from the fuel, as was shown above, but with a greater wind velocity this air is constantly being replaced by a hotter, dryer air.
(10) Experiments carried on at Priest River have shown that with low wind velocities the rate of drying of the fuels in dense woods, sheltered from the wind, is much slower than the rate of drying in the open, exposed to the wind.

d. Other factors effecting moisture content in fuels.

There are several other factors that effect the moisture content in fuels besides those already mentioned. Probably the most important of these is the temperature of the moisture in the fuels. This factor ties in with the season of the year. In the hottest and most dangerous seasons the moisture, is of course, heated up more rapidly and hence the rate of evaporation is increased.

B. The wind velocity

Wind is so obvious in its effects and so readily discernible that it is universally recognized by fire fighters as a principal agent in spreading fires and effecting the methods of control. This fact is not hard to prove, but it is quite a hard thing to determine just how much the rate of spread is with the different wind velocities.

(9) Mr. Show carried on some experiments along this line in California which will, at least, give some ideas on just how the rate of spread varies with the wind.

He used the basic rate of spread, that at 0 miles per hour, as 100, and for a number of tests the values at different velocities were referred to this base. The values thus derived give, of course, not actual perimeters, but relative indices.

Mr. Show's Results

Wind velocity miles per hr.	Length perimeter Average	Value minus 100	V^2	Column $\frac{3}{4}$
0	100	0	0	0
1	132	32	1	32

Results (Continued)

2	220	120	4	30
3	385	285	9	32
4	600	500	16	32
5	815	715	25	29

An examination of these figures tends to show a mathematical law, which expresses rate of spread as governed by wind velocity.

Column 3 gives the average relative perimeter for wind velocities of 1 to 5 miles per hour; column 4 the square of wind velocity; and the last column, the index figures secured by dividing column 3 by column 4. The last figures are practically constant for the velocities tested. From the results of this experiment it may be said that the rate of spread in perimeter varies as the square of the wind velocity.

C. Time on rate of spread of fires

(9) Mr. Show carried on some other experiments to determine the effect of time on rate of spread. In these experiments he also used the perimeter of the fire as a measure of the spread. He found that, on level ground, with no wind, and with uniform cover, a fire spreads in a circle and the perimeter varies directly with the linear distance traveled. Wind and slope will, however, modify the shape of a fire so that it tends to become longer in one axis than the other, though still retaining a generally oval shape.

In other words, for a given geometrical figure, equal increments of time give equal increments of perimeter. In actual experimental fires it was found that, with slow rate of spread, the perimeter relation is approximately a straight line up to a period of two hours; with more rapid spread, under wind, the increment of perimeter increases from period to period and, instead of a simple arithmetical progression, perimeter on time tends toward a geometrical series. Two independent factors are acting in this case of rapid spread. First, the ratio between linear spread and perimeter tends to increase, so that perimeter increases more rapidly than distance traveled. Second, the release of a large amount of heat in a short time, results in convectional currents of air which increase the wind velocity and hence the rate of spread; or to put it more simply, a fire creates its own draft. The extent of this increase is difficult to measure. In one case, in which the wind velocity 300 ft. from the fire was 4.4 miles per hour, the velocity at the front of the fire was 6.2, or roughly 40% higher.

(9) The average perimeter increase by 5 minute intervals is given in the form of results from the experiments.

Periods after start(5 min.)	Perimeter (linear ft.)	Perimeter increment
1	33	33
2	66	33

Results (continued)

3	106	40
4	188	82
5	302	114
6	460	158
	Average	76

From the figures for the average fires given above I have constructed a curve which will show more clearly the rapid rate of spread of fires under the above conditions. I also have the figures for the increase in size of larger fires, acres by hours. These figures
(7) were based on 516 fires, that occurred from 1914 to 1918 on the Shasta National Forest. I have also reproduced here the curve which shows the rapid increase. The two curves can be tied together to bring out the point of the great saving in acreage burned and dollars spent, by beginning work on a fire a few minutes or hours sooner.

It is very clear that a close relation exists between the spead of attack and the size of the fire. The efficiency of the attacking crew and its size is not as important as the get away and travel time, but, of course, these factors are also important. From studies
(7) taken in California it was shown that slowness of attack was responsible for twice as many poor results as incorrect action after men get there. It should never be forgotten that almost any fire can be handled if it is

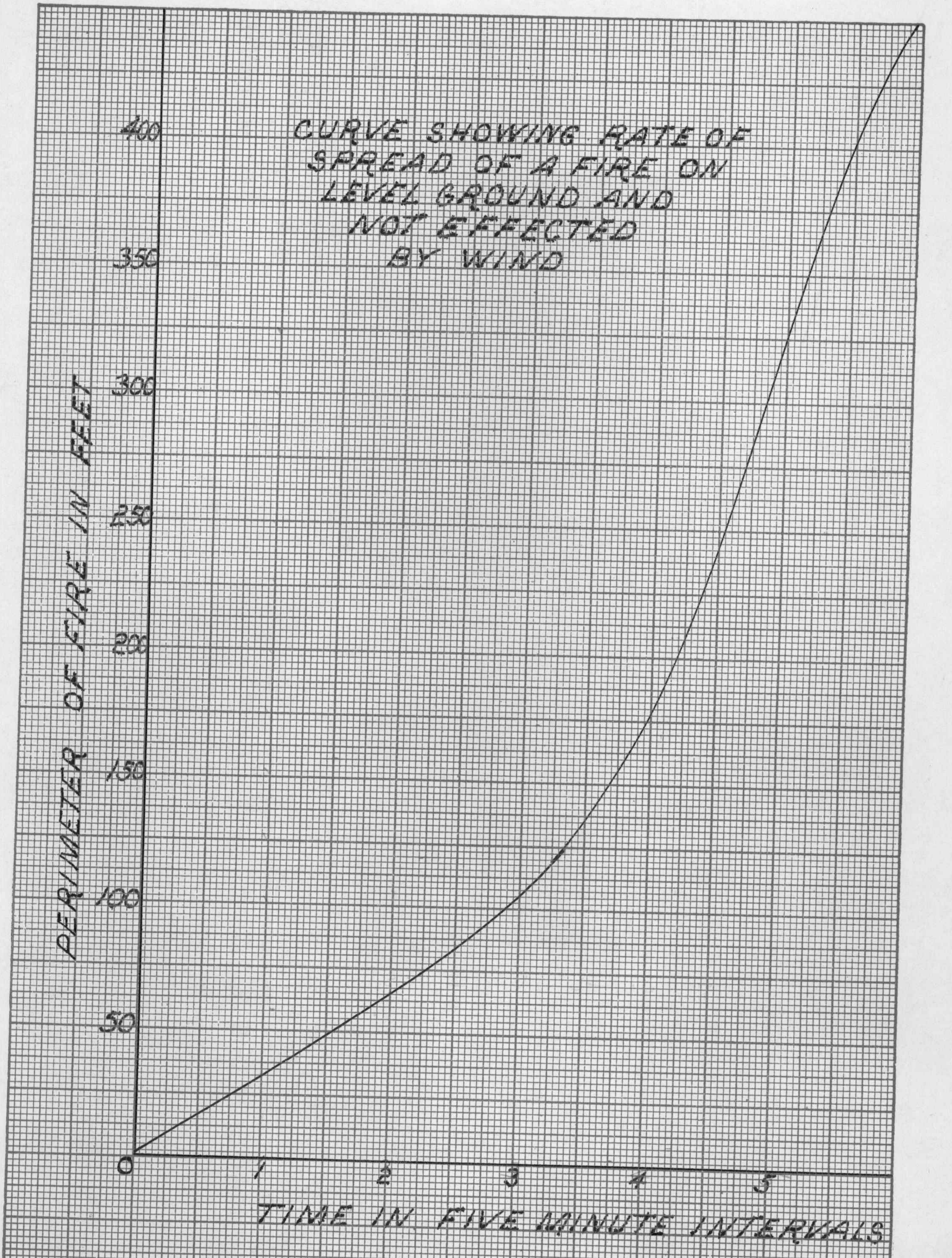
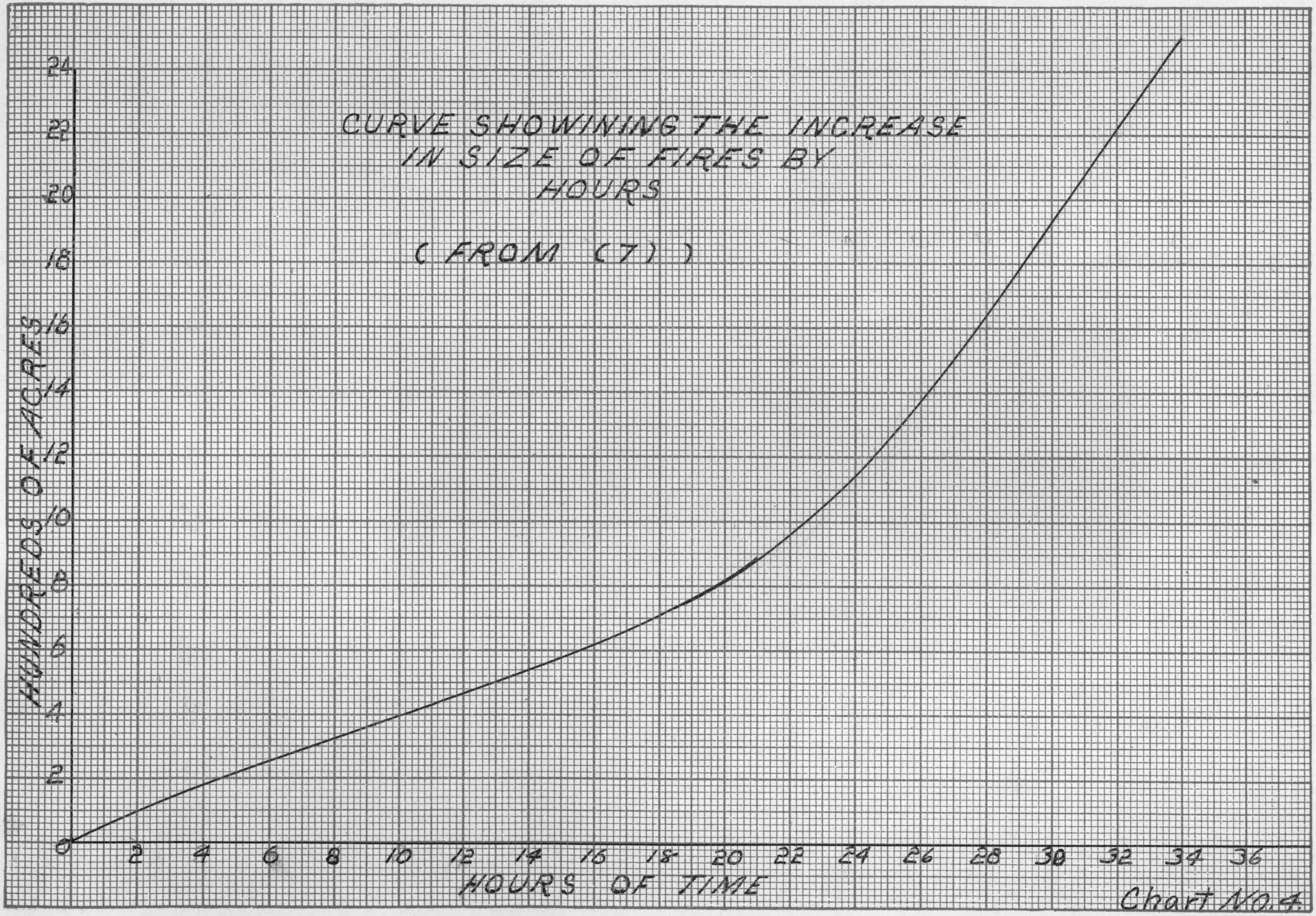

CURVE SHOWING RATE OF
SPREAD OF A FIRE ON
LEVEL GROUND AND
NOT EFFECTED
BY WIND
PERIMETER OF FIRE IN FEET
400
350
300
250
200
150
100
50
0
1
2
3
4
5
TIME IN FIVE MINUTE INTERVALS

Chart NO. 3


CURVE SHOWINING THE INCREASE
IN SIZE OF FIRES BY
HOURS
(FROM (7))
HUNDREDS OF ACRES
24
22
20
18
16
14
12
10
8
6
4
2
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
HOURS OF TIME
Chart No.4.

reached soon enough. As fires become larger, the opportunities for mistakes become, progressively more and more numerous. The great majority of the fires classed as poorly fought were reached after they had attained class C size.

If fires are large when attacked it often happens that hasty action is taken and one mistake leads to another. Particularly when a fire is so large that several crews must be employed at different points of attack, the organizing ability of the officers in charge is severly tested, so that the organization of the attacking forces may easily be at fault. Therefore, the major facts to be remembered are:

1. Prompt arrival of the attacking force is of the greatest importance.

2. Having a sufficient number of capable men, fully equipped and prepared on arrival.

4. Seasons of fire occurrence

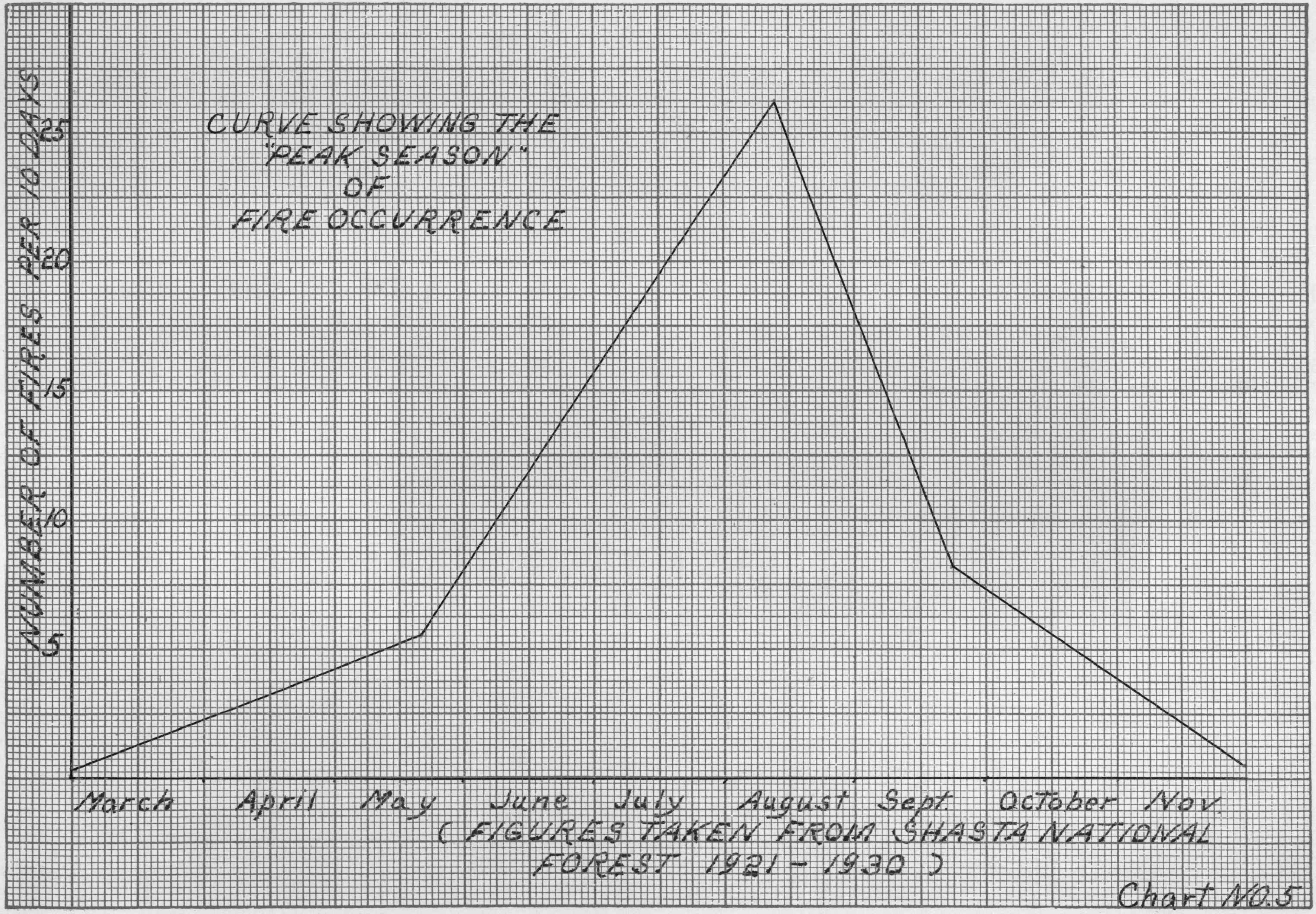
I have collected the figures for the occurrence of fires and the area burned on the Shasta National Forest for a ten year period (1921-1930) to use as a concrete example for the months of the year when the greatest number of fires occur and the acreage burned is the greatest. These months will, of course, vary with the climate in different localities, but since my thesis deals most completely with the Shasta region, these figures will serve as my illustrations.

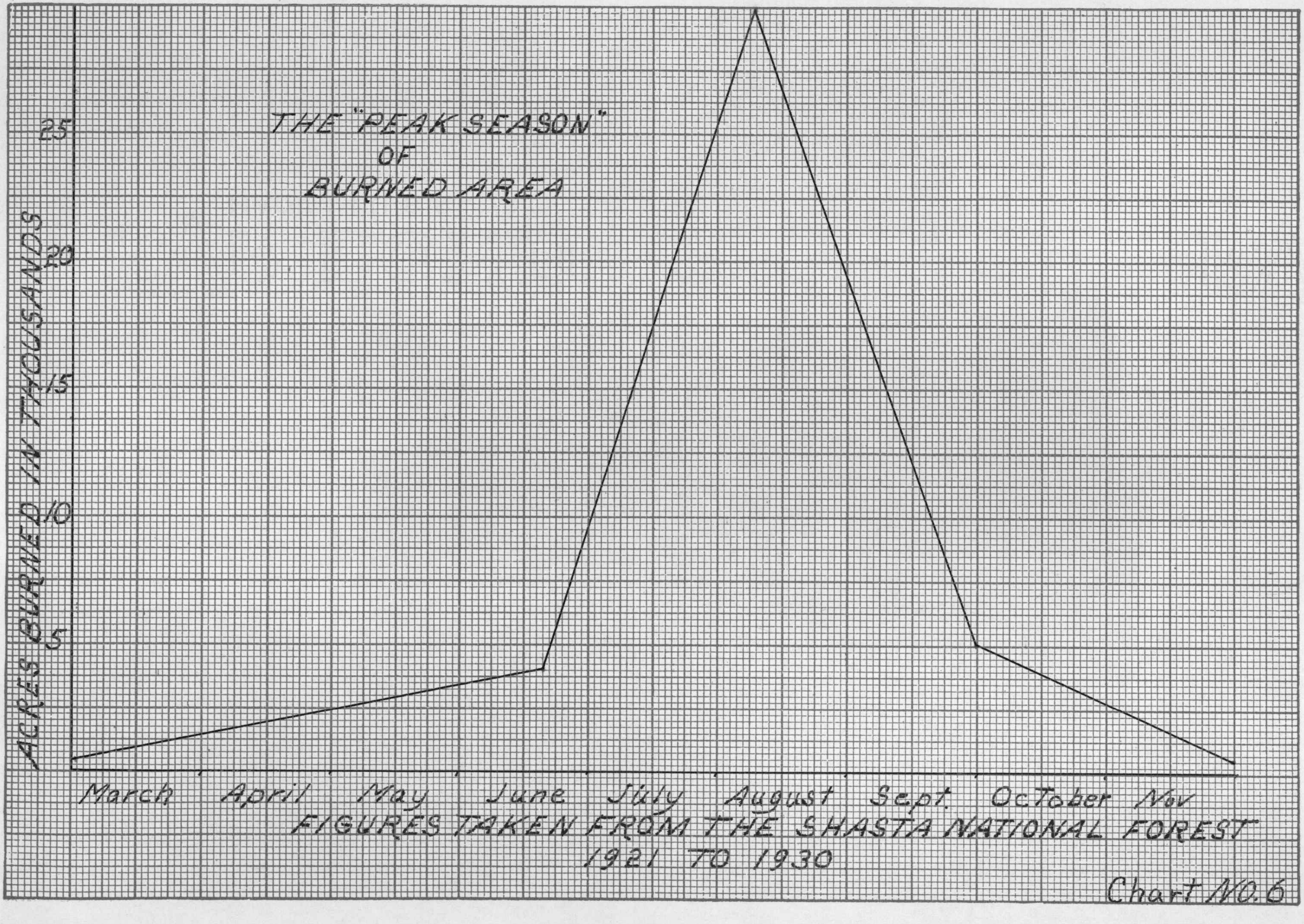
The figures were taken for each ten day period during the ten years. I have drawn graphs to make the significance of the figures more clearly understood. The graphs were not drawn by the use of any of the exact figures, but to represent the trends during the ten years.

It can be seen from these graphs that the occurrence of fires and the area burned pretty much coincide. However, the triangle formed by the occurrence figures is a somewhat broader one than that for the area burned. In other words, a large number of fires may occur early in the spring and late in the fall, but the climatic factors that come into play then are a distinct aid to the suppression force in keeping the acreage burned by these marginal fires small.

The points to choose from these figures and curves as the time to have the fire-fighting organization in full operation will depend on the amount of money available for suppression and the degree of efficiency and results desired.. One might say that from the first of May to the first of November would be a good average time to have the suppression organization in full swing. These dates will vary much from season to season according to the weather conditions, as shown by the ten year figures, but they will serve as an average.

In actual practice in the past the fire season on the Shasta National Forest has been defined from June 1, to


CURVE SHOWING THE
"PEAK SEASON"
OF
FIRE OCCURRENCE
NUMBER OF FIRES PER 10 DAYS
25
20
15
10
5
March
April
May
June
July
August
Sept.
October
Nov.
(FIGURES TAKEN FROM SHASTA NATIONAL
FOREST 1921 - 1930)
Chart NO.5


THE "PEAK SEASON" OF BURNED AREA
ACRES BURNED IN THOUSANDS
25
20
15
10
5
March
April
May
June
July
August
Sept.
October
Nov
FIGURES TAKEN FROM THE SHASTA NATIONAL FOREST
1921 TO 1930
Chart NO. 6

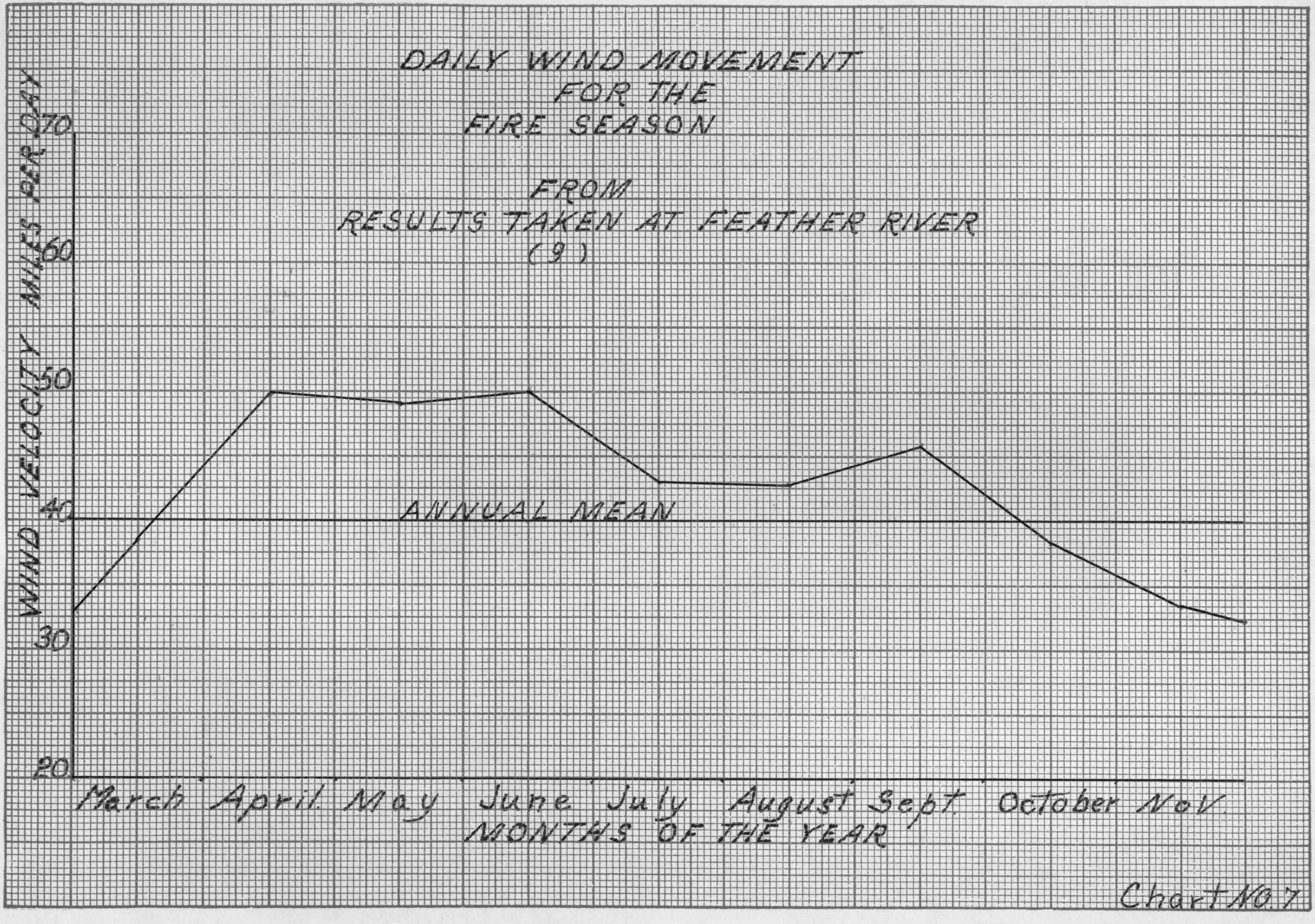
October 10. That this has been a faulty estimate of the fire season, has been proven many times. Large fires have occurred in May and October before and after the organization was functioning to capacity. These These large fires could very likely have been held to small size and the savings paid the wages of the men in the organization many times over.

5. Hook up of the fire season and the factors that effect start and spread of fire.

The name "Fire Season" is not just a certain time of the year when fires start and burn, but it is caused and really brought about by every one of the above mentioned factors.

A. The moisture content of the material on the forest floor gradually becomes lower as the hotter months of the year roll around. The moisture content is, of course, high in the wet months when there is plenty of rain, and then continues to get lower until the peak is reached just about the time of greatest fire danger. After which it again slowly rises. It ties in and plays its part in determining the fire season.

B. The wind velocity also shows an increase just during those months of the so called "Fire Season", and plays its part in making it so. The results of some measurements taken at the Feather River Experiment Station will serve to bring out this fact clearly. I
(9) have reproduced these results in chart form here.


DAILY WIND MOVEMENT
FOR THE
FIRE SEASON
FROM
RESULTS TAKEN AT FEATHER RIVER
(9)
WIND VELOCITY MILES PER DAY
70
60
50
40
30
20
ANNUAL MEAN
March April May June July August Sept. October Nov.
MONTHS OF THE YEAR
Chart No 7

The results show that the daily wind movement for the months of highest fire danger, April to September inclusive, give values above the average, while the others are below. It should be kept in mind that these figures were just taken from one section of the country and should be viewed in a relative sense only. They show the trend, which is the important thing.

C. Other factors also enter in to make the"Fire Season".

a. Lightning

(7) Some studies were made on the time of the year of lightning fires and it was found that on the average only 3.6% of all lightning fires occur in May and October, and 7.6% in September, leaving 88.7% in June, July, and August, with 77.3% in the latter two months. Thus a tremendous concentration of lightning fires comes in the most dangerous part of the season when the forests are dry and inflammable.

b. Camper fires.

These types of fires also assume importance in June, and, like lightning fires, reach their peak about August. However, they show a variation from lightning in that instead of dropping off rapidly in September and October, they continue on until the end of the hunting season, October 15.

c. Incendiary fires.

This type is somewhat different from the two before mentioned in that there is a very strong concentration in August, September and October. Only 7% of all incendiary fires occur before the end of June. The large number of fires from this source in the fall is indirect evidence of the responsibility of stockmen, as their practice in Pre-Forest Service days was to burn the range after the stock had been driven out. Fires during the summer months are set by prospectors, by men who want to make money as fire fighters, and by various persons actuated by motives of revenge, or the desire to see the country burned. With active incendiaryism, like now exists on the Shasta Forest, late season protection appears to be essential.

6. Organized Crews.

So far in this paper I have attempted to bring clearly to mind the great damage and cost resulting from forest fires, and to show that the use of any agency whatsoever that would materially reduce this cost and damage would be a distinct advantage to the Forest Service and to the people of the United States. I have also attempted to show the season of the year when this agency could be used most effectively.

The agency that I have in mind that would lessen this cost and damage and decrease the present "Hour Control" is organized crews.

A. First use

This idea was first tried out on the Shasta Na

National Forest this last year as an attempt to curb a serious outbreak of incendiary fires.

B. Organization

Twenty local men, who were good fire fighters, and in need of employment were placed under a capable fire warden. A camp was set up in the heart of the dangerous fire area. The men were hired on a monthly basis, and were on duty at all hours during the day or night.

C. Camp and Living quarters.

The camp was arranged and kept up to Forest Service standards as to order and cleanliness. The men were furnished good food and adequate housing quarters. Places to bathe, play games, and do other things that would aid to the contentment of the men were made available.

D. Equipment.

Each man was furnished with the best of tools and other equipment, and it was each man's responsibility to have his tools sharp, canteens filled and everything prepared so he could leave at a moments notice. The tools were so distributed among the men that the most effective work could be done anyplace a fire might be in the area under their control.

A fast and dependable truck was furnished the crew. One man was in direct charge of this truck. He drove it and kept it in readiness at all times.

E. Call system.

A telephone was run directly to the camp from the dispatchers office. A least one man remained by this phone both day and night. All other men were in close call of the man at the phone.

D. Occupation on "No fire days"

The men at first spent four hours each day piling brush around camp and cleaning up in general. After this was completed, a trail was started to a near by lookout. The men spent four hours per day on this trail. In this way they not only accomplished some much needed construction work but kept themselves in prime physical condition. A portable telephone, hooked up to the camp phone, followed the crew as it progressed farther away from camp each day.

7. Get away time of crews.

In order to test the speed at which the crew could be in readiness and on its way to a fire; and , in fact, to test the real usefulness of the crew for the purpose for which it was organized; a number of tests were carried on of which the crew itself had no previous knowledge. The results of these tests showed that the crew could be on its way in one minute and a half after it had received the fire call. This was the thing that made the crew a success from the start. In comparison to this, twenty "Pick Up Men" of the same caliber could not have been collected, equipped and started on their way in less time than one half hour.

Here was an initial saving of 30 minutes, we might say, on a fire that is just starting. The points on the spread of fire, before brought out, will show the significance of this saving. It means that the hour control has been shortened by just that length of time, or the area included in the first hour control has been extended by the ratio that 30 minutes is of the first.

8. Travel time of the crews.

The truck used was constructed to easily haul the twenty men and travel at its maximum speed. It safely averaged 40 miles per hour on paved roads while going to fires. In comparison to this a commercial truck would not average more than 30 miles per hour with the same load. As most "Pick up men" were hauled in commercial trucks, and most of the area was covered by good roads this was another distinct saving in time.

9. Other factors of saved time.

Not only do the factors above mentioned reduce the get-away and travel time a measurable amount, but other factors, that are not so easily measured in saved time, also play their part in reducing these times in favor of organized crews.

English?

A. One of these is the advantage and time saved in starting to work on the fire upon arrival. The men in the crews are picked men and know just what to do, so it takes a minimum amount of time to get them organized for the job they are to do. Pick up men, on the other hand, must be told just what to do and how to do it when they arrive at the fire. This takes up several minutes of valuable time when the fire is just getting under way. This point is really very important and so often overlooked when men are gathered to fight fire. Many fire wardens take the first men they come to rather than spending a few minutes time to segregate them and pick out those who know "what it is all about". Much time would be saved in the long run if this fact were recognized.

B. Another advantage of the organized crews upon arrival is that they have been well fed and are in condition to put their maximum amount of effort in on the fire at the start, and continue for a longer time without food, if the case may require it, than the average pick up man is qualified to do. Many times fires can be held small if just a little more effort can be expended to hold gained ground. ~~or natural barriers~~.

C. Last, but by no means least, is the fact that the men on the organized crews are paid on a monthly basis and it does not influence their "Pay Check" in the least whether they fight 20 fires in a month or only one, or whether the fire lasts 5 days or 5 hours. It is naturally to their concern to put the fire out as soon as possible and get back to camp, because the longer the fire burns and the bigger it gets the more work they have to do and the greater are the hardships that are placed upon them with no extra pay. The men all see this point and are anxious to take advantage of it.

On the other hand, the men who get their pay on the hour basis are not nearly so concerned about getting the fire out in the shortest possible time. At the present time the majority of the pick up men are of the unemployed class and the few dollars they earn on the fire line means that they can buy a little more and better food than they have been accustomed to having. This fact cannot be overlooked no matter how much we respect the inherent nobleness in man, and it will remain until fire consciousness has become a dominating influence among the masses.

V. Conclusions

Fire protection is becoming a more important matter each year, and continued advance is absolutely essential to any organized program of silviculture or reforestation.

The fire problem is no longer a simple one but is coming to be very complicated with the new situations that are continually arising. It requires that new methods to meet these situations be advanced each year and experimented with. Actual test and thorough experimentation are the only means by which these methods can be proven successful.

Each region and forest has its own problems to face and it must work out its own solutions to the problems.

Standardization in fire fighting, in the strict sense of the word, cannot be attained for any large area, because the many different factors that arise in different regions all play their part.

The organized crew, whose importance I have tried to bring out, is just one of these new methods. Whether or not it will be successful after thorough experimentation, or whether it will meet the conditions in any other region, or forest, it is, of course, impossible to say. Surely it is just in the experimental stage and will need constant revision to meet changing conditions, but the basis upon which it was organized is sound.

All these things go to show that the field of Forest Protection is a very fertile one. It is full of excitement and reward for the ambitious young man who seeks adventure. It is a field in which the young, trained forester can be of service to his nation and to the people of the United States.

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